Intangible Investment in Japan: Its Measurement and Contribution to Economic Growth

Presented at Intellectual Capital for Communities in Knowledge Economy (IC5), Paris

May 28-29, 2009

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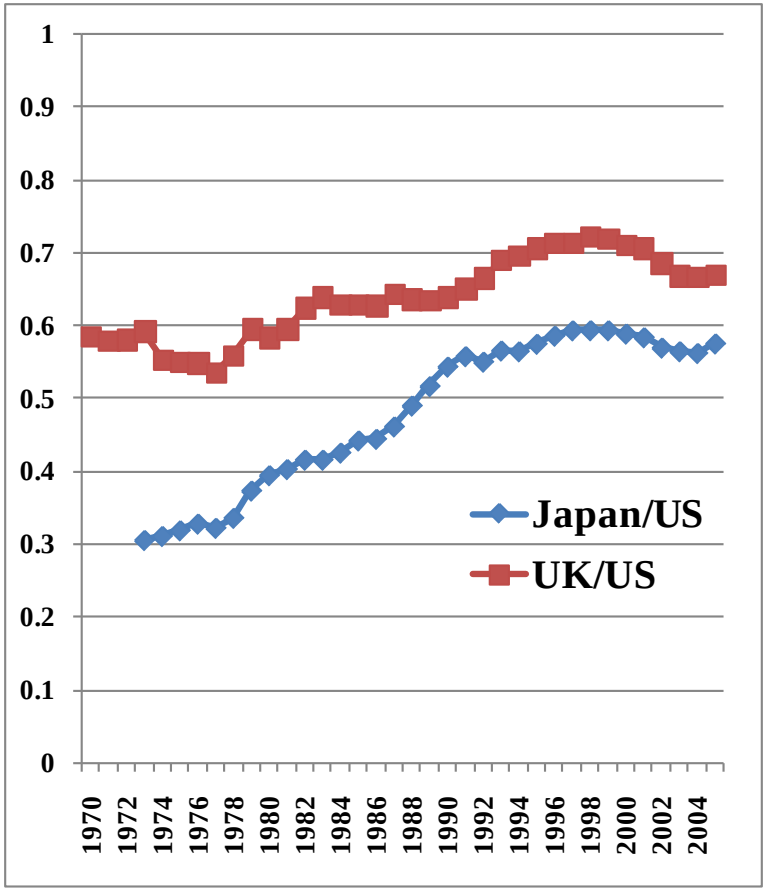
1. Motivation

- **Convergence of labor productivity in Japan to the US level came to a halt in the mid-1990s.**
- **Growth accounting shows that the cause of this phenomenon is the slowdown in capital deepening, MFP growth in Japan and the acceleration of MFP growth in the US.**

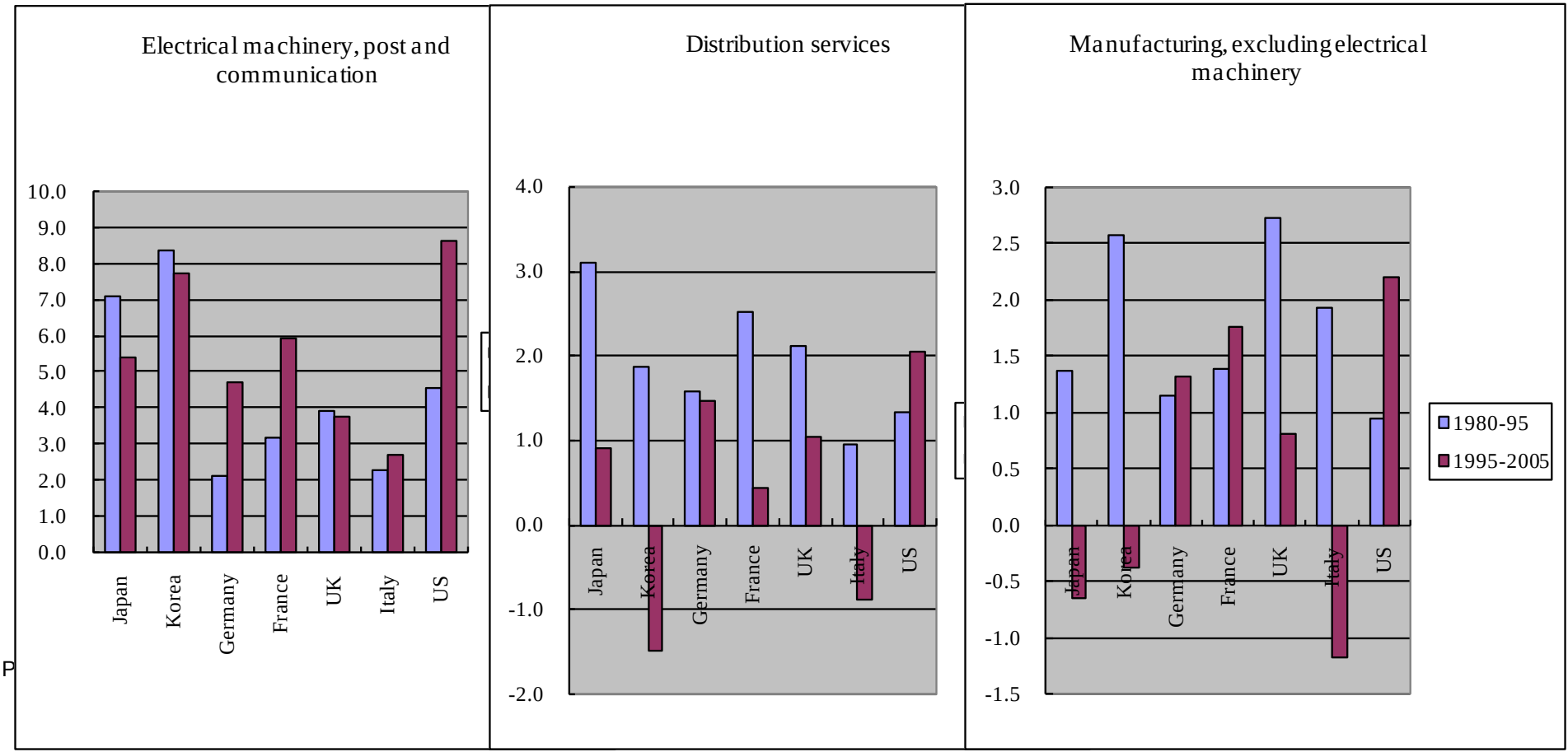
GDP per man-hour input in Japan and the UK in comparison with the US: 1975-2005, based on gross output PPP of 1997



Source: EU KLEMS, March 2008

1. Motivation (cont'd.)

- **Japan's MFP growth was high in the ICT-producing sector. But MFP growth stagnated in ICT-using sectors, such as distribution services and non-ICT manufacturing, which have much larger output shares in the economy than the ICT-producing sector.**



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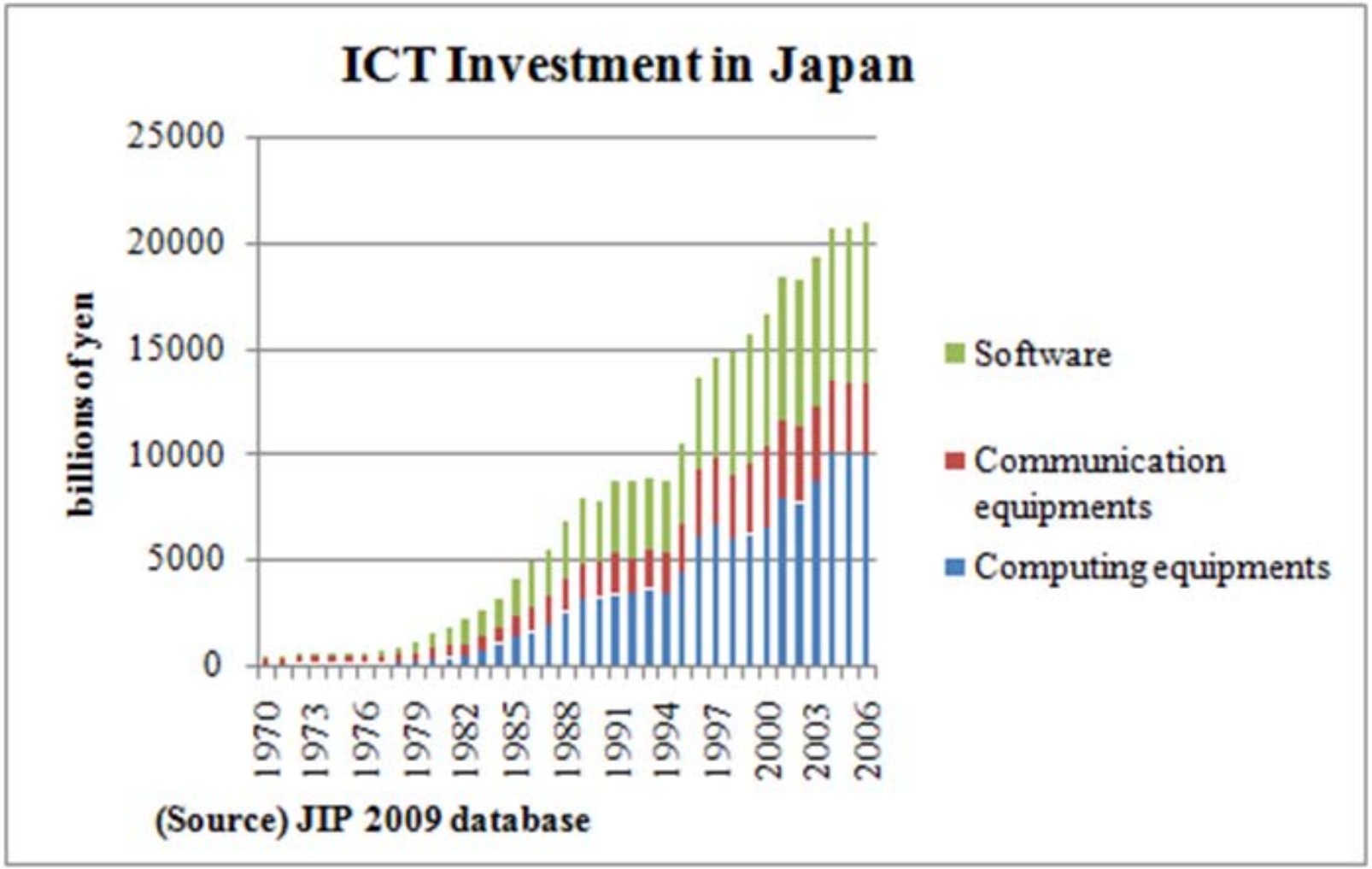
- **It seems that Japan and continental EU countries did not experience an "ICT revolution," partly because of the stagnation of ICT investment.**



2. Measurement of intangible investment in Japan

We measure the intangible investment in Japan following the approach of Corrado, Hulten, and Sichel (2005, 2006). We estimated the three categories of intangible asset investment using the sources listed below.

1. <u>Computerized information</u>

Software and databases → *IO tables, Survey on Selected Service Industries, ICT Workplace Survey,* etc.

2. <u>Innovative property</u>

Scientific and nonscientific R&D, mineral exploitation, copyright and license costs, and other product development, design, and research expenses → *Japan Industrial Productivity (JIP) Database, Survey of Research and Development,* etc.

3. <u>Economic competencies</u>

Brand equity, firm-specific human capital, and organizational structure → *JIP Database, The General Survey on Working Conditions,* and *Financial Statements Statistics of Corporations by Industry*

2. Measurement of intangible investment in Japan (Cont'd.)

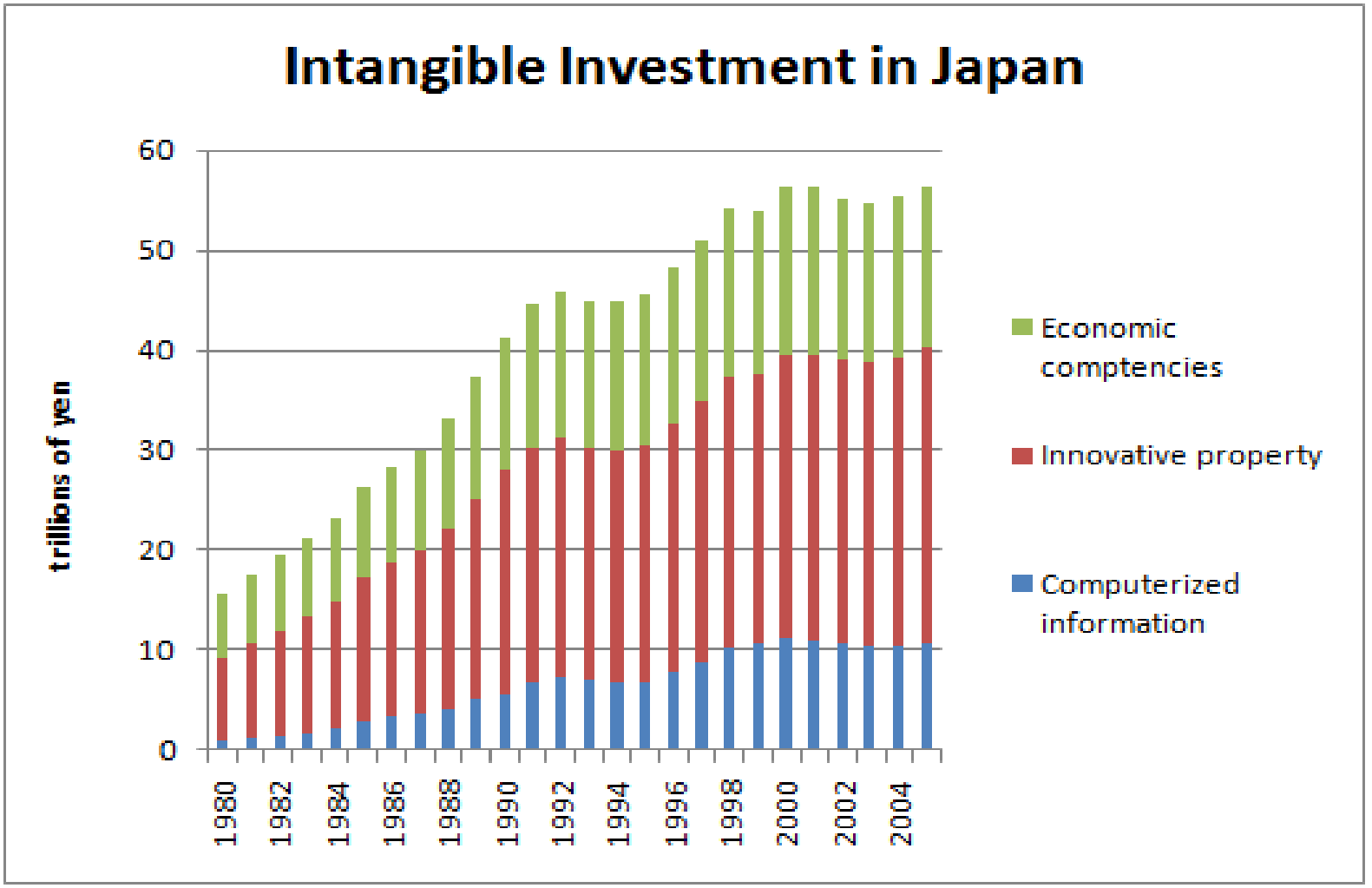
Features of the JIP Database:

The database was constructed in order to measure sectoral productivity growth in Japan. It includes data on output, intermediate inputs, labor, and capital for 108 industries for the period 1970-2006. The JIP Database can be found at: http://www.rieti.go.jp/en/database/JIP2008/index.html.

Using this database, we can estimate intangible investment at the sector level.

2. Measurement of intangible investment in Japan (Cont'd.)

- **Annual intangible investment in Japan was 53 trillion yen on average from 2000 to 2005.**
- **Computerized information: the ratio of this investment to GDP increased rapidly until 2000. However, it has stagnated since then.**
- **Innovative property: innovative property investment (R&D expenses, other product development, etc.) has been the largest among the three categories of intangible investment. The ratio of this investment to GDP was stable from 1998 to 2005.**
- **Economic competencies: the ratio of this type of investment to GDP increased until 1990. However, it started to decrease from 2002 because firms cut training expenses and remuneration for executives as part of their restructuring measures.**


Intangible Investment in Japan
trillions of yen
60
50
40
30
20
10
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Economic competencies
Innovative property
Computerized information

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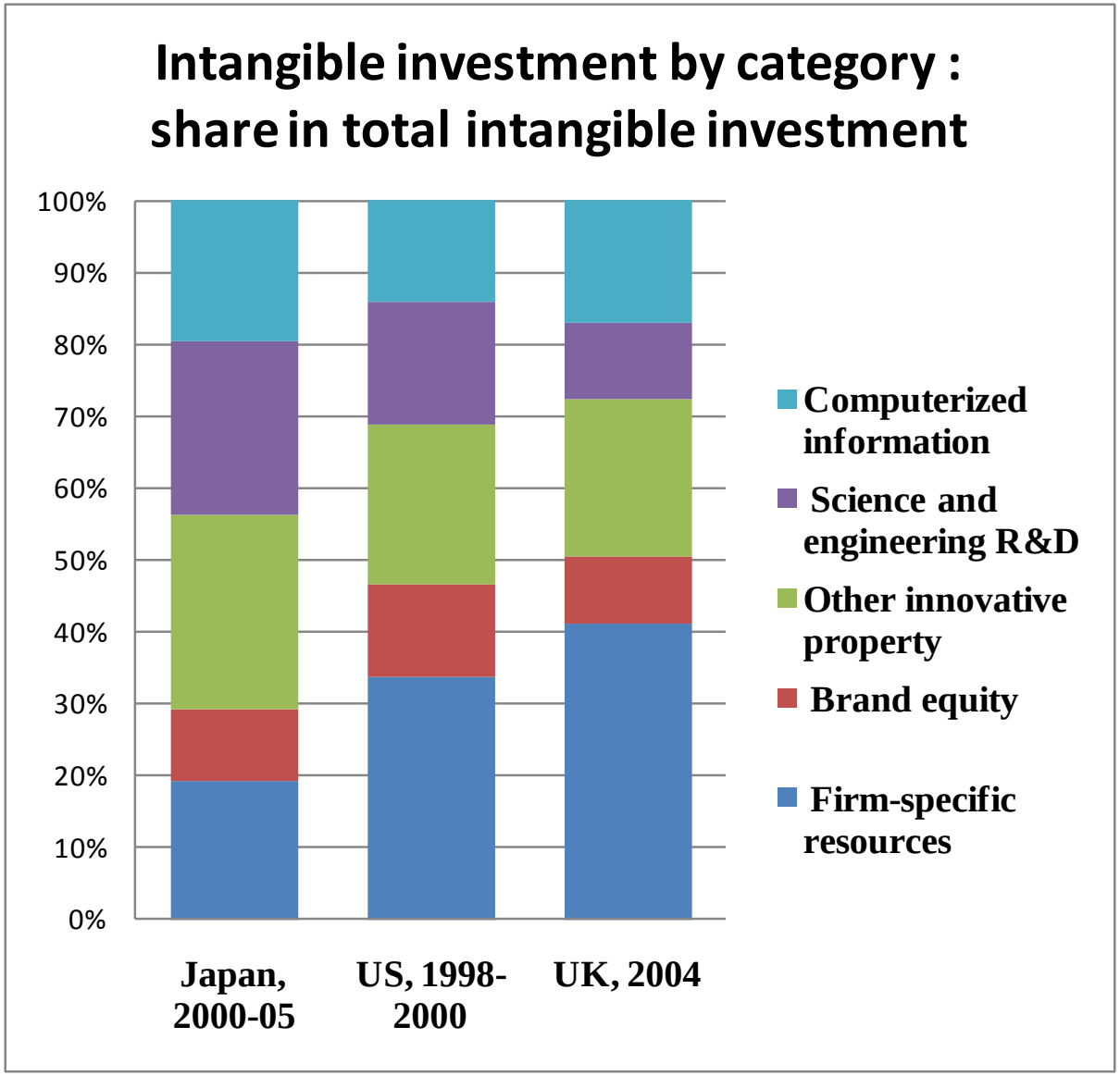
Japan invests significantly in R&D but very little in economic competencies.



Sources: Japan: Authors' calculations, US: Corrado, Hulten and Sichel (2006), UK: Marrano and Haskel (2006).

2. Measurement of intangible investment in Japan (Cont'd.)

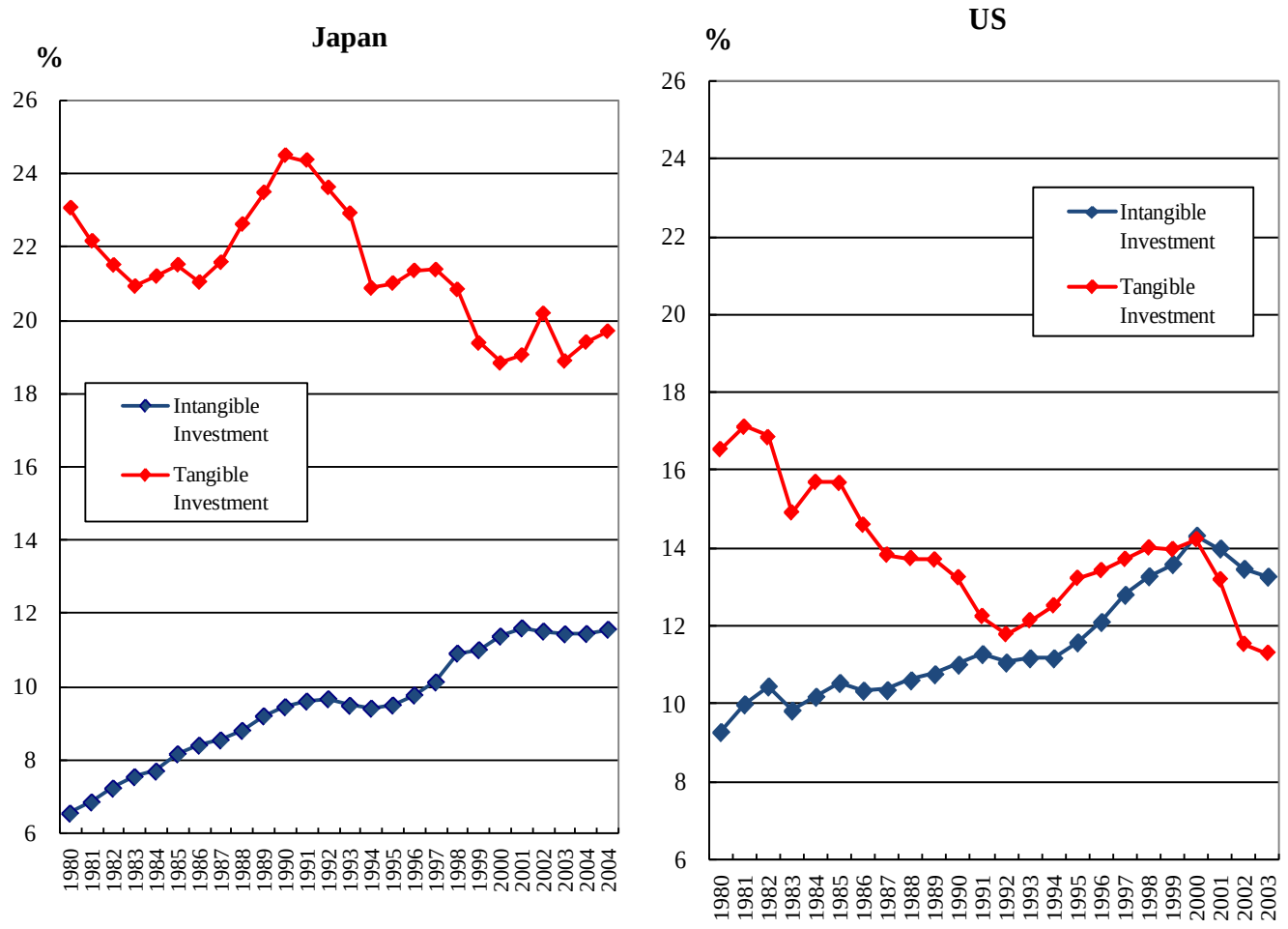
- **The ratio of intangible investment to GDP was 11.1%, similar to the estimate for the US by CHS (2006) and larger than that for the UK by Marrano and Haskel (2006). However, the figure is lower than the unpublished estimates by Dr. Corrado which suggest that the intangible investment/GDP ratio in the US in the early 2000s had reached 13.8 percent.**
- **While investment in computerized information and innovative property in Japan was not lower than that in the US and the UK, investment in economic competencies (especially firm-specific human capital and organizational change) was much lower than that in the US and the UK.**
- **Moreover, the ratio of intangible investment to tangible investment was much lower than that in the US.**
- **While in the US, intangible investment has exceeded tangible investment since the mid-1990s, in Japan, intangible investment is still smaller than tangible investment.**

Intangible investment by category: comparison among Japan, the US, and the UK

	Japan		US		UK	
	2000-2005 (billion yen)	GDP share	CHS (2006) 1998-2000 (billion US dollars)	GDP share	MH (2006) 2004 (billion pounds)	GDP shar
Computerized information	**10,803**	**2.2**	**154**	**1.7**	**19.8**	**1.7**
Custom software	6,584	1.4			7.5	0.6
Packaged software	848	0.2	151	1.6		
In-house software	2,332	0.5			12.4	1.1
Databases	1,039	0.2	3	0.0		
Innovative property	**28,629**	**6.0**	**425**	**4.6**	**37.6**	**3.2**
Science and engineering R&D	13,690	2.8	184	2.0	12.4	1.1
Mineral exploitation	16	0.0	18	0.2	0.4	0.0
Copyright and license costs	5,161	1.1	75	0.8	2.4	0.2
Other product development, design, and research expenses	9,761	2.0	149	1.6	22.4	1.9
Economic competencies	**13,764**	**2.9**	**505**	**5.4**	**58.8**	**5.0**
Brand equity	5,534	1.2	140	1.5	11.1	1.0
Firm-specific human capital	2,241	0.5	365	3.9	28.5	2.4
Organizational structure	5,988	1.2			19.2	1.6
Total	**53,197**	**11.1**	**1085**	**11.7** (13.8)	**116.2**	**10.0**
Intangible investment/Tangible investment	0.6		1.2 (1.1)		1.1	

1) Sources: Japan:authors' calculations, US:Corrado, Hulten and Sichel (2006), UK:Marrano and Haskel (2006).
2) Figures in parentheses indicate estimates for the period from 2000 to 2003.

2. Measurement of intangible investment in Japan (Cont'd.)



2. Measurement of intangible investment in Japan (Cont'd.)

- **We measured intangible investment not only for the whole economy but also separately for the manufacturing and the service sector.**
- **The share of the manufacturing sector in the intangible investment of the economy as a whole has declined since 1990. The share of the service sector has increased gradually.**
- **However, the investment/gross value added ratio in the manufacturing sector is higher than that in the service sector, because the manufacturing sector invested more in innovative property than the service sector.**
- **The composition of intangible investment differs substantially in the two sectors.**

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Intangible investment by category in the manufacturing sector and the service sector

	Manufacturing sector		Services sector	
	2000-2005 (billion yen)	Ratio to value added (%)	2000-2005 (billion yen)	Ratio to value added (%)
Computerized information	**2,447**	**(2.1)**	**6,125**	**(2.4)**
Custom software	1,526	(1.3)	4,197	(1.6)
Packaged software	184	(0.2)	388	(0.1)
In-house software	510	(0.4)	1,065	(0.4)
Databases	226	(0.2)	475	(0.2)
Innovative property	**13,316**	**(11.5)**	**9,161**	**(3.6)**
Science and engineering R&D	9,312	(8.0)	1,052	(0.4)
Mineral exploitation	0	(0.0)	16	(0.0)
Copyright and license costs	472	(0.4)	4,152	(1.6)
Other product development, design, and research expenses	3,531	(3.0)	3,940	(1.5)
Economic competencies	**3,579**	**(3.0)**	**8,364**	**(3.2)**
Brand equity	1,876	(1.6)	3,477	(1.3)
Firm-specific human capital	584	(0.5)	1,334	(0.5)
Organizational structure	1,120	(0.9)	3,553	(1.4)
Total	19,342	(16.6)	24,577	(9.2)
Intangible investment/Tangible investment	0.8		0.5	

1) Source: authors' calculations

2. Measurement of intangible investment in Japan: growth accounting (1)

We examine the contribution of intangible assets to economic growth in Japan by following CHS (2006). The growth accounting results are as follows:

1. **The contribution of intangible capital accumulation to labor productivity has declined since 1985.**
2. **This is because the contribution of intangible assets, as well as the contribution of tangible assets have declined, i.e., the total capital deepening effect has slowed down. Instead, the contribution of MFP growth has rebounded since 1995.**

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Growth accounting with intangibles

(%)

	1985-90	1990-95	1995-2000	2000-05
Growth rate of GDP	4.89	1.05	1.24	1.50
Growth rate of labor input	0.93	-0.11	-0.52	-0.61
Growth rate of labor productivity	3.96	1.16	1.76	2.11
Contribution of capital deepening	2.66	1.75	1.34	1.17
Contribution of tangible capital	1.77	1.25	0.86	0.83
Contribution of intangible capital	0.89	0.49	0.47	0.33
Contribution of MFP growth	1.30	-0.59	0.43	0.95

1) Source: authors' calculations.

2. Measurement of intangible investment in Japan: growth accounting (2)

- **The share of the contribution of intangible capital to labor productivity growth was 16% (2000-05), which is smaller than the share estimated by CHS for the United States (27%).**
- **If the contribution of intangible capital to labor productivity growth in Japan were as large as in the United States, then Japanese labor productivity growth in the 2000s would have been 0.3 percentage points higher than it actually was.**

3. Discussions

- **The differences in intangible investment between Japan and the other countries reflect differences in data sources and the definition of intangible investment.**

- **Here, we focus on the measurement of firm-specific human capital and organizational change because there is a large gap in these expenditures between Japan and the other countries.**

3. Discussions: on firm-specific human capital

- **On-the-job training is not included in the measurement of investment in firm-specific resources employed CHS (2005), but Japanese firms often utilize on-the-job training to accumulate firm-specific human capital.**

- **According to a survey by the Cabinet Office in 2007, Japanese workers spend about 10% (weighted average across all types of workers and all industries) of their time in on-the-job training.**

3. Discussions: on firm-specific human capital (Cont'd.)

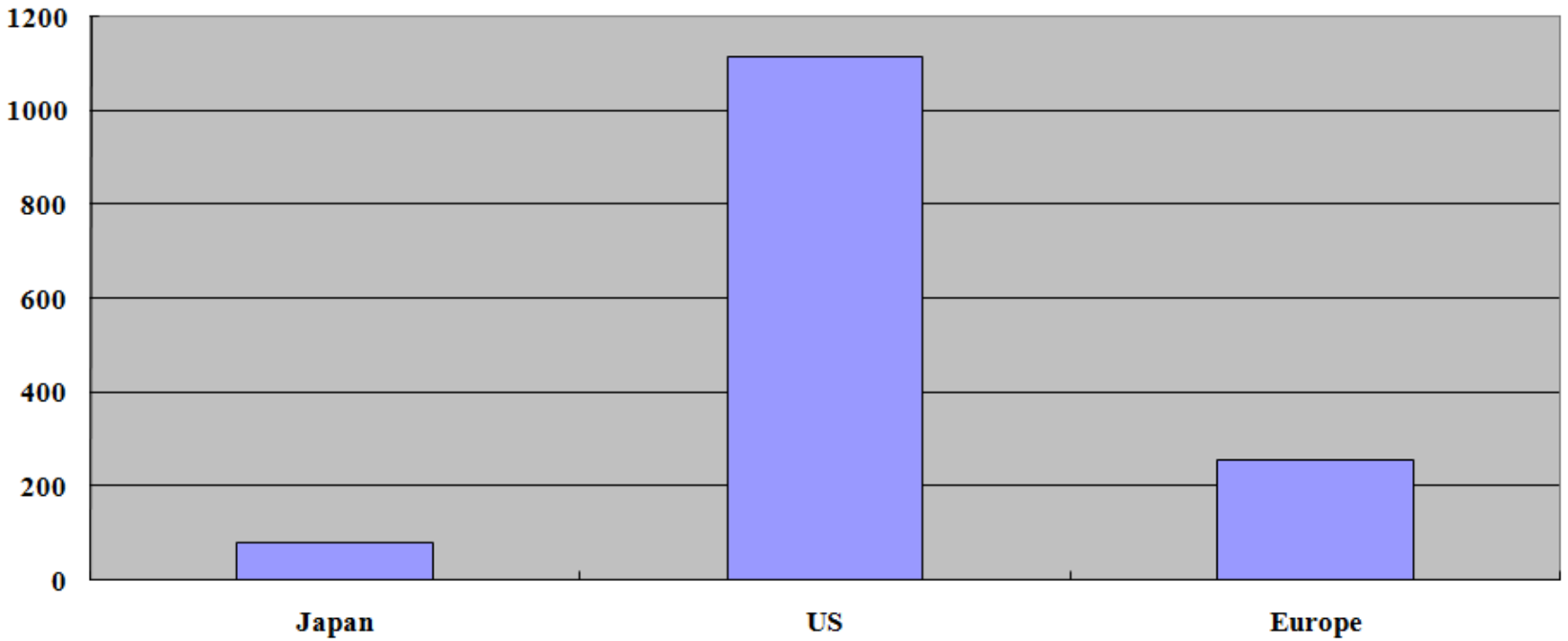
- **A separate, but related, issue is double counting.**
- **CHS (2006) use off-the-job training cost data of the BEA survey.**
- **If workers gain non-firm-specific skills from off-the-job training, such accumulation of human capital will be reflected in their wage rates.**
- **Since in standard growth accounting, wage increases by age are already taken into account as improvements in labor quality, there is the risk of double counting.**
- **According to a survey conducted by Keio University, workers stated that 63% of total skills gained through off-the-job training supported by their employers will be useful even if they change their jobs.**

3. Discussions: on organizational structure

- **CHS (2006) assumed that executives spend 20% of their working time on managing organizational structure and therefore calculated investment in organizational structure by multiplying the remuneration of executives from the Bureau of Labor Statistics by 0.2.**
- **The gap in expenditure on organizational structure between the US and Japan may reflect the difference in remuneration of executives in both countries.**
- **According to Robinson and Shimizu (2006) who surveyed Japanese CEOs to find the time spent on each activity, Japanese CEOs spent only 9% of their working time on strategy development, developing new business, and re-organization.**
- **This survey shows that if we follow CHS (2005; 2006), we may overestimate investment in organizational structure.**

3. Discussions: on organizational structure

Average Remunerations of CEOs in major companies in Japan, the US, and Europe (2003)



Source: The Guideline for the Remuneration of CEOs published by Japan Executives Association

Note: Japanese data is taken from the list of high tax payers who worked for the 100 highest firm asset value companies as a CEO. In the US and Europe, we took the data from remunerations of CEOs in firms whose sales were over 1trillion yen.

4. Sensitivity Analysis

- **In order to examine the robustness of our results, we also conducted a sensitivity analysis.**
- **We studied the following four cases.**

Case 1: We assumed that the depreciation rate of firm-specific human capital is 20 percent rather than the 40 percent assumed by CHS (2006) .

Case 2: On-JT *(is this short for on-the-job training?)* cost +0.37* Off-JT cost+0.09*the remuneration of executives.

Depreciation rates for intangible assets

Category	Depreciation rate (%)
Computerized information	33
Innovative property	20
Brand equity	60
Firm-specific human capital	40

Source: Corrado, Hulten and Sichel (2006).

4. Sensitivity Analysis (cont'd.)

- **Our sensitivity analysis shows that if on-the-job training costs are taken into account, the ratio of intangible investment to GDP in Japan is actually higher than that in the US or the UK.**
- **However, the results on MFP growth remain unchanged because of the stagnation of estimated firm-specific human capital in Japan.**

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Sensitivity Analysis

The share of intangible investment in Japan's GDP (%, nominal)

	1985–89	1990–94	1995–99	2000–2005
Base case	8.33	9.21	9.91	11.06
Case 1	8.33	9.21	9.91	11.06
Case 2	11.52	12.21	12.96	13.75

Labor productivity growth (%, real)

	1985–89	1990–94	1995–99	2000–2005
Base case	3.96	1.16	1.76	2.11
Case 1	3.96	1.16	1.76	2.11
Case 2	3.90	1.20	1.72	2.03

Capital deepening (intangibles, %, real)

	1985–89	1990–94	1995–99	2000–2005
Base case	0.89	0.49	0.47	0.33
Case 1	0.89	0.52	0.47	0.33
Case 2	0.95	0.54	0.44	0.29

MFP growth (%, real)

	1985–89	1990–94	1995–99	2000–2005
Base case	1.30	−0.59	0.43	0.95
Case 1	1.30	−0.62	0.43	0.95
Case 2	1.20	−0.59	0.41	0.92

5. Conclusions

- **Like the continental EU countries, Japan's economic growth from the mid-1990s is characterized by**

  1) slow MFP growth in ICT-using sectors, and

  2) relatively stagnant ICT investment
- **We measure intangible investment in Japan following the approach of Corrado, Hulten, and Sichel (2005, 2006).**

- **We found that in comparison with the US, Japan invests significantly in tangible assets but less in intangible assets.**
- **Japan's intangible investment is also characterized by**

  1) much investment in R&D but very little in economic competencies.

  2) The contribution of intangible capital deepening to labor productivity growth is relatively large in manufacturing but small in the service sector.

5. Conclusions (cont'd.)

- **We think that our estimation of intangible investment is relatively weak in the case of investment in firm-specific human capital and investment in organizational structure.**

  1) We do not have robust official statistics on On-JT costs.

  2) There is a double counting problem in the case of Off-JT costs.

  3) We do not know anything about expenditures on organizational restructuring by firm divisions that are specialized in such tasks.

- **As for the estimation of investment in broad categories of intangible assets at the firm level, we started conducting a new survey in Japan. Based on this result, we will reexamine our estimates in the near future.**

6. Implications of our study

- **Why is Japan's intangible investment/GDP ratio so low? Preliminary answers:**

(1) **The lower share of firm-specific human capital and organizational change: Japanese firms reduced training expenses and remuneration for executives as part of restructuring measures.**

(2) **The effects of Japan's financial system, where banks play a central role: Because banks require collateral to provide funds to firms, Japanese firms tend to accumulate tangible assets.**

6. Implications of our study (Cont'd.)

<u>How to accelerate the accumulation of intangible assets in Japan</u>

- **The government can promote job training by firms.**
- **Implement necessary reforms of the accounting system and the financial system.**
- **Introduce a new accounting system that takes intangible assets into account. This would open the path for banking and insurance firms to recognize intangible assets as collateral for finance.**
- **Make efforts to transform the current system in which banks dominate corporate financing to a new financial system in which even small firms can gain access to funds through capital markets.**