RIETI Discussion Paper Series 07-E-046

Productivity in Japan, the US, and the Major EU Economies: Is Japan Falling Behind?

FUKAO Kyoji
RIETI

MIYAGAWA Tsutomu
RIETI

Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 07-E-046

Productivity in Japan, the US, and the Major EU Economies: Is Japan Falling Behind?

July 30, 2007

Kyoji Fukao
Hitotsubashi University

Tsutomu Miyagawa
Gakushuin University

Abstract

Using the recently released EU KLEMS Database (March 2007) and other statistics, we examined whether Japan experienced similar problem as the major EU economies with regard to the introduction of ICT to market services. The major results obtained through our analysis are follows:

1. It is not the gap in TFP growth but differences in factor input growth that underlie the large difference in the economic growth performance of France, the UK and Italy on the one hand and Japan on the other in the period after 1995. The four major EU economies (Germany, France, the UK and Italy) and Japan experienced a slowdown in TFP growth of a similar magnitude after 1995. The US was exceptional in accomplishing an acceleration in TFP growth.
2. TFP growth in the electrical machinery, post and communication sector was still highest in Japan among the six economies after 1995. However, the problem for Japan is that, like in other countries, the share of this sector in the economy overall is not very large. The largest declines in TFP growth in Japan occurred in distribution services (retail, wholesale and transportation) and in the rest of the manufacturing sector (i.e., excluding electrical machinery). The labor input shares of these two sectors were very large (23.4% and 16.8% respectively). The US and the major EU economies except Italy recorded high TFP growth in these two sectors.
3. In manufacturing sectors, productivity levels in Japan were on par with those in the US, Germany and France. However, they were very low in comparison with the three countries both in market services and other goods-producing industries. It therefore seems that there is large room for improvement in Japan's productivity in market services and other goods-production services through the adoption of already existing technologies and better resource allocation.
4. The US and the UK experienced a very rapid increase in ICT capital service inputs after 1995. In contrast with this, in Japan, the contribution of ICT capital service input growth declined in all sectors after 1995. Across the six countries, we can observe a positive correlation between ICT capital service input growth and TFP growth. This fact supports the conjecture that Japan's sluggish growth in ICT capital service inputs is at least partly responsible for the slowdown in Japan's TFP growth after 1995.
5. According to several recent studies, it seems that in order to fully realize the direct and indirect efficiency-improving effects of ICT capital, the simultaneous accumulation of intangible assets, such as human capital and organizational capital, is indispensable. Investment activity in intangibles is less active in Japan than in the US and the UK, although there are many high-skilled workers in Japan. The relatively low level of intangible investment may be a good candidate to explain why the accumulation of ICT capital and TFP growth stalled in Japan.

1. Introduction

Following the collapse of the bubble economy in the early 1990s, Japan's economic growth stalled: real GDP growth in the period 1995-2004 did not exceed 1.0%, which is considerably slower than the 3.3% growth registered in 1973-1995 (based on data from the EU KLEMS Database, March 2007) and the lowest among the six major developed economies (the US, Japan, Germany, France, the UK and Italy).

A frequently heard argument in Europe and the US is that the core countries of the EU, such as Germany and France, have been falling behind the US in terms of increasing productivity. Inklaar et al. (2006), for example, found that although the level of labor productivity in Germany, France and the Netherlands was almost same as that in the US, total factor productivity (TFP) growth in these countries since the mid-1990s has been much slower than in the US, especially in market services. Similarly, van Ark et al. (2006) report that TFP growth in industries using information and telecommunication technology (ICT-using industries) in the core EU countries since 1995 has been much slower than in the US. Meanwhile, Stiroh (2002a) and Triplett and Bosworth (2002) report that TFP growth in ICT-using industries in the US, such as communication, finance and commerce, has accelerated substantially since 1995 and this acceleration represents the main engine of productivity growth in the US economy.

The slowdown of Japan's economic growth and the above mentioned studies comparing TFP growth in the EU and the US raise the question whether Japan has a similar problem as the major EU economies with regard to the introduction of ICT to market services. Yet, despite the importance of this issue, there have been few studies which compare TFP growth and the impact of the ICT revolution in the major EU economies, Japan and the US at the industry level – probably because of the lack of appropriate data for a broad and rigorous international comparison.

In order to analyze this issue, researchers of the Japan Industrial Productivity Database Project, including the authors, have joined the EU KLEMS consortium and supplied original data on Japan for the EU KLEMS database. The first public-release version of the EU KLEMS database is available online at the EU KLEMS website, <http://www.euklems.net/>. In this paper, using this database, we compare productivity growth and the accumulation of ICT capital by industry in Japan, the major EU economies, and the US. We also use the results of the labor productivity comparison project at the Japan Center of Economic Research.

The remainder of the paper is organized as follows. In Section 2, we present an overview of the pattern of economic growth and productivity improvement in Japan, the major EU economies, and the US. We also compare the absolute labor productivity levels of these countries by industry. In Section 3, we analyze the role of ICT investment on economic growth in these countries. It is frequently argued that in order to fully realize the direct and indirect efficiency-improving effects of ICT capital, the simultaneous accumulation of intangible assets, such as human capital and organization capital, is indispensable. This issue is examined in Section 4. Section 5, finally, presents our conclusions.

2. Overview of Economic Growth and Productivity Improvement in the Major EU Economies, Japan and the US

We first compare the results of growth accounting for Japan, the major EU economies (Germany, France, the UK and Italy), and the US. Figure 1 shows the growth accounting results for the market sector of these countries for the periods of 1980-95 and 1995-2004. The figure shows that Japan experienced a severe downturn during the latter period and, of the countries considered here, registered the highest annual rate of growth (3.6%) in 1980-95, but the lowest rate (0.7%) in 1995-2004. Germany experienced a mild slowdown in economic growth (from 1.9% to 1.1%).[1] The other four countries registered acceleration in economic growth after 1995. The average growth rate for the four countries rose from 2.3% in 1980-95 to 2.6% in 1995-2004.

INSERT Figure 1

There is a stark difference in the causes underlying the acceleration in growth in France, the UK and Italy on the one hand and the US on the other. In the three EU countries, the acceleration in economic growth was mainly achieved through labor input growth. As Figure 2 shows, the increase in labor input growth in France and Italy did not take the form of improvements in labor quality but of increases in total hours worked. In contrast, in the case of the UK, the quality of labor input improved substantially. Until 1995, these three countries suffered high unemployment rates, especially among the less-educated young, but succeeded in creating jobs for these unemployed. The average of the standardized unemployment rate of the three countries declined from 11.3% in 1995 to 7.4% in 2004. On the other hand, the standardized unemployment rate in Japan increased from 3.1% to 4.7% during the same period (OECD 2006). In contrast with the three EU countries just mentioned, the main cause of the growth acceleration in the US was an increase in TFP growth (from 0.7% in 1980-95 to 1.6% in 1995-2004).

INSERT Figure 2

Turning to TFP growth in Japan and the four major EU economies, a similar slowdown can be observed. Comparing the two periods, Japan's average TFP growth rate dropped by 0.8 percent points, from 1.2% in 1980-95 to 0.4% in 1995-2004. In the four major EU economies, the TFP

[1] The EU KLEMS data on Germany for years before Germany's unification include East Germany.

growth rate also declined by 0.8 percent points, from 1.0% in 1980-95 to 0.2% in 1995-2004. Thus, among the six major developed economies, the US is exceptional in the acceleration in TFP growth it experienced.

Looking at the factors contributing to the slowdown in growth in the market sector of Japan's economy, the most important is the decline in the contribution of capital input growth. Of the 2.9 percentage-point decline in the growth rate of Japan's market sector from the earlier to the latter period, 42% was accounted for by the deceleration in capital accumulation. In contrast, in all of the other five countries, the contribution of capital input growth increased (Figure 3). In particular the US and the UK experienced an acceleration in capital accumulation. As Figure 3 shows, this capital deepening in the two countries was caused by the rapid accumulation of ICT capital.

INSERT Figure 3

To sum up the above analysis, it is not the gap in TFP growth but differences in factor input growth that caused the large difference in the economic growth performance of France, the UK and Italy on the one hand and Japan on the other in the period after 1995. The four major EU economies (Germany, France, the UK and Italy) and Japan experienced a slowdown in TFP growth of a similar magnitude after 1995. Only the US accomplished an exceptional acceleration in TFP growth.

Figure 4 compares industry level TFP growth in the six countries before and after 1995. TFP growth in the electrical machinery, post and communication sector was still highest in Japan among the six economies after 1995. However, the problem for Japan is that, like in other countries, the share of this sector in the economy overall is not very large. The average share of labor input (hours worked) in this sector in Japan's total labor input in 1995-2004 was 4.1%. In the US, this share was 3.3%. The largest declines in TFP growth in Japan occurred in distribution services (retail, wholesale and transportation) and in the rest of the manufacturing sector (i.e., excluding electrical machinery). The labor input shares of these two sectors were 23.4% and 16.8% respectively. The US and the major EU economies except Italy recorded high TFP growth in these two sectors. Compared with Germany, France and the UK, Japan's TFP growth in 1995-2004 was low in other goods- producing industries (construction, mining, agriculture, fishery and forestry), but relatively high in finance and business services. Except in France, TFP growth in personal and social services stalled in all the countries examined here.

INSERT Figure 4

If a country's productivity is at the world top level, then in order to accomplish further productivity improvement, the country needs to innovate (Acemoglu et al. 2006) and to adjust her economic structures to novel technologies. On the other hand, if a country's productivity level lags behind the world frontier, then the adoption of already existing technologies and improvements in her resource allocation are probably more important. Inklaar et al. (2006) found that labor productivity levels in market services in continental Europe were on par with the US in 1997, but since then productivity growth in Europe has been much weaker, suggesting that the continental European countries need to do more to innovate and adjust economic structures to novel technologies. This observation raises the question: Is Japan in a similar situation as the continental European countries?

Unfortunately, the EU KLEMS Database (March 2007 version) does not include data that allow a comparison of productivity levels across countries. In this paper, we therefore use the results of a comparison of labor productivity conducted by the Japan Economic Foundation (JEF) and the Japan Center for Economic Research (JCER) (JEF-JCER 2007).[2] The study compares 27 industries covering the whole economy for the period 1980-2003 (1980-2002 in the case of Japan). The JEF-JCER comparison of labor productivity for Japan, Germany, France, the UK and the US is mainly based on purchasing power parity (PPP) data for 1997 from the EU KLEMS Project, real value added and man-hour input data from the EU KLEMS 60-Industry Database, the Input-Output Tables of the OECD STAN Database, and the Asian International Input-Output Table 2000 of the Institute of Developing Economies.[3] Differences of labor input quality across countries and over time are not taken account of in the JEF-JCER labor productivity comparison. Basically the study compares the real value added per man-hour after adjustments for absolute price differences.

INSERT Figures 5, 6, 7 and 8

Figures 5, 6, 7 and 8 show the results of the JEF-JCER study for 2002. In the case of the comparisons between the US and European countries, the results are similar to those of Inklaar et al. (2006). Productivity levels in Germany and France were very close to those in the US both in market services and manufacturing, while productivity levels in the UK were lower than in the two continental European countries. In manufacturing sectors, productivity levels in Japan were on par with those in the US, Germany and France (Figure 5). However, they were very low in comparison with the three countries both in market services and other goods-producing industries. It therefore seems that there is large room for improvement in Japan's productivity in market services and other

---

[2] We would like to thank Ms. Reiko Suzuki of the JCER for helping us to gain access to the JEF-JCER data and providing us with various valuable comments.

[3] The JEF-JCER study also compared the labor productivity of China and the US and of Korea and the US by industry. In addition to the above-mentioned data sources, the intra-Asian comparisons are based on the PPP data of the International Comparison of Productivity Among Asian Countries (ICPA) Project conducted by the Research Institute of Economy, Trade and Industry (RIETI).

goods-production services through the adoption of already existing technologies and better resource allocation.

3. The Role of ICT Investment in the Economic Growth of the Major EU Economies, Japan and the US

There are several studies which suggest that a main factor underlying the acceleration in economic growth in the US after the mid-1990s was an increase in ICT investment (Stiroh 2002a, Triplett et al. 2002, van Ark et al. 2003). Given these results, other developed countries have started to follow the US example and are promoting ICT investment. In this study, using data from the EU KLEMS Database (March 2007), we examine the role of ICT investment in Japan and the major EU economies.

The EU KLEMS Database defines ICT investment as investment in computing equipment, communication equipment, and software. Figure 9 shows the growth paths of ICT capital service inputs in the economy overall for the US, the four major EU economies, and Japan. ICT capital service inputs are calculated based on the three types of ICT capital stock used in the EU KLEMS definition.

INSERT Figure 9

From the viewpoint of ICT capital accumulation at the macro level, it seems that the six countries can be divided into three pairs of countries. The front runners are the US and the UK, which experienced a very rapid increase in ICT capital service inputs after 1995. Their capital service input indices in 2004 are as much as four times as high as their 1995 levels. The next pair consists of France and Germany. Their capital service inputs in 2004 were about 2.8 times greater than in 1995, meaning that capital service inputs in these two countries grew at 12% per annum from 1995 to 2004. The last pair consists of Japan and Italy. ICT capital service inputs in 2004 in both countries were less than twice as high as their 1995 levels. Before 1995, the average growth rate of ICT capital service inputs in Japan was second highest, trailing only behind the UK among the six countries. However, investments in computers in the 1980s mainly consisted of main-frame computers, and Japan's low investment in capital service inputs during the latter period, likely to be at least partly the result of the long-term economic stagnation during the 1990s, suggests that firms were unable to keep up with the rapid trend of computer downsizing and the mass introduction of office PCs in the 1990s.

When we look at movements in ICT capital service inputs by industry, we find almost the same trends as in the economy overall. The growth rate in ICT capital service inputs in Japan was relatively low, particularly in service sectors such as distribution services and personal service industries, as shown in Figures 10 and 11.

INSERT Figures 10 and 11

The impact of the accumulation of ICT capital on economic growth can be classified into two types of effects. The first is the direct effect of capital accumulation. This can be measured by using investment costs, since it can be assumed that cost minimizing investors will equalize the marginal productivity of ICT capital services with their marginal costs. The second type is the indirect or external effects. An increase in ICT capital may enhance the efficiency of firms' production processes or engender a more efficient pattern in the division of labor in each industry and hence accelerate TFP growth.

Table 1 shows the direct contribution of ICT capital to economic growth by industry. In the US and the UK, the contribution of ICT capital increased in almost all sectors after 1995. In France, the contribution of ICT capital service input growth increased in all sectors except personal and social services. In Germany, the contribution of ICT capital service input growth increased in all sectors except two (distribution service and personal and social services). In contrast, in Japan and Italy, there are many sectors where the contribution of ICT service input growth decreased after 1995. In Japan, the contribution of ICT capital service input growth declined in all sectors after 1995, while in Italy, it fell in all sectors except two (finance and business services and personal and social services).

INSERT Table 1

We now turn to the indirect effect of ICT capital service input on economic growth based on the fact that the introduction of ICT equipment raises the efficiency of business activities at the firm- and industry-level and stimulates TFP growth. Across the six countries, we can observe a positive correlation between ICT capital service input growth and TFP growth (Figure 12). For example, the US enjoyed a high TFP growth rate coupled with a high growth rate in ICT capital service inputs, while, on the other hand, in Japan and Italy, a low growth rate in ICT capital service inputs coexisted with a low or negative TFP growth rate. We should note that based on Figure 12 alone we cannot say anything about the direction of causality between ICT capital service inputs and TFP growth. In order to determine the direction of causality, we need to conduct formal econometric tests such as those by Stiroh (2002b) or Miyagawa, Ito, and Harada (2004). However, the preliminary findings in Figures 3 and 4 support the conjecture that ICT capital service input growth promotes economic efficiency.

INSERT Figure 12

4. Intangible Assets as Complements to ICT Capital

According to several recent studies, it seems that in order to fully realize the direct and indirect efficiency-improving effects of ICT capital, the simultaneous accumulation of intangible assets, such as human capital and organizational capital, is indispensable (van Ark 2004, Minetaki 2004, Bloom et al. 2006, and Kanamori and Motohashi 2006). We examine this issue in this section.

Van Ark (2004) emphasized that intangible assets played a complimentary role to ICT capital in affecting productivity growth. In his study, he classified intangible assets that were complementary to ICT capital into five types: human capital, knowledge capital, organizational capital, marketing of new products, and social capital (see Table 2).

With regard to these different types of intangible assets, the EU KLEMS Database provides data on the accumulation of human capital. Human capital accumulation is usually measured by the share of skilled labor in the economy. In the EU KLEMS Database, high-skilled labor is defined as workers who graduated from university. If human capital enhances the direct effect of ICT capital, the return to ICT capital will tend to be high in countries with higher human capital and such countries will have a more active accumulation of ICT capital. Figure 13 shows the share of high-skilled labor input in total labor input in the US, the four major EU economies, and Japan. The figure illustrates that the share of high-skilled labor inputs in all countries is on an upward trend, and shares do not seem to converge to a certain level. The US has maintained the highest high-skilled labor share among the six countries for the past 24 years, while Japan has maintained the second highest share. Judging from this figure and our finding that ICT capital service input growth in Japan has been stagnated since 1995, it seems that formal university-level education is not a key intangible asset that enhances the accumulation of ICT capital.

INSERT Table 2 and Figure 13

Next, let us compare the accumulation of broader categories of intangible assets in developed economies. Our comparison is based on preceding research, including our own (Fukao et al. 2007) which estimated various types of intangible assets in developed economies using the methodology developed by Corrado et al. (2005, 2006).

Intangible assets in Corrado et al.'s approach consist of three major categories: computerized information, innovative property, and economic competencies. Computerized information consists of software, databases, etc. Innovative property includes scientific and nonscientific R&D, where the latter refers to, for example, mineral exploitation, copyright and license costs, and other product development, design, and research expenses. Economic competencies include brand equity, firm-specific human capital, and organizational structure.

Fukao et al. (2007) measured intangible investment in Japan using the above classification.[4] The results of Fukao et al. (2007), Corrado et al. (2006) on the US, and Marrano et al. (2006) on the UK are summarized in Table 3. Intangible investment in Japan was about 50 trillion yen on average from 1995 to 2002. The amount is equivalent to 9.6% of Japan's GDP, a ratio that is smaller than that in the US or the UK.

INSERT Table 3

Moreover, comparing the relative levels of intangible and tangible investment in Japan and the US, other significant differences emerge. For example, Corrado et al. (2006) found that in the United States, intangible investment was 1.2 times the level of tangible investment. However, according to Fukao et al. (2007), the ratio of intangible to tangible investment in Japan is only 0.5. Figure 14 shows the ratio of intangible to tangible investment in Japan and the United States. The figure illustrates that the ratio of intangible to tangible investment in the United States is on an upward trend. The intangible investment series estimated following Corrado et al.'s (2005, 2006) approach is one of the most comprehensive measures of the accumulation of intangible assets. According to this measure, investment activity in intangibles is less active in Japan than in the US and the UK, although there are many high-skilled workers in Japan.[5] The relatively low level of intangible investment may be a good candidate to explain why the accumulation of ICT capital and TFP growth stalled in Japan.

INSERT Figure 14

5. Conclusions

Using the recently released EU KLEMS Database (March 2007) and other statistics, we examined whether Japan experienced similar problem as the major EU economies with regard to the introduction of ICT to market services. The major results obtained through our analysis are follows:

1. It is not the gap in TFP growth but differences in factor input growth that underlie the large difference in the economic growth performance of France, the UK and Italy on the one hand

---

[4] In this paper, using new data on design and legal services, we revised the estimates of investment in innovative property and economic competencies by Fukao, et al. (2007).

[5] We should note that both ICT capital and intangible assets in Corrado et al.'s (2005, 2006) definition include computer software. However, Japan's sluggishness in intangible asset accumulation cannot be explained by sluggishness in computer software investment, since compared with the US and the UK, Japan's investments in innovative property and economic competencies were small.

and Japan on the other in the period after 1995. The four major EU economies (Germany, France, the UK and Italy) and Japan experienced a slowdown in TFP growth of a similar magnitude after 1995. The US was exceptional in accomplishing an acceleration in TFP growth.

2. TFP growth in the electrical machinery, post and communication sector was still highest in Japan among the six economies after 1995. However, the problem for Japan is that, like in other countries, the share of this sector in the economy overall is not very large. The largest declines in TFP growth in Japan occurred in distribution services (retail, wholesale and transportation) and in the rest of the manufacturing sector (i.e., excluding electrical machinery). The labor input shares of these two sectors were very large (23.4% and 16.8% respectively). The US and the major EU economies except Italy recorded high TFP growth in these two sectors.
3. In manufacturing sectors, productivity levels in Japan were on par with those in the US, Germany and France. However, they were very low in comparison with the three countries both in market services and other goods-producing industries. It therefore seems that there is large room for improvement in Japan's productivity in market services and other goods-production services through the adoption of already existing technologies and better resource allocation.
4. The US and the UK experienced a very rapid increase in ICT capital service inputs after 1995. In contrast with this, in Japan, the contribution of ICT capital service input growth declined in all sectors after 1995. Across the six countries, we can observe a positive correlation between ICT capital service input growth and TFP growth. This fact supports the conjecture that Japan's sluggish growth in ICT capital service inputs is at least partly responsible for the slowdown in Japan's TFP growth after 1995.
5. According to several recent studies, it seems that in order to fully realize the direct and indirect efficiency-improving effects of ICT capital, the simultaneous accumulation of intangible assets, such as human capital and organizational capital, is indispensable. Investment activity in intangibles is less active in Japan than in the US and the UK, although there are many high-skilled workers in Japan. The relatively low level of intangible investment may be a good candidate to explain why the accumulation of ICT capital and TFP growth stalled in Japan.

References

Acemoglu, Daron, Philippe Aghion, and Fabrizio Zilibotti (2006) "Distance to Frontier, Selection, and Economic Growth," *Journal of the European Economic Association*, vol. 4, no. 1, pp. 37-74.

Ark, Bart van (2004) "The Measurement of Productivity: What Do the Numbers Mean?" in G. Gelauff, L. Klomp. S. Raes, and T. Roelandt (eds.), *Fostering Productivity*, Elsevier, Amsterdam.

Ark, Bart van, Robert Inklaar, and Robert H. McGuckin (2003) "ICT and Productivity in Europe and the United States: Where Do the Differences Come from?" *Economics Program Working Paper Series*, no. 03-05, The Conference Board, New York.

Bloom, Nick, Raffaella Sadun, and John Van Reenen (2006). "It Ain't What You Do, It's the Way You Do IT: Investigating the Productivity Miracle Using the Overseas Activities of US Multinationals," working paper, London: Centre for Economic Performance, London School of Economics.

Corrado, C., C. Hulten, and D. Sichel (2005) "Measuring Capital and Technology: An Extended Framework," in C. Corrado, J. Haltiwanger, and D. Sichel (eds.), *Measuring Capital in the New Economy*, The University of Chicago Press, Chicago,.

Corrado, C., C. Hulten, and D. Sichel (2006) "Intangible Capital and Economic Growth," *NBER Working Paper* No. 11948.

Fukao, K., S. Hamagata, T. Miyagawa, and K. Tonogi (2007), "Intangible Investment in Japan: Measurement and Contribution to Economic Growth," *RIETI Discussion Paper Series*, 07-E-034.

Inklaar, Robert, Marcel P. Timmer and Bart van Ark (2006) "Mind the Gap! International Comparisons of Productivity in Services and Goods Production, *Hi-Stat Discussion Paper Series*, no.175, Hitotsubashi University, Tokyo.

Japan Economic Foundation (JEF) and Japan Center of Economic Research (JCER) (2007) *Kikai Sangyo To no Seisan-sei no Kokusai Hikaku ni Kansuru Chosa Kenkyu Hokoku-sho [Report on the Study of International Productivity Comparison in Machinery and Other Industries]*, JCER, Tokyo.

Kanamori, Takahito and Kazuyuki Motohashi (2006) "Centralization or Decentralization of Decision Rights? Impact on IT Performance of Firms," *RIETI Discussion Paper Series* 06-E-032, Tokyo.

Marrano, M. G. and J. Haskel, (2006) "How Much Does the UK Invest in Intangible Assets?" Department of Economics, Queen Mary University of London, *Working Paper* No. 578.

Minetaki, Kazunori (2004) "The Effect of Information and Communication Technology on the

Japanese Economy," *Japanese Economy* 32(1), 76-86.

Miyagawa, T., Y. Ito, and N. Harada (2004) "The IT Revolution and Productivity Growth in Japan," *Journal of the Japanese and International Economy* 18, 362-389.

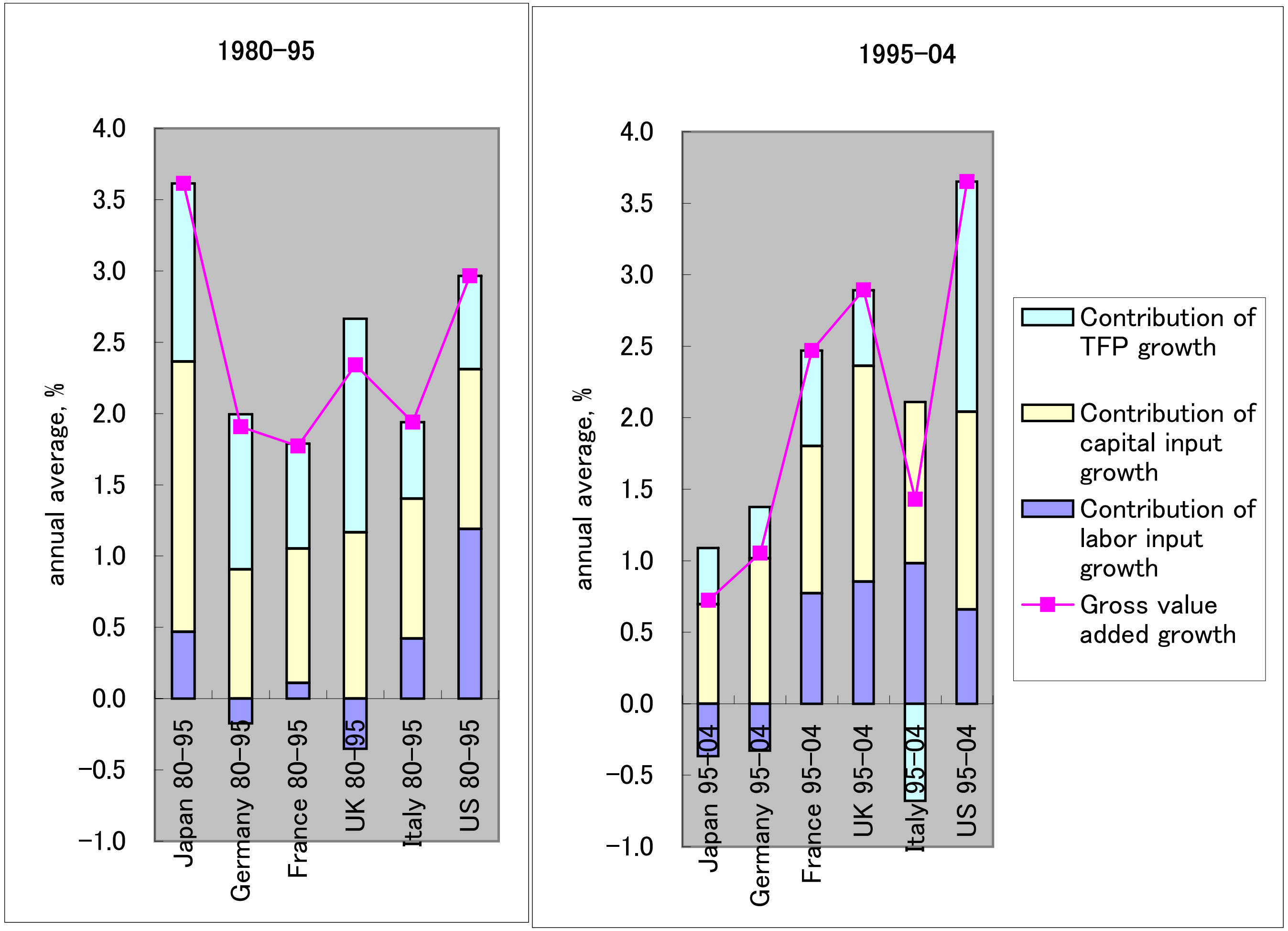
OECD (2006) *Economic Outlook*, no. 80, Statistical Annex Tables, downloaded at http://www.oecd.org/document/61/0,2340,en_2649_201185_2483901_1_1_1_1,00.html on March 20, 2007.

Stiroh, K.J. (2002a) "Information Technology and the US Productivity Revival: What Do the Industry Data Say?" *American Economic Review* 92(5), 1559–1576.

Stiroh K. J. (2002b) "Are ICT Spillovers Driving the New Economy?" *Review of Income and Wealth* 48, 33-58.

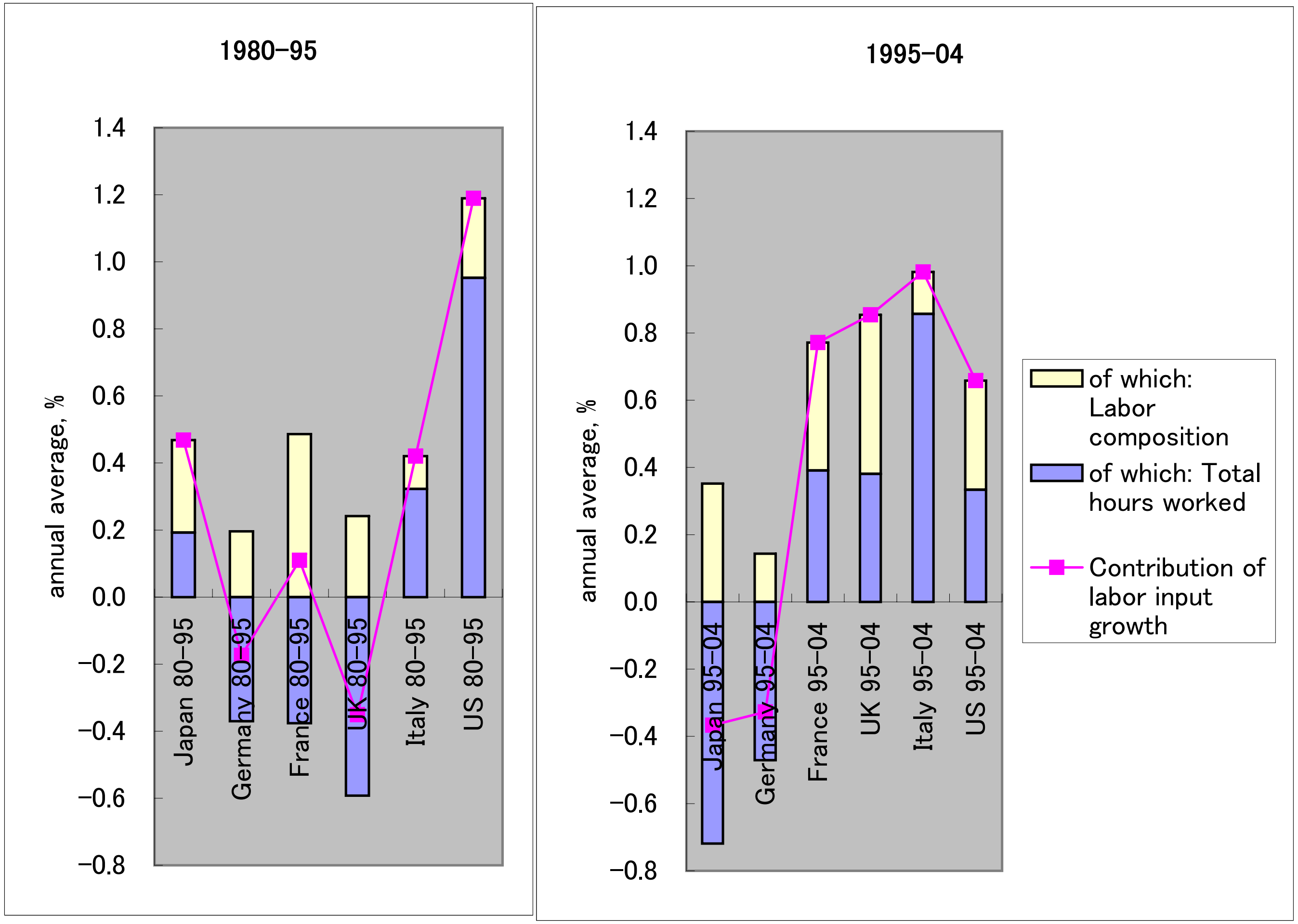
Triplett, J.E. and Bosworth, B.P. (2002), "'Baumol's Disease' Has Been Cured: IT and Multifactor Productivity in U.S. Services Industries," mimeo, available at: http://www.brookings.edu/dybdocroot/views/papers/triplett/20020419.pdf)

Figure 1. Growth Accounting for the Market Sector in Japan, the US, and the Major EU Economies



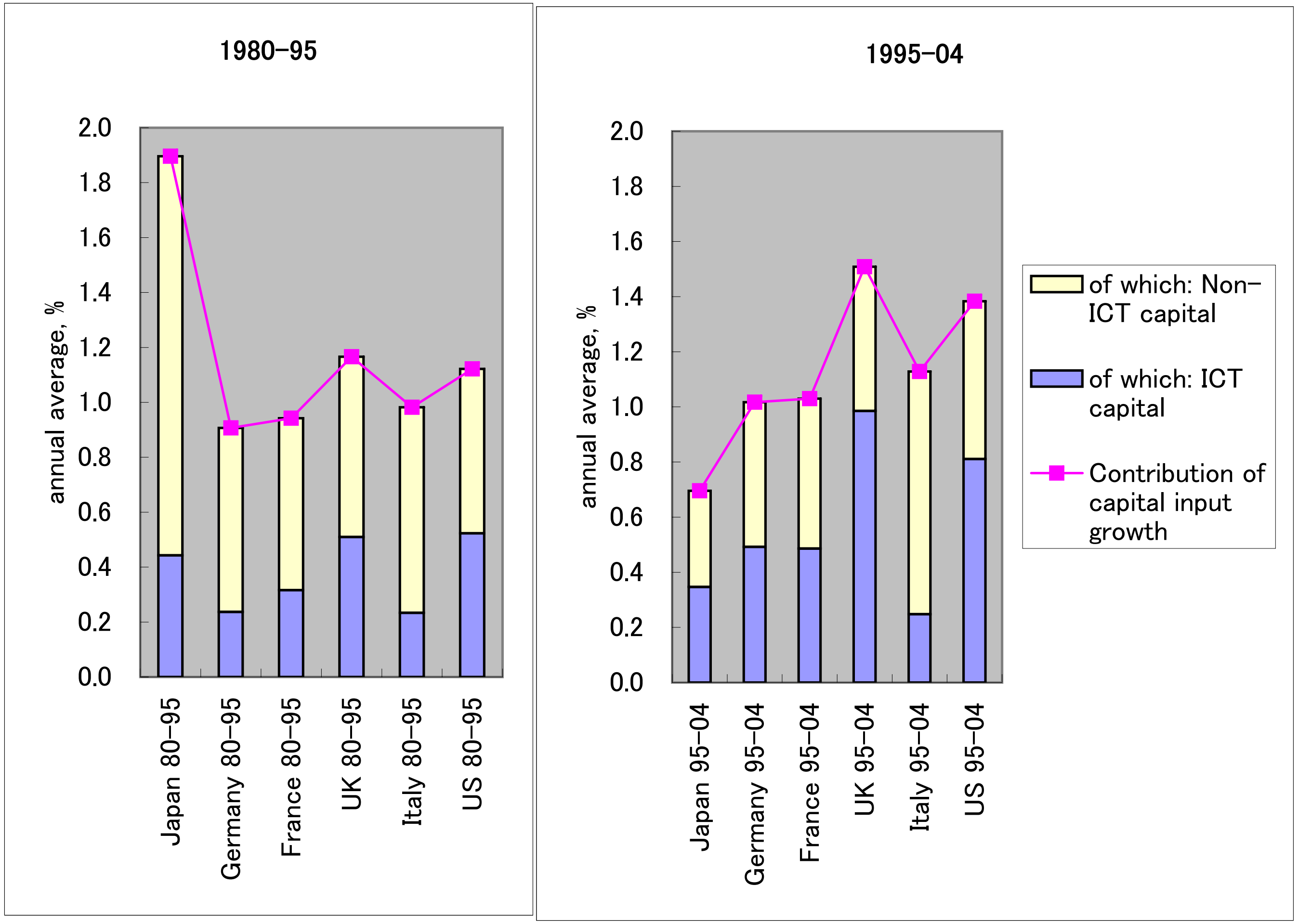
Source: EU KLEMS Database, March 2007.

Figure 2. Contribution of Labor Input Growth: Japan, the US and the Major EU Economies



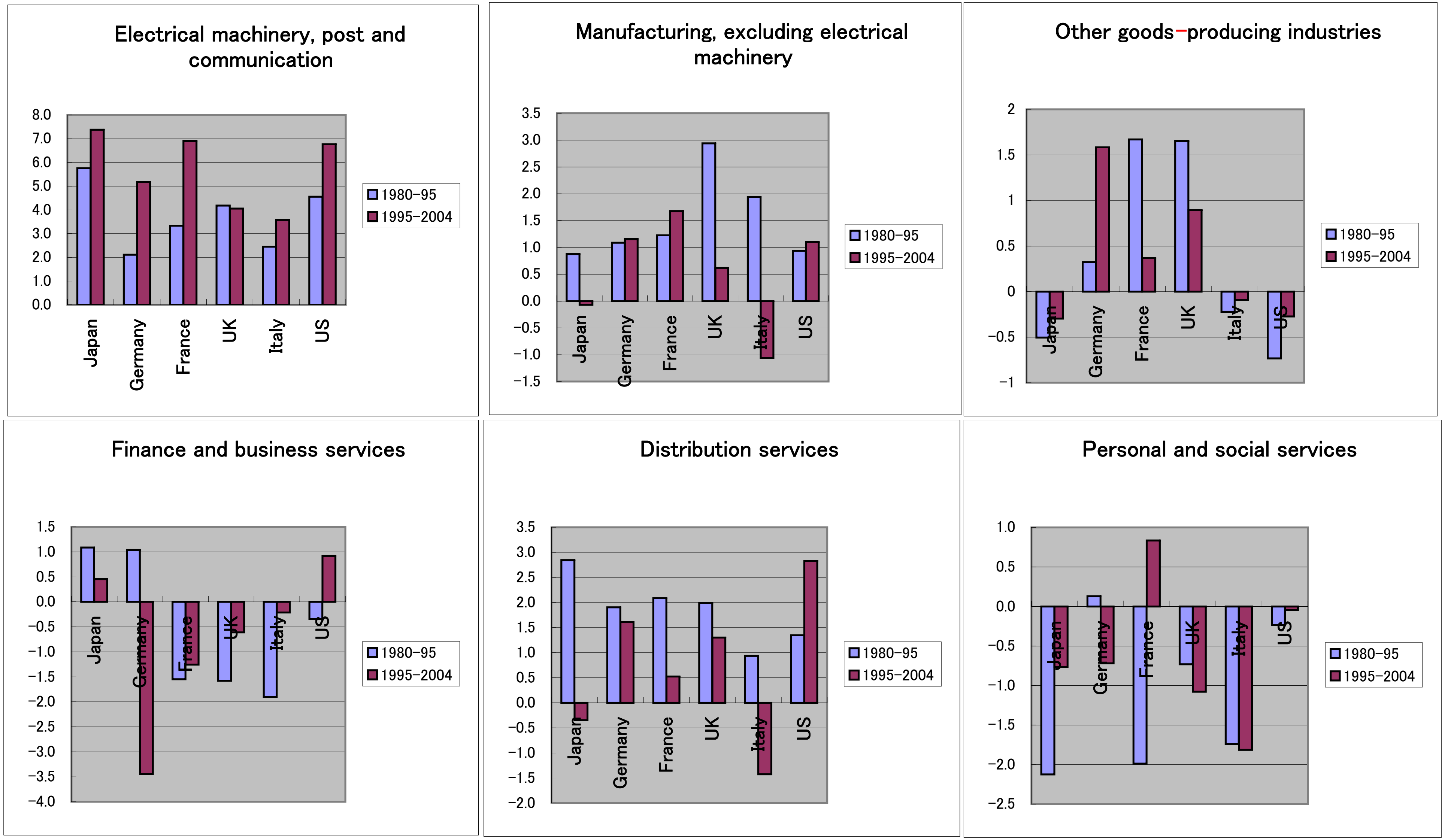
Source: EU KLEMS Database, March 2007.

Figure 3. Contribution of Capital Input Growth: Japan, the US and the Major EU Economies



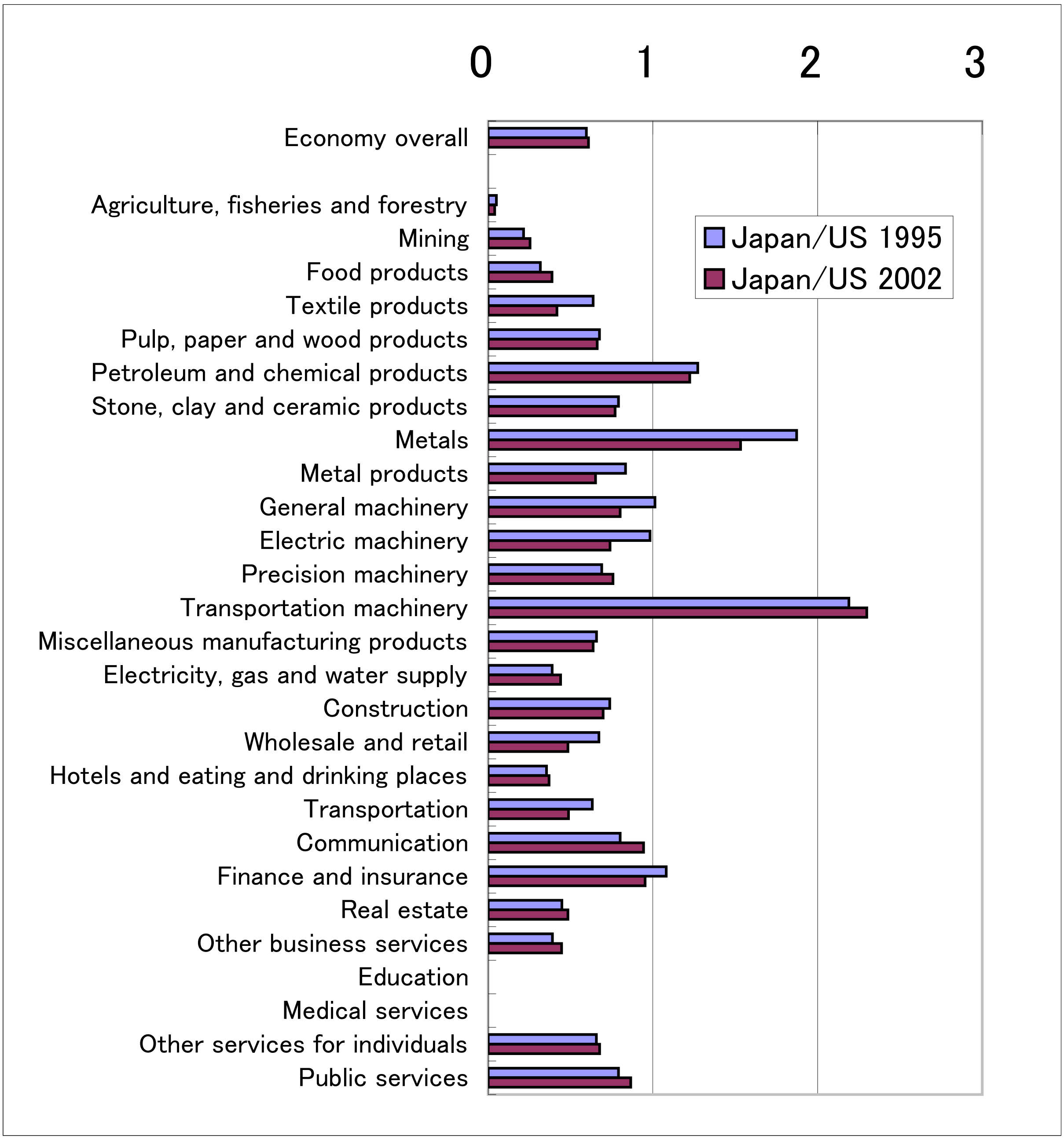
Source: EU KLEMS Database, March 2007.

Figure 4. TFP Growth in the Market Sector: by Sector and by Country



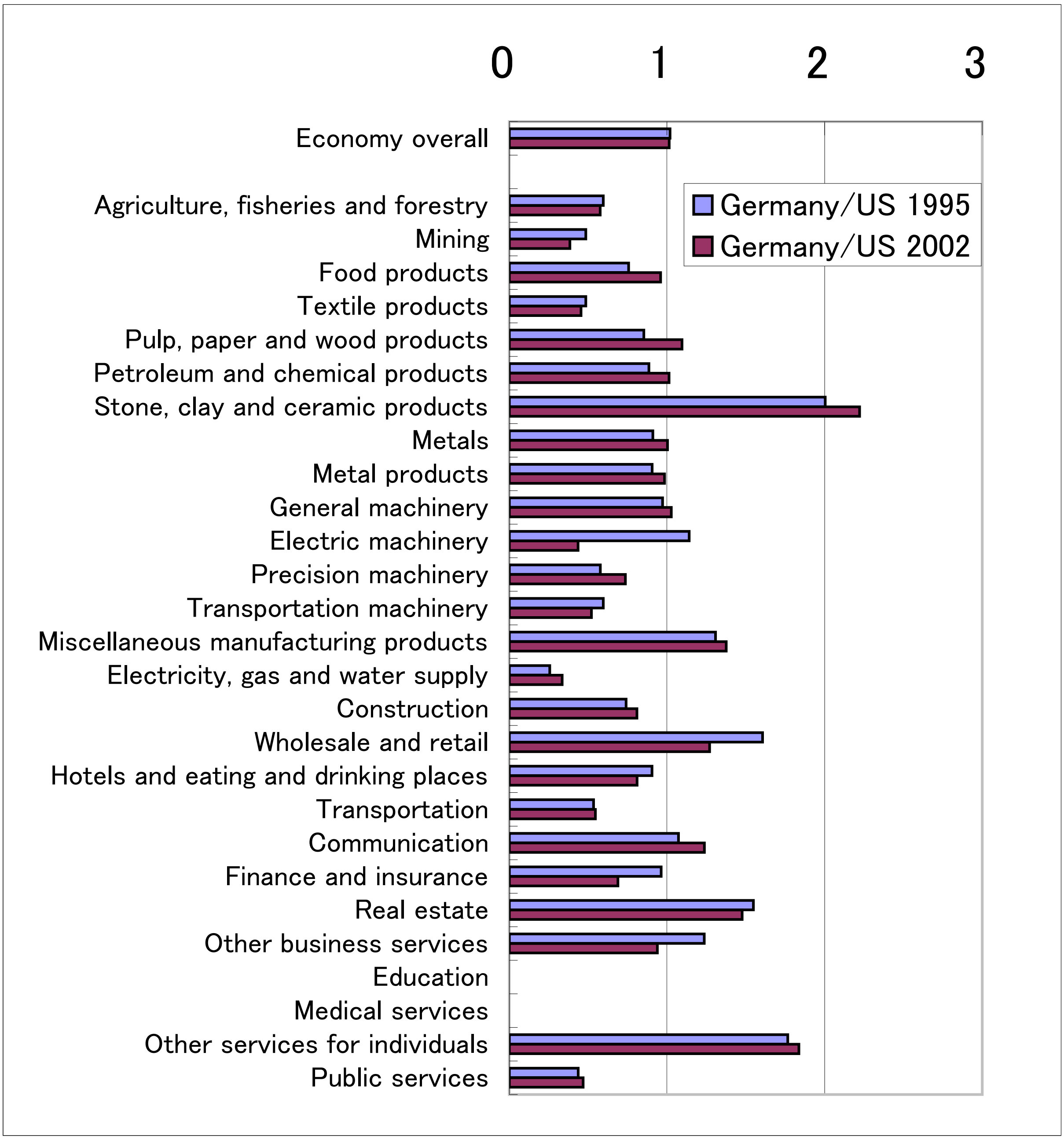
Source: EU KLEMS Database, March 2007.

Figure 5. Labor Productivity: Japan-US Comparison



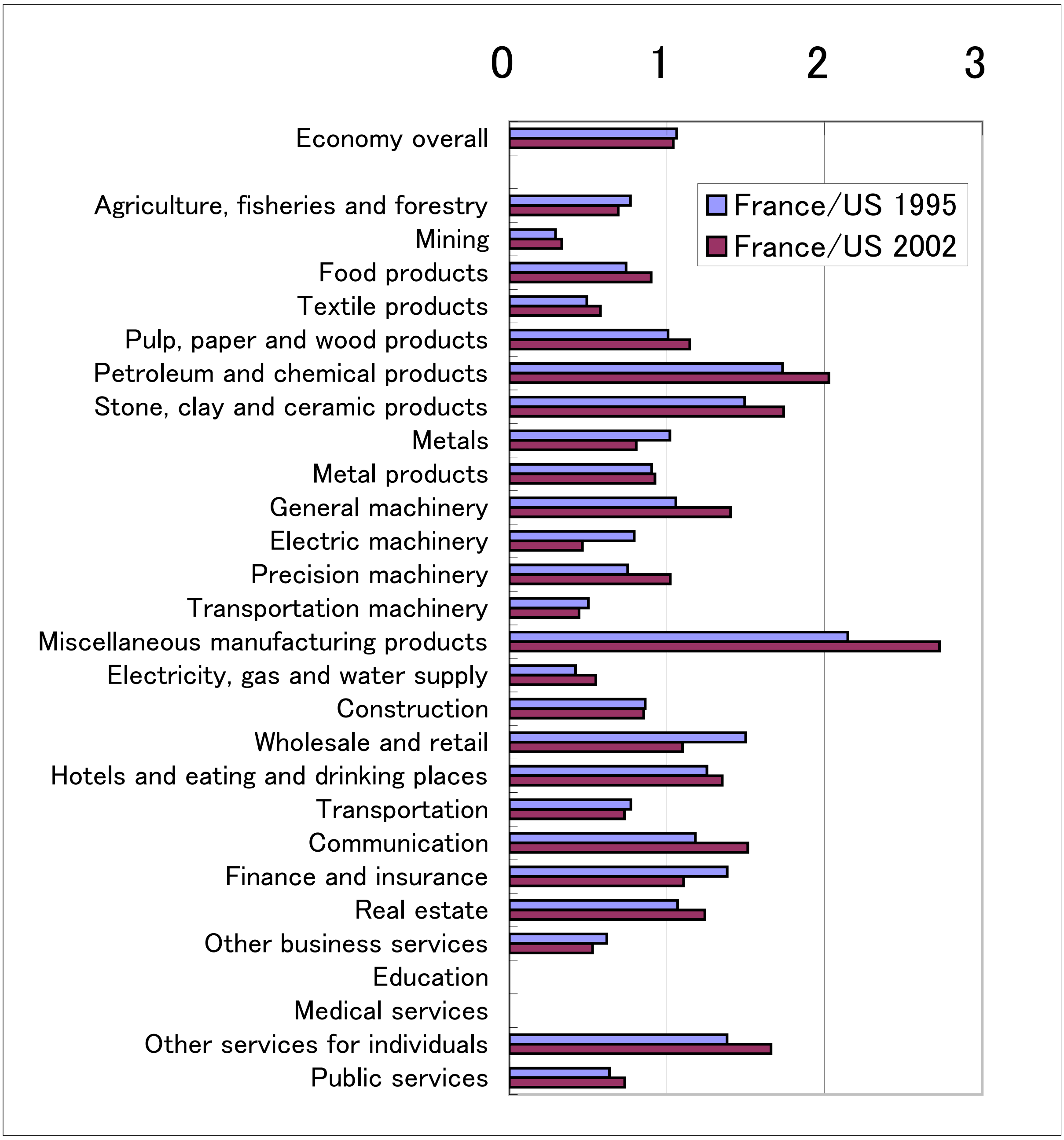
Source: JEF-JCER (2007).

Figure 6. Labor Productivity: Germany-US Comparison



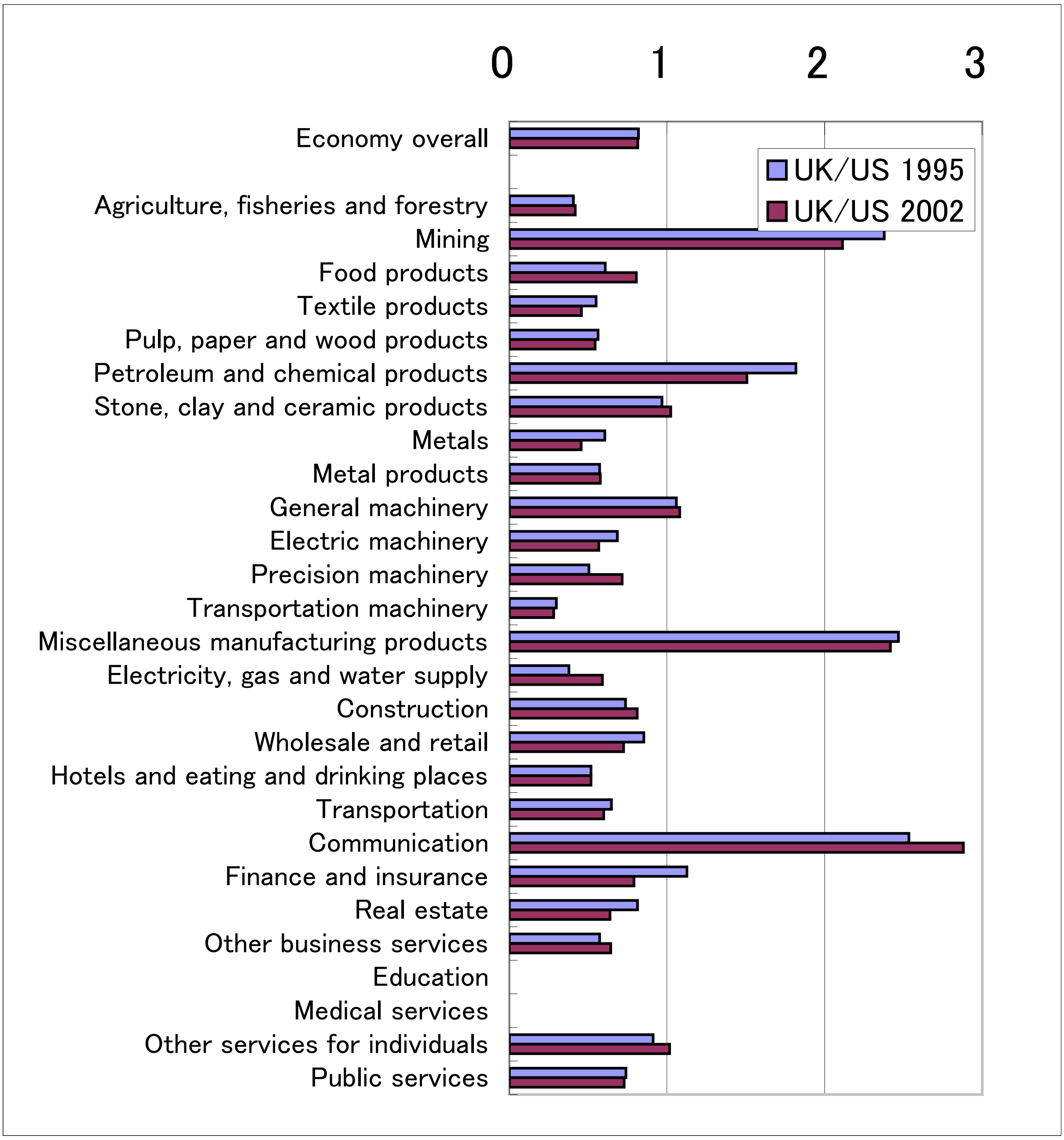
Source: JEF-JCER (2007).

Figure 7. Labor Productivity: France-US Comparison



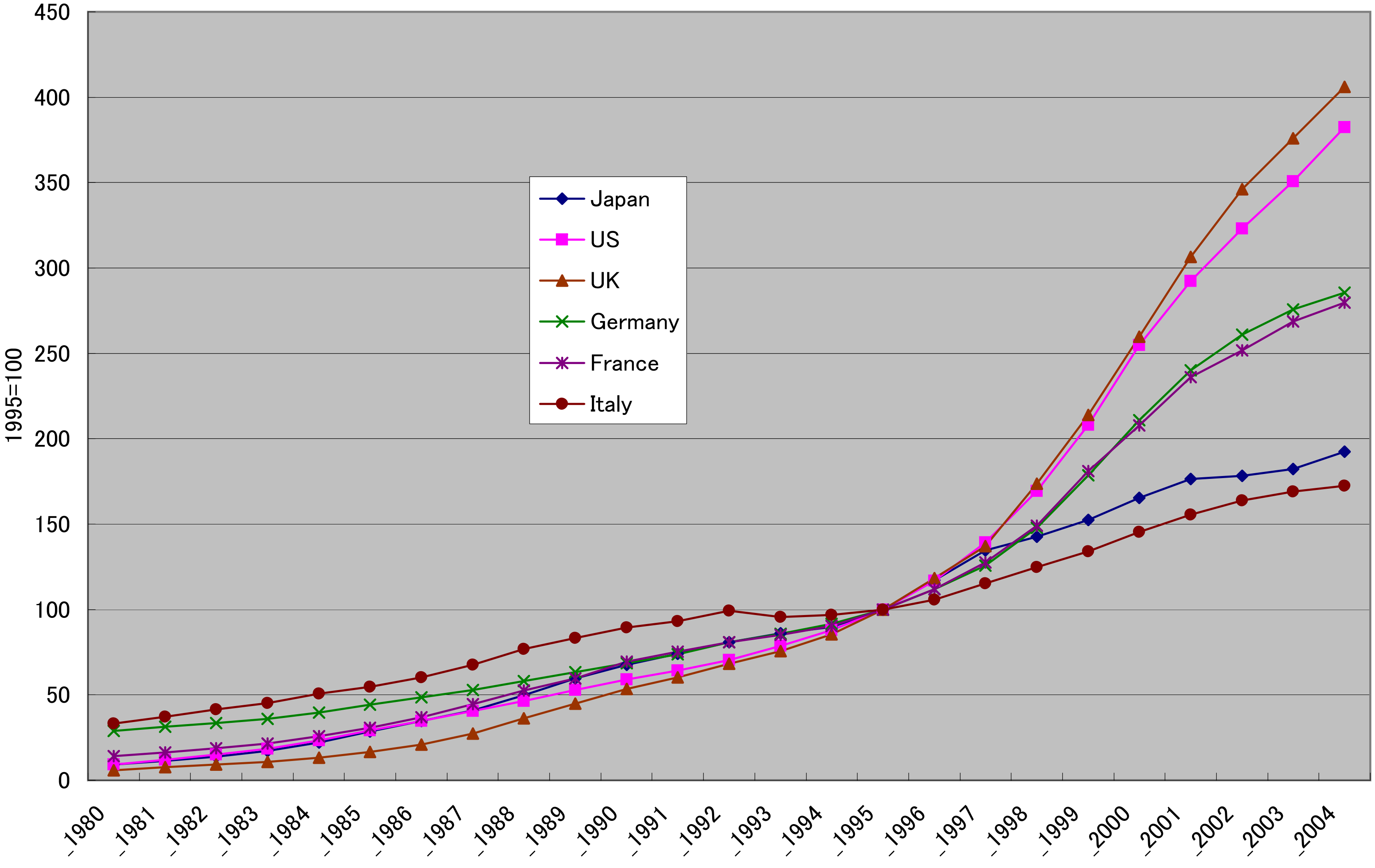
Source: JEF-JCER (2007).

Figure 8. Labor Productivity: UK-US Comparison



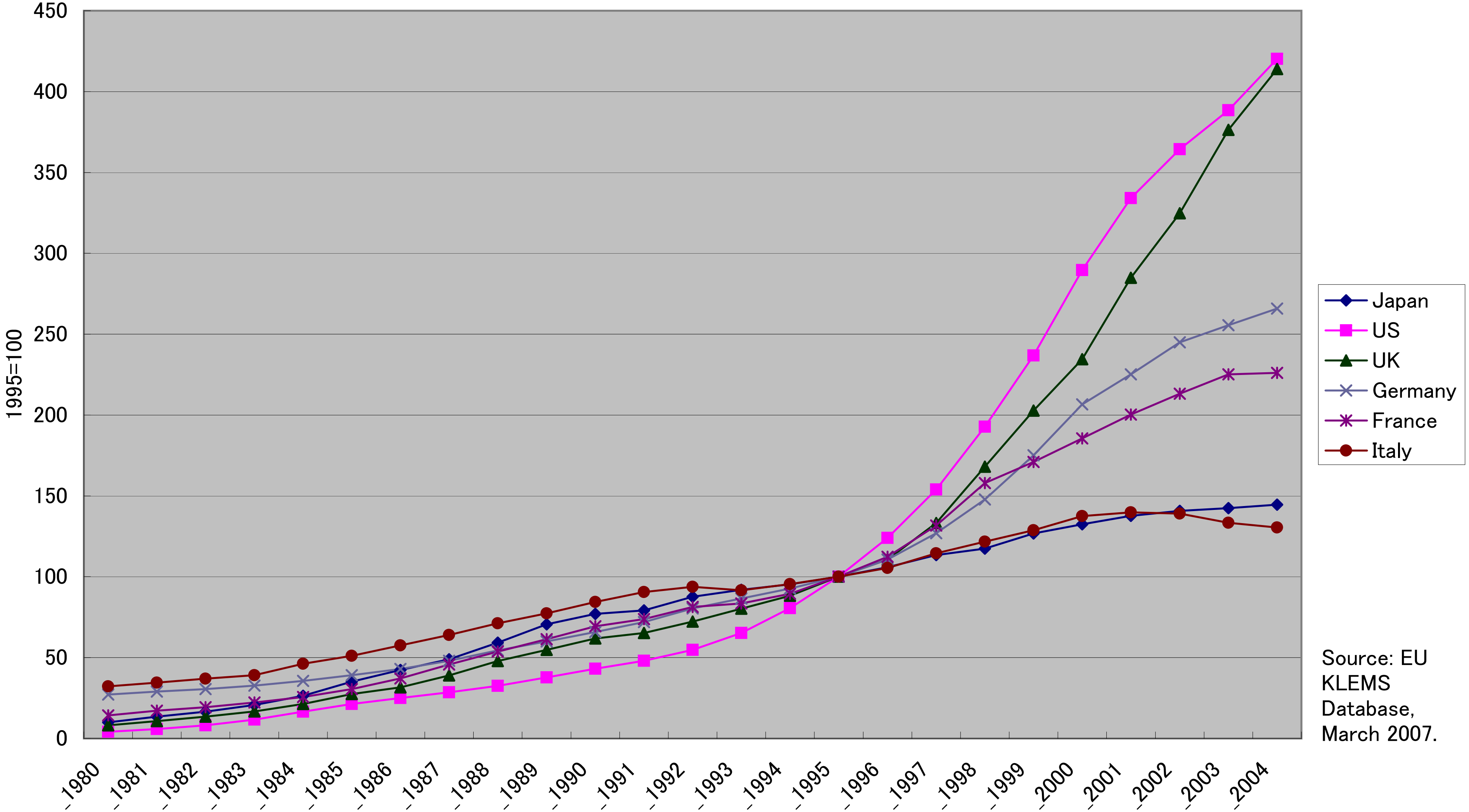
Source: JEF-JCER (2007).

Figure 9. Growth of ICT Capital Service Input in the Economy Overall



Source: EU KLEMS Database, March 2007.

Figure 10. Growth in ICT Capital Service Inputs in the Distribution Industry



Source: EU KLEMS Database, March 2007.

Figure 11. Growth in ICT Capital Service Inputs in Personal and Social Services

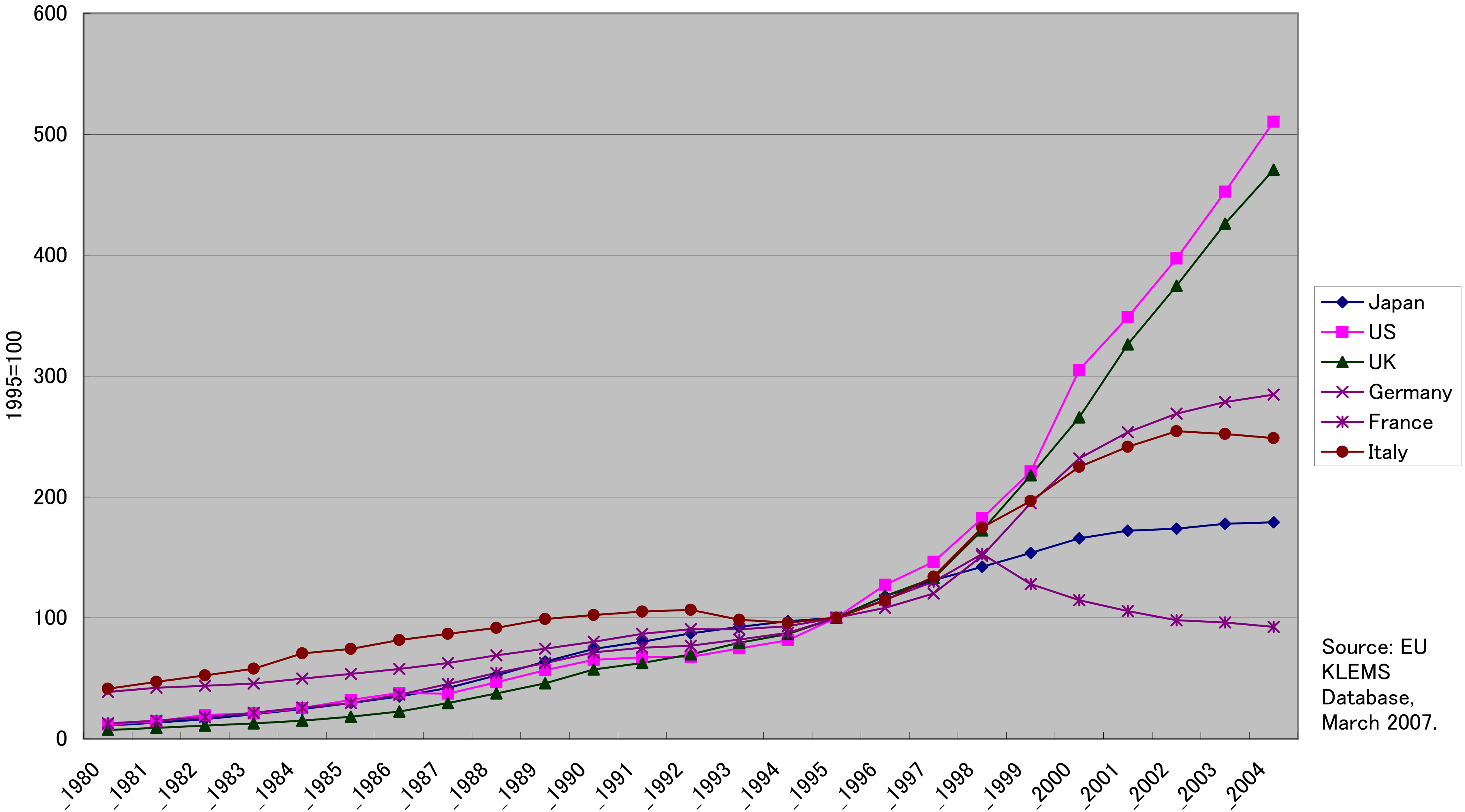


Table 1. Direct Contributions of ICT Capital Service Input Growth to Economic Growth

	1980–95						1995–2004					
	Japan	US	France	Germany	Italy	UK	Japan	US	France	Germany	Italy	UK
Market sector total	0.4	0.5	0.3	0.9	0.2	0.5	0.3	0.8	0.5	1.0	0.2	1.0
Electrical machinery, post and communication	1.2	1.0	0.4	2.3	0.8	1.3	1.0	1.5	0.8	2.7	0.2	2.7
Manufacturing, excluding electrical machinerv	0.2	0.3	0.2	0.4	0.1	0.3	0.1	0.4	0.3	0.5	0.1	0.5
Other goods-producing industries	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.2	0.1	0.0	0.1
Distribution services	0.2	0.6	0.2	0.5	0.3	0.4	0.1	1.0	0.3	0.8	0.2	0.8
Finance and business services	1.6	1.0	0.7	2.2	0.5	1.0	1.2	1.2	1.0	1.8	0.7	1.8
Personal and social services	0.3	0.2	0.5	0.6	0.0	0.4	0.2	0.4	0.0	0.5	0.3	0.5

Source: EU KLEMS Database, March 2007.

Figure 12. TFP Growth and Growth in ICT Capital Service Inputs

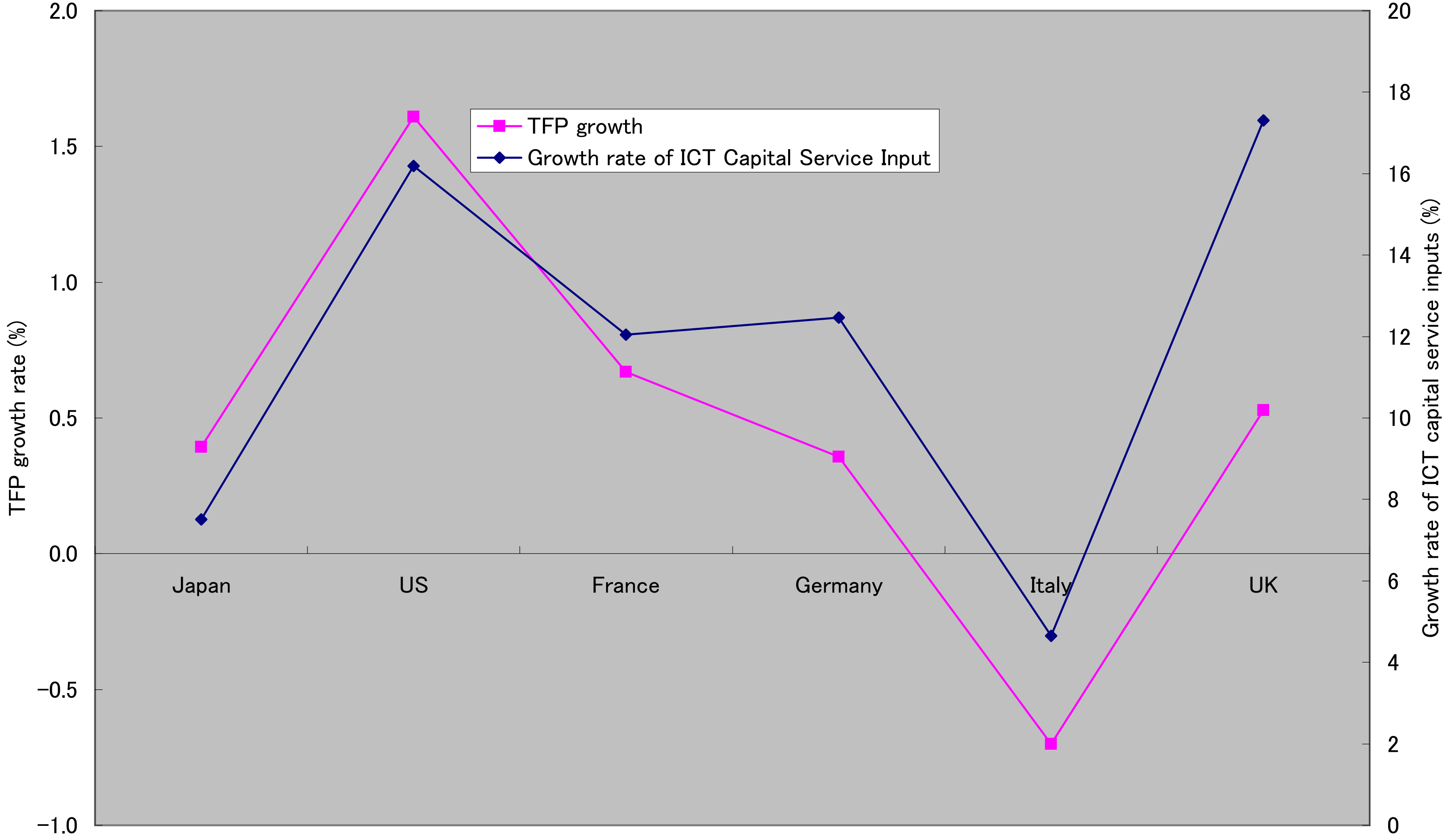


Table 2. Classification in Knowledge Capital

(A) ICT capital
(A1) Hardware
(A2) Telecommunication infrastructure
(A3) Software
(B) Human capital
（B1) Formal education
(B2) Company training
(B3) Experience
(C) Knowledge capital
（C1) Research and development and patents
(C2) Lincenses, brands, and copyrights
(C3) Other technological innovation
(D) Organizational capital
（D1) Engineering design
(D2) Organizational design
(D3) Structure in database and its use
(D4) Remuneration of innovative ideas
(E) Marketing of new products ('customer capital')
(F) Social capital

Source: van Ark (2004).

Figure 13, Share of High-Skilled Labor Input in Total Labor Input

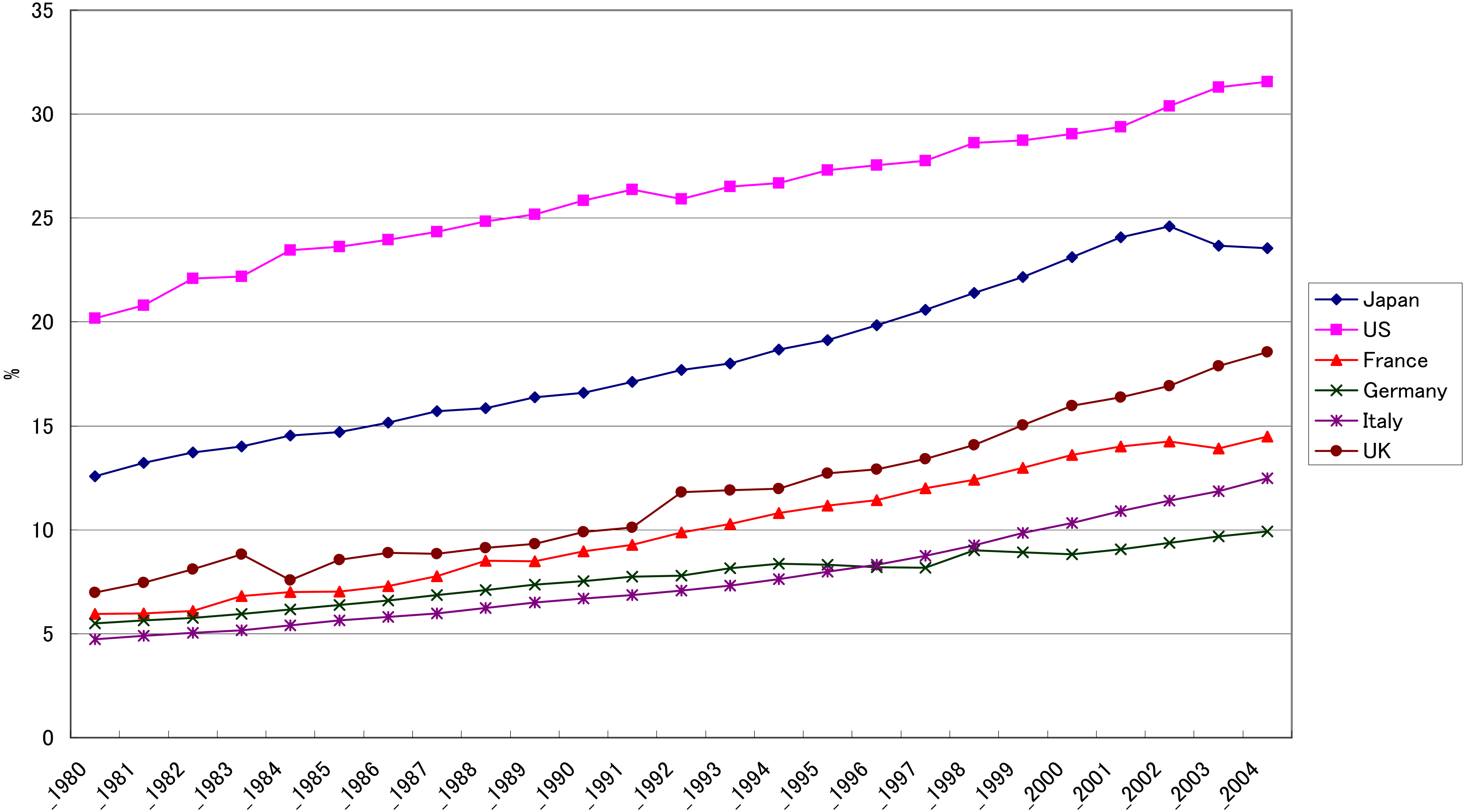


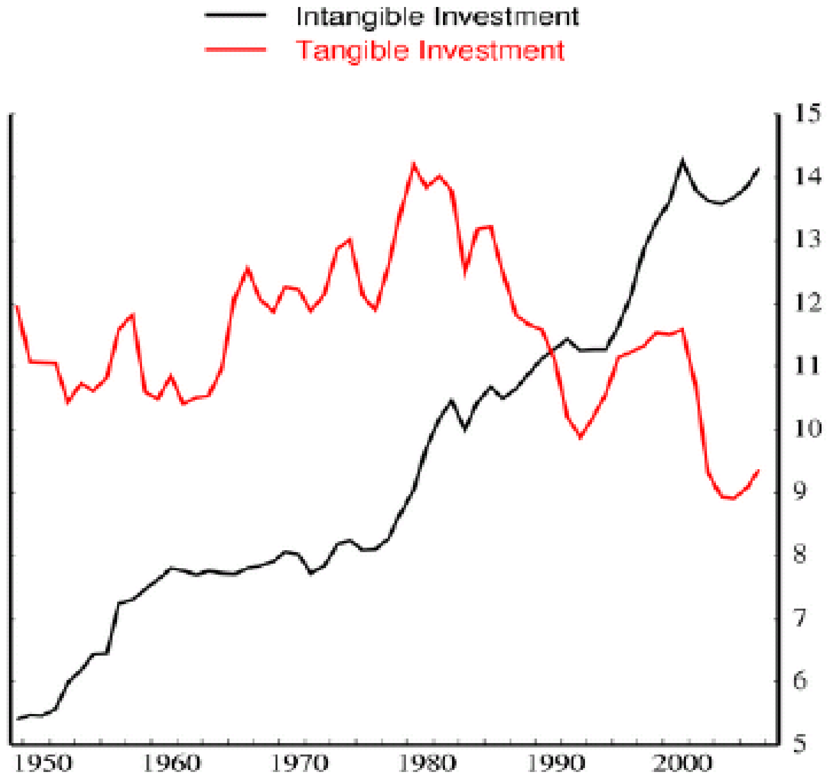
Table 3 Intangible Investment: Japan, the US and the UI

	Japan	US	UK
		CHS (2006)	MH (2006)
	2000-04 (average, billion yen)	1998-2000 (billion US dollars)	2004 (billion pounds)
Computerized information	**10,630**	**154**	**19.8**
Software	9,556	151	19.9
Custom software	6,626		
Packaged software	841		7.5
In-house software	2,088		12.4
Databases	1,075	3	
Innovative property	**26,796**	**425**	**37.6**
Science and engineering R&D	13,522	184	12.4
Mineral exploration	19	18	0.4
Copyright and license costs	4,579	75	2.4
Other product development, design, and research expenses	8,676	149	22.4
Economic competencies	**13,356**	**505**	**58.8**
Brand equity	4,982	140	11.1
Firm-specifc resouecs	8,374	365	47.7
Firm-specific human capital	1,426		28.5
Organizational structure	6,948		19.2
Total	**50,783**	**1085**	**116.2**
Total intangible investment /GDP (%)	**9.6**	**11.7**	**10.9**
Intangible investment/tangible investment	**0.5**	**1.2**	

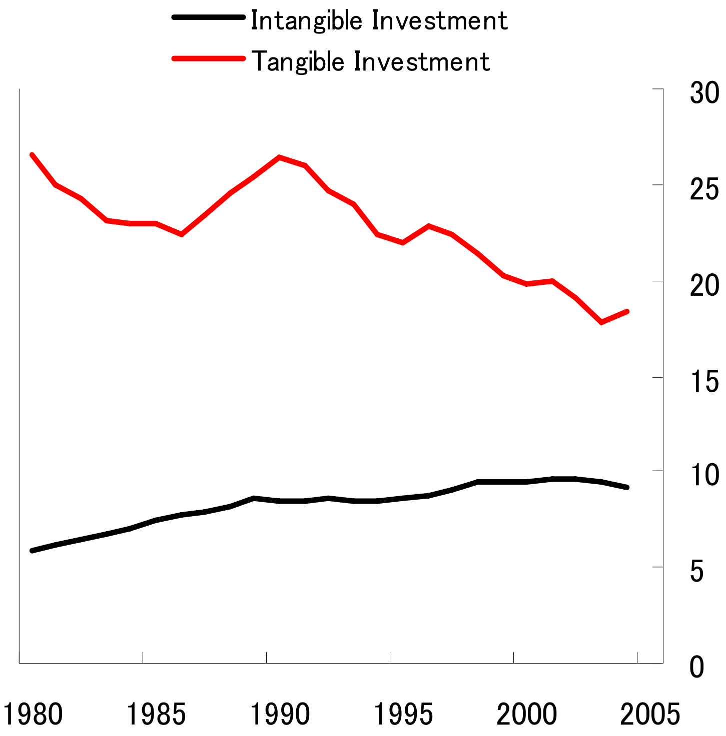
Sources: Fukao et al. (2007), Corrado et al. (2006) and Marran and Haskel (2006).

Figure 14. Business Investment (percent of business output)

US



Japan



Source: Corrado et al. (2006)

Source: Fukao et al. (2007)