University of Groningen

Groningen Growth and Development Centre

RuG

Structural Change in Advanced Nations: A New Set of Stylised Facts

Research Memorandum GD-115

Dale W. Jorgenson and Marcel P. Timmer

RESEARCH MEMORANDUM

Structural Change in Advanced Nations:
A New Set of Stylised Facts

-

Dale W. Jorgenson

(Harvard University)

Marcel P. Timmer*

(University of Groningen)

October 2009

This paper is under review by

Scandinavian Journal of Economics

Abstract

We provide new evidence on patterns of structural change in advanced economies, reconsidering the stylised facts put forward by Kaldor (1967), Kuznets (1971) and Maddison (1980). Since 1980 the services sector has overwhelmingly predominated in the economic activity of the European Union, Japan and the U.S., but there is substantial heterogeneity among services. Personal, finance and business services have low productivity growth and increasing shares in employment and GDP. By contrast, shares of distribution services are constant and productivity growth is rapid. We find that the labour share in value added is declining, while the use of ICT-capital and skilled labour is increasing in all sectors and regions.

* Corresponding author.

I. Introduction

More than three decades ago, Nicholas Kaldor, Simon Kuznets and Angus Maddison established a number of empirical regularities in the structural transformation of advanced economies (Kaldor, 1963; Kuznets, 1971; Maddison, 1980). Kuznets and Maddison described the canonical shifts of output and labour first from agriculture to industry, and later on from industry to services. In addition, they suggested that productivity growth in the services sector was much lower than in the rest of the economy, and services output prices tended to increase more rapidly. This is also known as the cost disease of services (Baumol, 1967). Kaldor's most notable finding was the stability of the share of labour in GDP over time. These stylised facts have been a crucial ingredient in much subsequent work on economic growth, development economics, international macroeconomics and trade, business cycles and labour markets.[1] The purpose of this paper is to examine whether these stylised facts provide an accurate description of more recent structural changes.

To establish a new set of stylised facts we rely on a new data source, the EU KLEMS database, containing detailed measures of output, labour and capital inputs (O'Mahony and Timmer, 2009). This greatly facilitates tracking of sectoral trends in GDP, employment, prices, input shares and multifactor productivity. We search for similarities in long-run growth patterns since 1980 across three major regions – Europe, Japan, and the U.S. These regions include a very large part of the OECD and the world economy. When considering sectoral developments in Europe, it is important to aggregate across European countries. Specialisation may generate differences in country patterns as relatively small countries trade widely. Therefore, we study developments in the European Union as a whole, rather than individual European countries, as in Kaldor (1963), Kuznets (1971) and Maddison (1980).

[1] For example, sectoral differences in productivity are an important cornerstone in models of real exchange rates (Obstfeld and Rogoff, 1996). They also underpin the hypothesis of cost disease of the services sector described by Baumol (1967) and motivate the recent surge in multi-sector endogenous growth models, e.g. Restuccia, Yang and Zhu (2008) and Ngai and Pissarides (2007).

We find that the analysis of structural change requires a radical shift of emphasis from goods production to the production of services. The division of the economy among agriculture, industry and services has lost most of its relevance. The agricultural sector has become small, while services now comprise about three-quarters of GDP. And our disaggregated industry analysis reveals substantial heterogeneity within the services sector. Personal, finance and business services follow the classical pattern of low productivity growth, rising relative prices and increasing shares in employment and GDP. The shares of non-market services in GDP and employment have also continued to rise. On the other hand, the shares of distribution services have been stable, and productivity growth has been rapid. Contrary to Kaldor's finding, we find that the labour share in value added has been declining in all sectors and regions over the period 1980-2005, except in U.S. finance and business services. Finally, the use of ICT capital and skilled labour is increasing in all sectors, in particular in the services industries.

The remainder of the paper is organised as follows. In Section II we describe our data sources. Section III is devoted to changes in industry shares in GDP and employment. In Section IV, we discuss trends in productivity, as well as in output prices. We study patterns in the use of labour and capital, in particular skilled labour and ICT capital, in Section V. Section VI concludes.

II. Data Sources

The data for this study are taken from the EU KLEMS database, March 2008 version (available at www.euklems.net). The Japanese data in EU KLEMS are based on the Japan Industrial Productivity (JIP) Database Project (Fukao, *et al.,* 2007) and data for the U.S. are based on Jorgenson, Ho and Stiroh (2005). The data for the European Union covers ten major European countries for which capital input data are available by industry: Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Spain and the United Kingdom.[2] Output and inputs have been aggregated across European countries by means of relative

[2] This group of countries is called EU15ex in the EU KLEMS database.

prices of output (PPPs) which are industry-specific. The EU KLEMS database has been constructed largely on the basis of data from national statistical institutes and processed according to harmonised procedures. These procedures ensure international comparability and generate growth accounts in a consistent and uniform way. Data are available from 1980 onwards and for some countries back to 1970.[3] O'Mahony and Timmer (2009) provide a detailed description of the contents and construction of the EU KLEMS database, so that we can be brief.

Nominal and real series for output and value added at the industry level are taken directly from the national accounts. The most important innovation in the EU KLEMS database is that estimates of multifactor productivity incorporate detailed measures of labour and capital services.[4] Labour input is based on hours worked, weighted by wages of various types of labour, cross-classified into 18 categories by educational attainment, gender, and age. Imputations for the labour compensation of self-employed are made by assuming that the compensation per hour of the self-employed is equal to the compensation per hour of employees with similar characteristics. Capital input is defined in terms of capital services rather than capital stocks. Capital stocks, cross-classified by eight categories of assets are weighted by rental prices rather than asset prices.[5] The rental prices of each asset consist of a nominal, ex-post rate of return, depreciation, and capital gains. The nominal rate of return exhausts capital income and is consistent with constant returns to scale. For each type of asset stocks have been estimated on the basis of investment series using the perpetual inventory method (PIM) with geometric depreciation profiles.

To analyse broad changes in the economy, we have aggregated the 31 industries in the EU KLEMS database to a smaller set of sectors. These sectors are representative of the heterogeneity in patterns of growth and structural change. In addition, we distinguish the

---

[3] For historical analysis back to 1950 and an extension to non-OECD countries, see the GGDC 10-sector database at www.ggdc.net.

[4] A short history of growth accounting is presented by Jorgenson (2009).

[5] These assets are residential structures, non-residential structures, transport equipment, information technology equipment, communication technology equipment, other machinery and equipment, software and other fixed capital assets.

ICT-producing sector which has played a critical role in recent U.S. economic growth (Jorgenson, Ho and Stiroh 2005). For this purpose we focus on seven sectors: ELECOM (ICT-production), MexELEC (manufacturing excluding ICT-production), OtherG (other goods production including agriculture, construction, mining and utilities), DISTR (distribution services), FINBU (finance and business services) and PERS (personal services) and NONMAR (non-market services, including public administration, education, health and real estate).[6] Table 1 provides the precise definition of each group in terms of the NACE rev 1 industry classification scheme.

III. Sector Shares of GDP and Employment

The shift from agriculture to industry, featured prominently in the earlier literature on modern growth, is still an important characteristic of growth in emerging countries (Temple, 2005). Currently, agriculture typically employs six percent or less of the labour force in the EU, Japan and the U.S., so that the shift from industry to services characterizes the process of structural change since the 1970s. In Figure 1a we show the ratio of value added in services (including market and non-market services) to goods production over the period from 1980 to 2005. In all regions, the importance of services has steadily increased. A similar trend is found for hours worked (Figure 1b). While this confirms the first Kuznets-Maddison fact,[7] these figures show that services totally dominate value added and hours worked in advanced economies with at least double the output and hours worked of goods production in the EU and Japan and more than triple in the U.S.

Table 2 presents value added by our seven sectors as a percentage of GDP in 1980 and 2005 for each region, and similarly for hours worked in Table 3. This more disaggregated

[6] In EU KLEMS as elsewhere we refer to these sectors as 'non-market services', recognising that some output of these sectors is provided by the private sector and the extent of this varies across countries. Non-market services should not be confounded with household production or home services. We rely on data collected within national accounts that exclude household activities. Real estate is grouped in non-market services as for the most part the output of the real estate sector is imputed rent on owner-occupied dwellings. Input in this sector consists mainly of residential buildings and meaningful (labour) productivity estimates cannot be made.

[7] Ngai and Pissarides (2007) provide a model that explains these sectoral shifts as a country grows richer. They stress the importance of differences in technology across sectors, rather than non-homothetic tastes, as the driving force of structural change.

view reveals striking differences among the four service industries. In 1980 non-market services already had the highest shares in output and employment in all regions and these increased slowly through 2005. Personal services also increased their shares in the overall economy; their share in employment is about double the share of value added in GDP. The biggest increase in shares is in finance and business services, both in value added and employment. By contrast to these three services industries, shares of the distribution sector remained constant or slightly declined.

The increase in the shares of services came at the expense of traditional goods production. Shares of manufacturing and other goods production declined rapidly in all regions. In 2005 manufacturing accounted for around 15%, while other goods accounted only for about 10% of GDP. Declines in employment were equally strong. The production of ICT goods and services makes up only a minor part of GDP and this share has been slightly declining in the EU and U.S. The decline is particular strong in hours worked. Despite the low shares, the contribution of this sector to aggregate productivity growth is high due to rapid productivity growth, as discussed in the next section.

The shares of the various sectors across the three regions display a remarkable similarity in 2005, especially if one accounts for differences in international trade patterns such as a higher share of manufacturing exports in Japan.[8] The most surprising difference is to be found in the employment share of non-market services, which is much higher in the U.S. than in the EU or Japan. The gap in the employment share of services between the EU and U.S. has often been highlighted as an "anomaly" (Rogerson, 2008, and Pissarides, 2007). Explanations for this anomaly should focus on the non-market services sector, rather than market services, since the share of market services is essentially identical in the EU, Japan and the U.S. By 2005 transatlantic differences in the share of services employment are mainly in non-market services, such as health and education.

[8] See Redding et al. (2008) for an analysis of the difference in the timing of de-industrialisation across the OECD.

IV. Productivity Growth and Relative Prices Trends

In the previous section we have demonstrated that developments in the sector shares in GDP and employment are more or less the same in the EU, Japan and U.S. Services have become predominant in all three regions. At the same time we have found considerable heterogeneity among the different services sub-sectors, almost totally ignored in the previous literature. One of the other empirical regularities documented by Kuznets and Maddison is the slow growth of labour productivity in services compared to industry. Traditionally, manufacturing activities have been regarded as the locus of innovation and technological change and thus the central source of economic growth. This was originally the key to post-World War II growth in Europe and Japan through realisation of economies of scale, capital intensification, and incremental innovation.

More recently, rapid technological change in computer and semiconductor manufacturing has seemingly reinforced the pre-dominance of innovation in the manufacturing sector. By contrast, the services sector was believed to be characterised by limited scope for innovation and technical change with productivity growth rates that are much lower than in industry. This was prominently featured in Baumol's analysis of the cost disease of services (Baumol, 1967).[9] In this section we will study sectoral trends in productivity and prices since 1980. Due to a lack of data on capital inputs, Kuznets and Maddison focused only on trends in labour productivity. Here we will focus also on multifactor productivity (MFP), which measures the efficiency with which all inputs are being used, rather than labour alone.

To calculate MFP we rely on the neoclassical production theory framework motivated by the seminal contributions of Solow (1957) and Jorgenson and Griliches (1967). This is based on production possibility frontiers where industry value added is a function of

[9] In fact, Baumol made a careful distinction between progressive and stagnant industries and explicitly stated that some services industries can be progressive as well. This subtlety was often lost in subsequent discussions. See Baumol, Blackman and Wolf (1985) and Nordhaus (2008) for a more recent analyses based on detailed U.S. data.

capital, labour, and technology, which is indexed by time, *T*.[10] Each industry, indexed by *j*, can produce a set of products and purchases a number of distinct capital and labour inputs to produce its output. The production function is given by:

$$Y_j = f_j\left(K_j, L_j, T\right) \qquad (1)$$

where *Y* is value added, *K* is an index of capital service flows and *L* is an index of labour service flows. We assume a flexible trans-log production frontier for each sector. Under the assumptions of competitive factor markets, full input utilization and constant returns to scale, the growth of output can be expressed as the (cost share) weighted growth of inputs and a residual measure called multifactor productivity (MFP).[11] MFP growth (denoted by $\Delta \ln A_{jt}$) is defined as follows:

$$\Delta \ln A_{jt} \equiv \Delta \ln Y_{jt} - \bar{v}_{jt}^{K} \Delta \ln K_{jt} - \bar{v}_{jt}^{L} \Delta \ln L_{jt} \qquad (2)$$

where $\bar{v}^{i}$ denotes the two-period average share of input *i* in nominal value added and $\bar{v}^{L}$ and $\bar{v}^{K}$ add to one. Under the neo-classical assumptions, MFP is an indicator of disembodied technological change.

An important innovation in the EU KLEMS database is that we define each of the inputs as a translog function of its components which leads to:[12]

$$\Delta \ln L_{jt} = \sum_{l} \bar{w}_{l,jt}^{L} \Delta \ln L_{l,jt} \qquad (3)$$

$$\Delta \ln K_{jt} = \sum_{k} \bar{w}_{k,jt}^{K} \Delta \ln K_{k,jt} \qquad (4)$$

where $\Delta \ln L_{l,t}$ indicates the growth of hours worked by labour type *l* and weights are given by the period average shares of each type in the value of labour compensation, and similarly

[10] More generally, one should model gross output as a function of capital, labour, intermediate inputs and technology. As yet, the EU KLEMS database does not contain measures of output that account for intra-industry deliveries. In our restrictive value-added model, we rely on the assumption that production is separable in capital, labour and technology (see Jorgenson, Gollop and Fraumeni, 1987).

[11] A is also known as *total* factor productivity. But as the current measure indicates the productivity of only two inputs (capital and labour) we prefer to call it multi-factor productivity.

[12] Aggregate input is unobservable and it is common to express it as a translog function of its individual components. This allows for different and non-constant substitution elasticities between the detailed input types. Then the corresponding index is a Törnqvist volume index (see Jorgenson, Gollop and Fraumeni, 1987, for further discussion).

for K. As we assume that marginal revenues are equal to marginal costs, the weighting procedure ensures that inputs that have a higher price also get a bigger influence in the input index. For example, a doubling of hours worked by a high-skilled worker gets a bigger weight than a doubling of hours worked by a low-skilled worker.

In our analysis of productivity we exclude the non-market services industries as productivity growth in these industries is not well-measured in the national accounts. Typically, growth of real output is proxied by the growth of inputs, such as number of employees, often with an arbitrary productivity adjustment. Recently, there has been a move within the statistical community to employ output quantity indicators to measure volumes of output. Until this process is more advanced, productivity measures for non-market services should be interpreted with care, if at all.[13]

In Figure 2 we present trends in productivity for the EU, Japan and U.S. over the period 1980-2005. This gives the ratio of productivity in market services over goods production, indexed to unity in 1980. For labour productivity (Figure 2a) it is clear that the trend identified by Kuznets and Maddison continued into the 1980s as the ratio declined in all regions. However, this trend stopped in Japan and the U.S. around 1990. Labour productivity growth in goods production was no longer higher than in market services, and even lagged behind in some sub-periods. This pattern also emerges for multifactor productivity (Figure 2b). The EU KLEMS database makes it possible to take into account changes in the composition of the labour force and in the use of capital services, so that multifactor productivity is a proxy for technical change. On the basis of Figure 2 we conclude that the stylized fact of higher productivity growth in goods production is no longer accurate for Japan and the U.S. For the European Union labour productivity in goods production kept increasing in the 1990s, while productivity growth in market services was lack-lustre.[14]

[13] See e.g. commentary by Lengellé on Maddison (1980) for an early statement of this problem, and Atkinson (2005) for a recent extensive discussion.
[14] Inklaar, Timmer and van Ark (2008) provide an in-depth discussion of the role of market services in an explanation of differences in growth in the U.S. and across Europe since the 1990s.

In addition, the sectors we consider are highly diverse in terms of their labour productivity performance, as shown in Figure 3 and Table 4. Table 4 provides average annual growth rates for the period 1980-2005 and Figure 3 presents trends with 1980 indexed to 100. By far the fastest growth in labour productivity is found in ICT production with annual average growth rates of 3% in the EU to more than 5% in Japan and the U.S.[15] The second-fastest growth in Japan and the U.S. has been in distribution services, more than doubling its labour productivity level since 1980. In fact, growth in this sector has been higher than in manufacturing.[16] On the other hand, labour productivity growth in other services industries has been very low. Finance and business services and personal services rank at the bottom in all regions during the entire period. The wide range in sectoral labour productivity growth rates is a striking development. With Cobb-Douglas technologies and homogeneous labour, labour productivity would grow at a similar rate in all sectors.[17] This suggests that sectors differ substantially in their production technologies: elasticities of substitution between labour and capital may not be one and/or the skill composition of the labour force differs across sectors and over time, as we show in Section V below.

Figure 4 and Table 5 show the cross-section variation in the rates of MFP growth, indexed to 100 in 1980 as before. Given the fact that all sectors have increased their use of skilled labour and of capital services (see next section), productivity growth of hours worked is higher than multifactor productivity growth. In some cases, the difference is huge. For example, in Japanese manufacturing average labour productivity growth was 3.3%. Taking into account the large increase in use of skilled labour and capital, productivity growth dropped to 0.6%. Multifactor productivity growth is by far the highest in ICT production, manufacturing and distribution services and slowest in finance and business services and personal services.[18]

---

[15] The trend for this sector is not shown in Figure 3 as it would dwarf all other curves.

[16] Interestingly Baumol (1967) highlights the retail trade sector as a prominent example of a stagnant sector, and expected the share of trade industries in employment to rise.

[17] Assuming labour can move freely across sectors and is paid its marginal product, see Temple (2005).

[18] MFP growth is sometimes even negative. This might seem improbable as, under strict neoclassical assumptions, this would indicate technological regress. However, in practice measured MFP includes a

In Table 6 we provide the contributions of industries to market economy productivity growth over the period 1980-2005. We follow the method of Stiroh (2002) and calculate the contribution of a sector to aggregate labour-productivity growth as the sectoral labour-productivity growth rate, weighted by its period-average share in aggregate value added.[19] Productivity growth rates are by far the highest in ICT production, but the contribution of this sector to aggregate growth is limited by its small share in overall value added. Manufacturing and other goods-producing industries have remained dominant in the EU, while the contribution of market services has been higher in Japan and the U.S. In particular, the contribution of distribution services stands out as productivity growth has been rapid and this sector commands a sizeable share of the economy.[20]

Differences in productivity growth across sectors drive developments in relative prices. In a recent analysis based on detailed U.S. industry data, Nordhaus (2008) finds strong evidence that high productivity growth in a sector is passed on to the buyers of their products in the form of lower prices. Technology shifts dominate shifts in demand or in mark-ups. In Figure 5 and Table 7 we provide the growth rates of output prices for our set of seven sectors for the EU, Japan and the U.S. Since rates of inflation differ, we subtract total economy price growth from the sectoral growth rates of output prices. We find that the development of the output price of a sector is rather similar across the three regions and is inversely related to productivity growth. Industries with low productivity growth such as finance and business services show relative high growth in output prices. By contrast relative prices for ICT production, manufacturing and distribution services grew only slowly, while productivity growth was high.

---

range of other effects including any deviations from the assumption that marginal costs reflect marginal revenues, changes in unmeasured inputs, such as intangible investments, and measurement errors in inputs and outputs. Clearly, MFP growth, especially in services sectors, should be interpreted with care (O'Mahony and Timmer, 2009).

[19] The reallocation term is calculated as the difference between weighted and aggregate growth. It is positive when output is shifted towards sectors with higher labour productivity levels.

[20] See Triplett and Bosworth (2006) for an early study of the role of market services in the recent acceleration of U.S. productivity growth.

Our analysis of structural change identifies important new stylized facts about the economies in advanced nations during the past quarter century. Productivity growth in goods production has continued, especially in ICT production, accompanied by a decline in relative prices and shares in output and employment. On the other hand, finance and business services and personal services remain stagnant sectors with low or no productivity improvements, increasing prices and increasing shares in employment. However, distribution services have been very dynamic with rapid productivity growth and a basically constant employment share. This is a radical change in perspective from the stylized facts of Kaldor, Kuznets, and Maddison, emphasizing the trichotomy of agriculture, manufacturing, and services. The detail available from the EU KLEMS database provides a distinctive and more sharply focused view of the forces driving the recent growth of the world's advanced economies.

V. Factor Shares and Use of ICT and Skilled Labour

Structural change not only entails the changes in output and productivity analysed by Kuznets and Maddison, but also shifts in the mix of inputs used in the production process. Kaldor's most influential fact is the stability of the labour share in GDP over time (Kaldor, 1963). This finding was based on historical evidence on U.S. and U.K. growth.[21] More recently, Blanchard (1997) found that although the labour share continued to be stable in the U.S. and other Anglo-Saxon countries, it tended to decrease in continental Europe over the period 1980-1995. He linked this difference to a stronger substitution process of labour with capital in Europe.[22]

In the spirit of Kaldor, we study changes in the structure of production technologies that appear in the factor shares in value added, not only for aggregate labour and capital inputs but also for a more detailed breakdown of inputs. Recent evidence suggests that technical change has favoured inputs that are well suited to the generation, processing, and diffusion of knowledge and information, namely skilled labour and information and

[21] See Gollin (2002) for more evidence across a large set of countries.
[22] See also Bentolila and Saint-Paul (2003).

communication technology (ICT) capital. For the U.S., Jorgenson, Ho and Stiroh (2005) have documented large increases in the use of both skilled labour and ICT capital across the economy. They also found substantial variation in the use of these inputs across individual industries. In this section we track the use of skilled labour and ICT-capital in major sectors in Europe, Japan and the U.S. to discover common patterns in the knowledge intensification of production.

In this paper we use the cost measures of inputs rather than the more frequently used quantity measures. The differences between these measures will be explained below. Input measures based on the cost approach start from the standard national accounting identity that value added equals the compensation for labour and capital. We will distinguish between two groups of labour (skilled *SL* and unskilled *UL*) and two types of capital (ICT assets *KIT* and non-ICT assets *KNIT*). Let P and Q denote prices and quantities respectively, indexed for value added and various inputs, then

$$P_{VA}Q_{VA} = P_{SL}Q_{SL} + P_{UL}Q_{UL} + P_{KIT}Q_{KIT} + P_{KNIT}Q_{KNIT} \qquad (5)$$

Using identity (6), we will look at three cost-shares as indicators, namely the labour-intensity of production *I(Labour)* defined as :

$$I(Labour) = \frac{P_{UL}Q_{UL} + P_{SL}Q_{SL}}{P_{VA}Q_{VA}} \qquad (6),$$

the skill-intensity of production *I(Skill)* defined as :

$$I(Skill) = \frac{P_{SL}Q_{SL}}{P_{VA}Q_{VA}} \qquad (7)$$

and the ICT-capital intensity of production *I(ICT)* defined as :

$$I(ICT) = \frac{P_{KIT}Q_{KIT}}{P_{VA}Q_{VA}} \qquad (8)$$

An increase in the cost shares indicates the increasing importance of an input in production. Note that the increase can be due to an increase in the price of the input or due to an increase in the quantity used, relative to the other inputs. These indicators are different from simpler measures that are often used, such as the share of high-skilled workers in total employment $Q_{SL}/(Q_{SL}+Q_{UL})$. This indicator is based on quantities alone and ignores price changes. Suppose that the marginal productivity of skilled labour increases more than that of unskilled labour due to skill-biased technological change. Under the standard assumption that differences in marginal productivity are reflected in relative prices, this is picked up in the cost share (7), but not in the share of high-skilled workers.

Another common alternative indicator is the share of high-skilled workers in total labour compensation: $P_{SL}Q_{SL}/(P_{SL}Q_{SL}+P_{UL}Q_{UL})$. This indicator corrects for differences in productivity between various types of labour, but does not take into account other inputs. For example, if labour (both skilled and unskilled) is substituted with capital, the share of high-skilled workers in labour compensation can increase while their importance in production actually declines. The cost share indicator defined in (7) takes account of substitution effects among labour types and between labour and other inputs.

The empirical implementation of (7) is relatively straightforward as the hours worked by skilled labour and their relative wages can be directly taken from the EU KLEMS database. We multiply total labour compensation of all workers (variable *LAB* in the database) with the share of high-skilled workers in total labour compensation (*LABHS*) and divided by nominal value added (*VA*). Labour compensation includes an imputation for self-employed workers. High-skilled workers are defined as workers with college education and above.

Measuring the ICT-capital intensity of production is less straightforward as quantities and prices of capital services are not directly observable. Simpler measures are often used such as the number of computers per employee, or the share of ICT-assets in total investment or capital stock. Our measure of the relative importance of ICT is based on the concept of capital services introduced by Jorgenson and Griliches (1967). In this approach, capital input is measured through its delivery of services in a specific period (in this case year) as measured by its user cost.

The user-cost approach is crucial because the annual amount of capital services delivered per euro of investment in ICT is much higher than that of an euro invested in, say, buildings. An ICT asset may typically be scrapped after 5 years while buildings may provide services for decades. In addition, asset prices for ICT equipment are falling rapidly. As a result, the user cost of ICT machinery is typically 50 to 60 percent of the asset price, while that of buildings is less than 10 percent. This is picked up by the rental price of capital services, $p_{k,t}^{K}$, which reflects the price at which the investor is indifferent between buying or renting the capital good *k* for a one-year lease in the rental market. In the absence of taxation the equilibrium condition can be rearranged, yielding the familiar cost-of-capital equation:

$$p_{k,t}^{K} = p_{k,t-1}^{I} r_t + \delta_k p_{k,t}^{I} - [p_{k,t}^{I} - p_{k,t-1}^{I}] \qquad (9)$$

with r_t representing the nominal rate of return, δ_k the depreciation rate of asset type *k*, and $p_{k,t}^{I}$, the investment price of asset type *k.* This formula shows that the rental fee is determined by the nominal rate of return, the rate of economic depreciation and the asset-specific capital gains. In the EU KLEMS database, the nominal rate of return is determined ex-post. It is assumed that the total value of capital services for each industry equals its compensation for all assets. This procedure yields an internal rate of return that exhausts capital income and is consistent with the accounting identity (5).[23] In the EU KLEMS database ICT assets include information technology assets, communication technology assets, and software. ICT intensity is measured by multiplying capital compensation (variable *CAP* in the database) with the share of ICT assets in total capital compensation (*CAPIT*), divided by nominal value added (*VA*).

[23] An alternative (exogenous) approach would allow for profits that are not part of capital compensation, see e.g. Oulton (2007).

Table 8 and Figure 6 provide trends in the share of labour in value added over the period 1980-2005, based on equation (6). In the EU the long-run trend of substituting labour with capital, described by Blanchard (1997), continued until the middle 1990s, but has tapered off since then. The overall labour share dropped from 72% in 1980 to 66% in 2005, and a similar declining trend can be found in all sectors. In Japan labour shares continued to drop over this period from 63% to 54%. In the U.S. the overall labour share declined from 67% in 1980 to 63% in 2005, in particular in manufacturing and ICT production. We conclude that the labour share has not been constant since 1980. Instead there has been a general decline in the labour share in all sectors (except US finance and business services). This decline was 5 to 10 percentage points in many sectors and most of it occurred in the period 1980-1995.

In Figure 7 and Table 9 we provide the wage bill of high-skilled workers as a share of value added for each industry. The patterns are strikingly similar across industries and across regions. The importance of high-skilled labour has gradually but steadily increased over the past decades. And the rate of increase is roughly constant across all sectors in a region. This holds, even when looking at detailed market services and goods industries.[24] This confirms the long-term trends documented in Berman et al. (1998) for manufacturing in the OECD, and in Jorgenson et al. (2005) for all industries in the U.S. Skill-upgrading of the economy is not primarily due to strong growth in a limited number of sectors, but rather reflects an economy-wide trend. Nevertheless, there are large differences between industries in the use of high-skilled labour. By far the most skill-intensive industry in the EU, Japan and the U.S. is finance and business services. In all regions, manufacturing and other goods production are among the least skill-intensive industries. This ordering of industries is remarkable constant over time and points at persistent differences in structures of production.

[24] Figure 7 should not be interpreted as evidence for the low skill-level of the labour force in the EU, compared to Japan and the U.S. As comparability of educational attainment and qualifications across countries is still problematical, cross-country comparisons of skill shares should be interpreted with care.

In Figure 8 and Table 10, the shares of ICT-capital compensation in value added are given for the EU, Japan and the U.S. Like skill intensity, ICT intensity is increasing over time in all sectors and regions. Typically, ICT intensity of production has doubled or even tripled over the period from 1980 to 2005. This increase had already started in the 1980s, but has paused with the bursting of the dot-com bubble in 2000. The rapid increase in the share of ICT in value added can be attributed to strong substitution with ICT induced by the rapid decline in its price relative to non-ICT assets and labour (Jorgenson, 2001). Figure 8 shows that the ordering of sectors in terms of their ICT-intensity is rather similar across regions. ICT production and finance and business services are the most intensive users of ICT, while goods production and personal services are least ICT-intensive. Distribution services was one of the least ICT-intensive sectors, but has had one of the highest growth rates. Finally, there is a strong correlation between the use of skilled labour and ICT at the sectoral level, suggesting the need for further research on the interrelationships among skills, capital and technology.[25]

VI. Concluding remarks

In this paper we have reconsidered the stylised facts put forward by Kaldor (1967), Kuznets (1971) and Maddison (1980), using new data on patterns of economic growth in the European Union, Japan and the U.S. since 1980 provided by the EU KLEMS data base. We conclude that the classical trichotomy among agriculture, manufacturing, and services has lost most of its relevance. Services now account for about three-quarters of value added and hours worked, and productivity growth in market services predominates over productivity growth in goods production in Japan and the U.S., although not in Europe.[26]

We have also discovered enormous heterogeneity among different services sub-sectors, largely ignored in the previous literature. Distribution services have rapid productivity growth

[25] Much of this work has been based on aggregate trends or manufacturing industries only, see e.g. Machin and van Reenen (1998), Autor, Katz and Kruger (1998) and Berman, Bound and Machin (1998).
[26] Timmer et al. (2010) provides an analysis of European growth trends.

rates and declining relative prices, while their shares in GDP and employment are more or less constant. Clearly, this sector has become a major engine of aggregate productivity growth in all regions. However, finance and business services still have the symptoms of Baumol's (1967) cost disease, as do personal services. These industries suffer from low productivity growth, increasing output prices and growing shares in employment and GDP. Non-market services have increased shares in output and employment as well, but little can be said about the productivity performance of this sector due to unresolved measurement issues.

We also find that the labour share in value added is declining, contrary to Kaldor's most notable stylised fact. This decline is pervasive in all sectors and regions, except in U.S. finance and business services. In addition, we have discovered important trends in the more detailed measures of inputs now available from the EU KLEMS database. We have demonstrated that the shares of skilled labour compensation and ICT in value added have increased substantially in all sectors. Nevertheless there are large differences among industries. In all regions, manufacturing and other goods production are among the least skill- and ICT-intensive industries. On the other hand use of these inputs is high in distribution services and in particular finance and business services. This ordering of industries is remarkable constant over time and points to persistent sectoral differences in structures of production. More generally, our findings suggest that the treatment of the services sector as a homogenous and stagnant sector in contrast to dynamic manufacturing is completely unwarranted.

These findings call for a greater attention to individual services sectors to understand the process of economic growth and structural change. This will open up a broad spectrum of research, ranging from empirical to more conceptual issues. For example, there is an urgent need for improved measurement of non-market services and finance.[27] And while much is known about the drivers of technical change in manufacturing, much less is known about

[27] Triplett and Bosworth (2004).

innovation in services.[28] Arguably, “soft” innovations in services with a greater emphasis on human resources, organizational change, and other intangible investments strongly specific to the firm are likely to be more difficult to imitate than “hard” technologies embodied in industrial equipment in manufacturing. This call for more research on services is certainly not new, but we have presented new evidence that underlines its importance.[29]

In addition, our findings also have a number of implications for theoretical and empirical work currently relying on the Kaldor-Kuznets-Maddison set of stylised facts. Recent multi-sector endogenous growth models have focused mainly on the shift from agriculture to industry or from industry to services. Given the large differences in technical progress and input structures within the services industries, reliance on an aggregate representation of the services sector is tenuous at best (see also Temple, 2005). Furthermore, greater attention must be given to how investments in ICT goods and services serve as a vehicle for technology diffusion (Vourvachaki, 2009). A more refined treatment of services will also allow a more precise analysis of models featuring household production (as in Pissarides, 2007; Rogerson, 2008). While household activities may substitute for certain services activities such as housekeeping, cooking and care-giving, this is much less appropriate for business services or public administration. Lastly, the simultaneous increase in the use of skills and ICT in all sectors is strongly suggestive of pervasive capital-skill complementarities.[30] This highlights new possibilities for investigating the links among investment, education, and technical change, based on the international evidence at a detailed industry level provided by the EU KLEMS database.

[28] An excellent survey of innovation, especially in services, is presented by Brynjolfsson and Saunders (2009).
[29] Fuchs (1968) is an early example, see also Griliches (1992) and Triplett and Bosworth (2004). Broadberry (2006) provides a re-appraisal of the role of services in historical growth episodes.
[30] See Hornstein, Krusell and Violante (2005) for an overview.

Acknowledgements

The research on which this paper is based is part of the EU KLEMS project on Growth and Productivity in the European Union. This project was supported by the European Commission, Research Directorate General as part of the 6th Framework Programme, Priority 8, "Policy Support and Anticipating Scientific and Technological Needs". We are grateful to participants at the EU KLEMS meeting in Frankfurt, January 2008, two anonymous referees and the editor for stimulating comments.

References

Ark, van B., M. O'Mahony and M.P. Timmer (2008), "The Productivity Gap between Europe and the U.S.: Trends and Causes", *Journal of Economic Perspectives,* 22(1), pp. 25–44.

Atkinson, A.B. (2005) *Measurement of Government Output and Productivity for the National Accounts.* London, UK, HMSO.

Autor, D. H., Katz L. F. and Krueger, A.B. (1998), 'Computing inequality: have computers changed the labour market?' *Quarterly Journal of Economics,* vol. 113 (4), pp.1169-1210.

Baumol, W. (1967), "Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis", *The American Economic Review*, 57(3), pp. 415-426.

Baumol, W.J., S. A. B. Blackman and E.N. Wolff (1985), "Unbalanced Growth Revisited: Asymptotic Stagnancy and New Evidence", *American Economic Review*, 75(4), pp. 806-17.

Bentolila, S. and G. Saint-Paul (2003) "Explaining Movements in the Labor Share," *Contributions to Macroeconomics*, vol. 3(1), Article 9.

Berman, E., J. Bound and S. Machin (1998), "Implications of Skill-Biased Technological Change: International Evidence", *Quarterly Journal of Economics*, 113(4), pp. 1245-79.

Blanchard, O.J. (1997), "The Medium Run", *Brookings Papers on Economic Activity*, 2, pp. 89-141.

Broadberry, S. (2006), *Market Services and the Productivity Race, 1850-2000: British Performance in International Perspective*, Cambridge, UK, and New York, Cambridge University Press.

Brynjolfssson, Erik, and Adam Saunders (2009), *Wired for Innovation,* Cambridge, MA, The MIT Press.

Fukao, K., S. Hamagata, T. Inui, K. Ito, H.U. Kwon, T. Makino, T. Miyagawa, Y. Nakanishi, J. Tokui (2007), "Estimation Procedures and TFP Analysis of the JIP Database 2006," *RIETI Discussion Paper* 07-E-003.

Fuchs, V.R. (1968), *The Service Economy*, New York, NBER.

Gollin, D. (2002), “Getting Income Shares Right”, *Journal of Political Economy*, 110(2), pp. 458-74.

Griliches, Z. (ed., 1992), *Output Measurement in the Service Sectors*, NBER, Studies in Income and Wealth, Volume 56, University of Chicago Press: Chicago.

Hornstein, A., P. Krusell and G. Violante (2005), “The Effects of Technical Change on Labor Market Inequalities”, Chapter 20 in P. Aghion and S.N. Durlauf (eds), *Handbook of Economic Growth, vol 1B*, Amsterdam, Elevier.

Inklaar, R., M. P. Timmer and B. van Ark (2008), “Market Services Productivity Across Europe and the U.S.”, *Economic Policy,* 23, pp. 141-194.

Jorgenson, D. W. (2001), “Information Technology and the U.S. Economy”, *American Economic Review,* 91(1), pp. 1-32.

Jorgenson, D.W. (2009), *The Economics of Productivity,* Cheltenham, UK, Edward Elgar.

Jorgenson, D.W., Gollop, F.M. and Fraumeni, B.M. (1987), *Productivity and US Economic Growth,* Cambridge, MA, Harvard University Press.

Jorgenson, D. W. and Z. Griliches (1967), “The Explanation of Productivity Change” *Review of Economic Studies*, 34(3), pp. 249-83.

Jorgenson, D.W., Ho, M.S. and Stiroh, K.J. (2005), *Information Technology and the American Growth Resurgence*, Cambridge, MA, The MIT Press.

Kaldor, N. (1961), “Capital Accumulation and Economic Growth”, in F. A. Lutz and D.C. Hague (eds), *Proceedings of a Conference Held by the International Economics Association,* London, MacMillan, pp.177-222.

Kuznets, S. (1971), *Economic Growth of Nations: Total Output and Production Structure*, Cambridge, MA , Harvard University Press.

Lengellé, M. (1980), “Development of the Service Sector in OECD countries: Economic Implications”, Chapter 6 in I. Levenson and J. Wheeler (eds), *Western Economies in Transition: Structural Change and Adjustment Policies in Industrial Countries*, Boulder, CO, Westview Press.

Machin, S. and Van Reenen, J. (1998), ‘Technology and changes in skill structure: evidence from seven OECD countries’, *Quarterly Journal of Economics,* vol. 113 (4), pp. 1215-44.

Maddison, A. (1980), “Economic Growth and Structural Change in Advanced Countries”, Chapter 3 in I. Levenson and J. Wheeler (eds), *Western Economies in Transition: Structural Change and Adjustment Policies in Industrial Countries*, Boulder, CO, Westview Press.

Nickell, S., S.Redding and J. Swaffield (2008), “The Uneven Pace of Deindustrialisation in the OECD”, *World Economy*, 31(9), pp. 1154-84.

Ngai, L. R. and C.A. Pissarides (2007), “Structural Change in a Multisector Model of Growth”, *American Economic Review*, 97(1), pp. 429-43.

Nordhaus, W.D. (2008), “Baumol's Diseases: A Macroeconomic Perspective”, *B.E. Journal of Macroeconomics: Contributions to Macroeconomics*, 8(1).

Obstfeld, M. and K. Rogoff (1996), *Foundations of International Macroeconomics*, Cambridge, MA, The MIT Press.

O’Mahony, M. and M.P. Timmer (2009), “Output, Input and Productivity Measures at the Industry Level: the EU KLEMS Database”, *Economic Journal*, 119(538), pp. F374-F403.

Oulton, Nicholas (2007), "Ex Post Versus Ex Ante Measures Of The User Cost Of Capital" *Review of Income and Wealth*, 53(2), pp. 295-317.

Pissarides, C. A. (2007), "Unemployment and Hours of Work: The North Atlantic Divide Revisited", *International Economic Review*, 48, pp.1-36.

Restuccia, D., D.T. Yang and X. Zhu (2008), "Agriculture and aggregate productivity: a quantitative cross-country analysis", *Journal of Monetary Economics*, 55(2), pp. 234-250.

Rogerson, Richard (2008), "Structural Transformation and the Deterioration of European Labor Market Outcomes", *Journal of Political Economy*, 116(2), pp. 235-259.

Solow, R. M. (1957), "Technical Change and the Aggregate Production Function" *Review of Economics and Statistics* 39(3), pp. 312-320.

Stiroh, K.J. (2002), "Information Technology and the U.S. Productivity Revival: What Do the Industry Data Say?", *American Economic Review*, vol. 92(5), pp.1559-1576.

Temple, J. (2005), "Dual Economy Models: A Primer for Growth Economists", *Manchester School*, 73(4), pp. 435-78.

Timmer, M.P., R. Inklaar, M. O'Mahony and B. van Ark (2010), *Economic Growth in Europe. A Comparative Industry Perspective*, Cambridge University Press (in press).

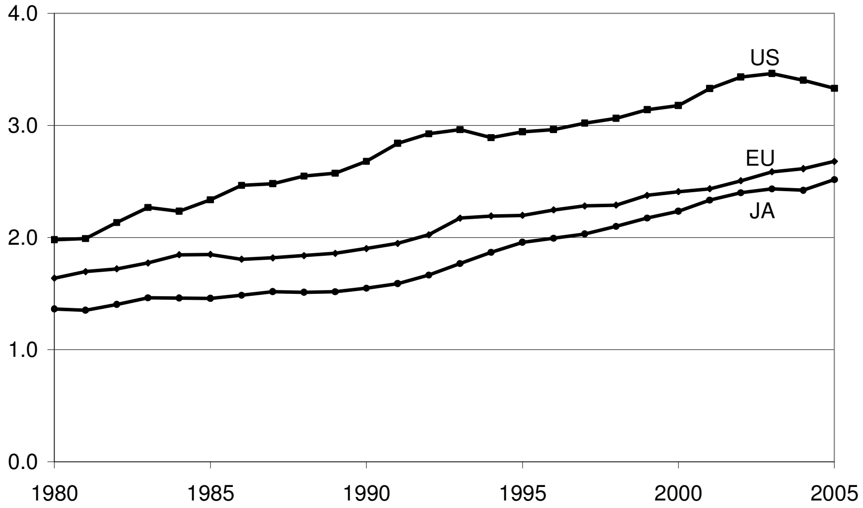
Triplett, J.E. and B.P. Bosworth (2004), *Productivity in the U.S. Services Sector; New Sources of Economic Growth*, Washington, Brookings Institution. .

Triplett, J. E and Bosworth, B. P. (2006), 'Baumol's Disease Has Been Cured: IT and Multi-factor Productivity in U.S. Service Industries.' In D. W. Jansen (ed.), *The New Economy and Beyond: Past, Present, and Future*, pp. 34-71, Cheltenham, Edward Elgar.

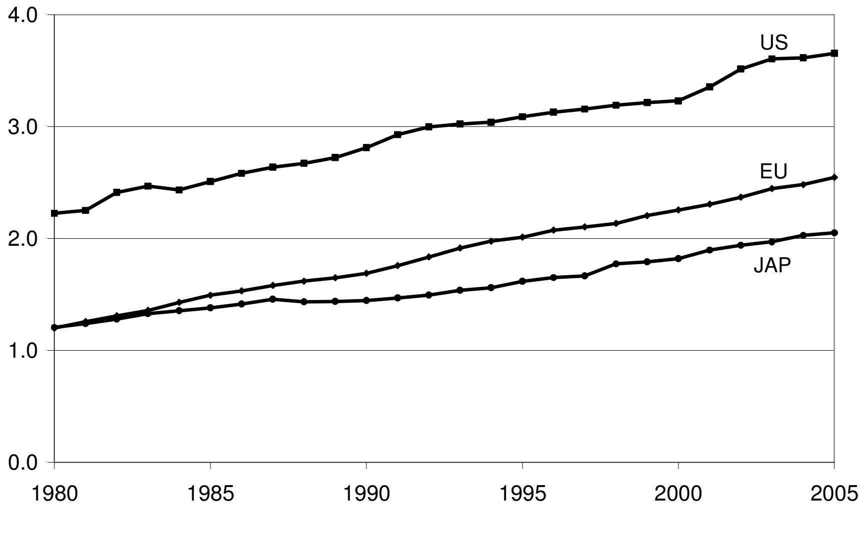
Vourvachaki, E. (2009), "Information and Communication Technologies in a Multi-Sector Endogenous Growth Model", *CERGE-EI Working Papers*, no. 386.

Figure 1 Ratio of services and goods production

A. Nominal value added



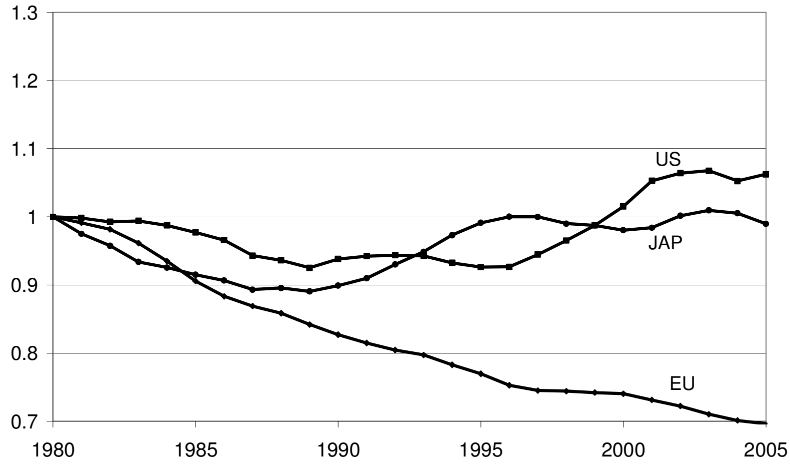
B. Hours worked



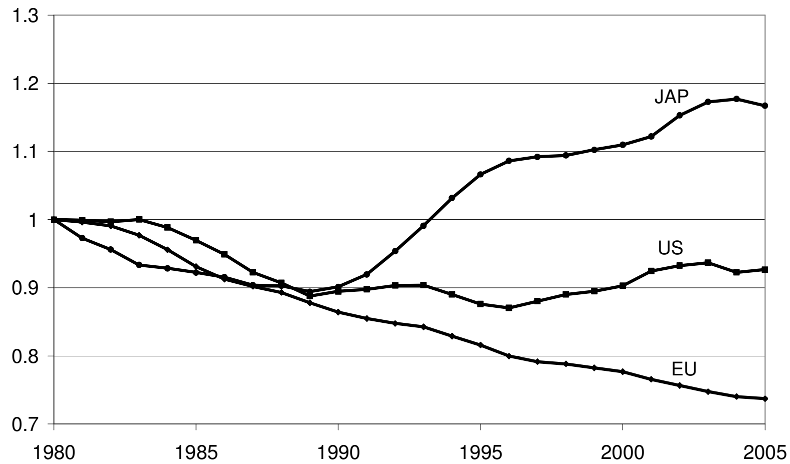
Source: Ratio of variable in services (market and non-market) over goods production. Based on EU KLEMS Database, March 2008, see O'Mahony and Timmer (2009).

Figure 2 Ratio of productivity in market services and goods production

A. Real value added per hour worked



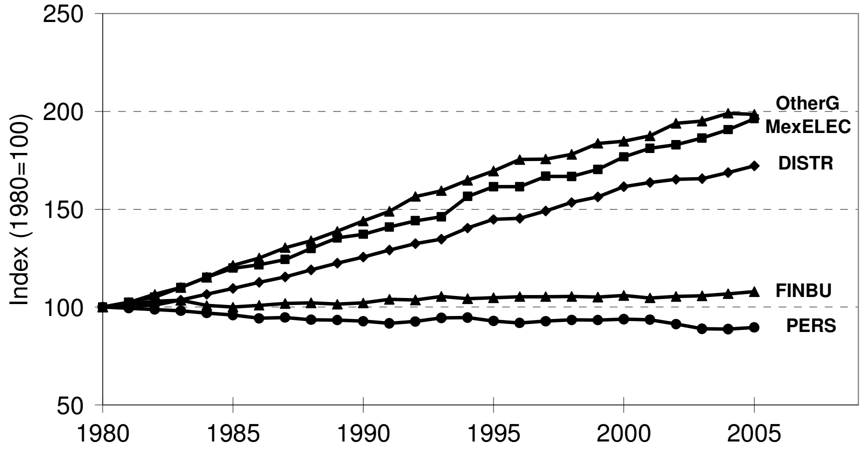
B. Multi-factor productivity



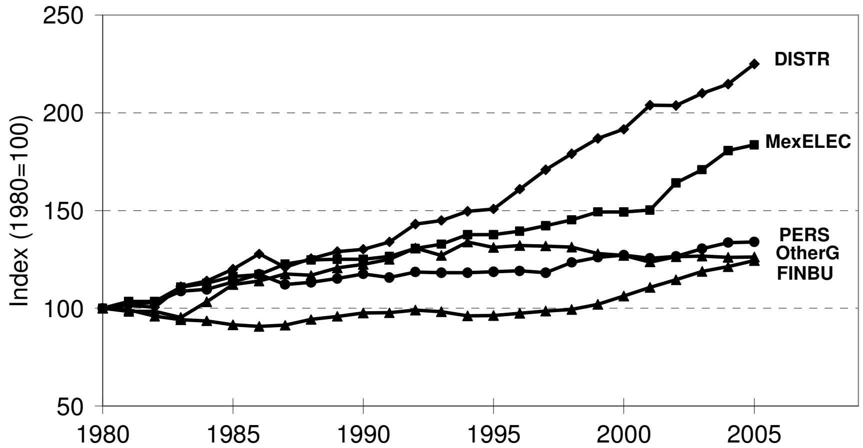
Source: Ratio of productivity in market services over goods production, 1980 is set to one. 3-year moving averages. Based on EU KLEMS Database, March 2008, see O'Mahony and Timmer (2009).

Figure 3 Real value added per hour worked (1980=100)

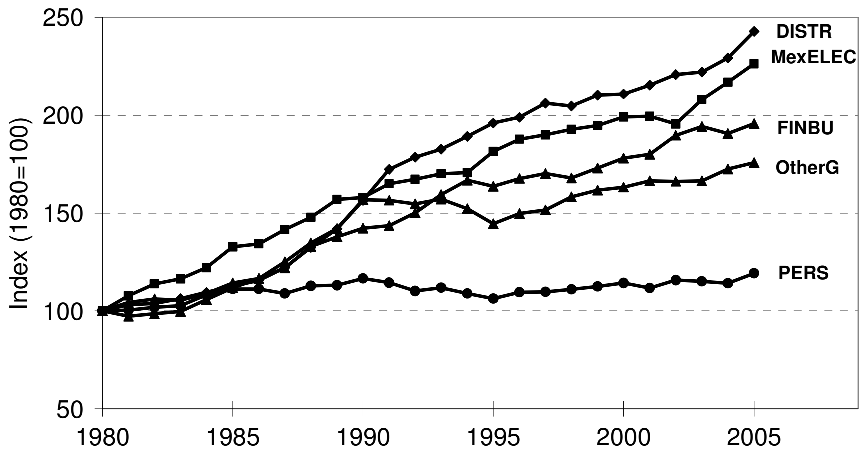
A. European Union



B. United States



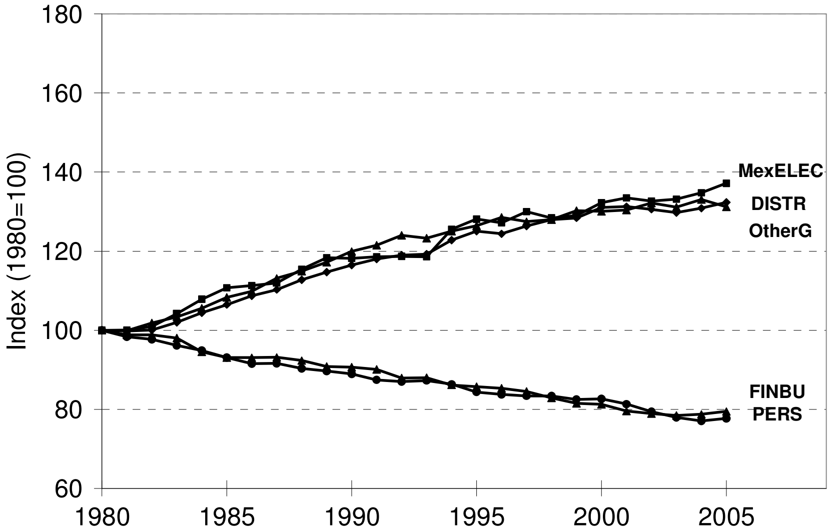
C. Japan



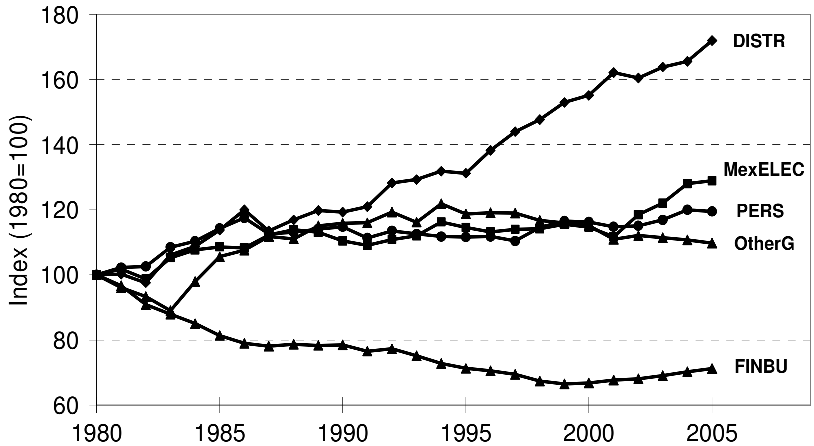
Source: Based on EU KLEMS Database, March 2008, see O'Mahony and Timmer (2009).

Figure 4 Multi-factor productivity (1980=100)

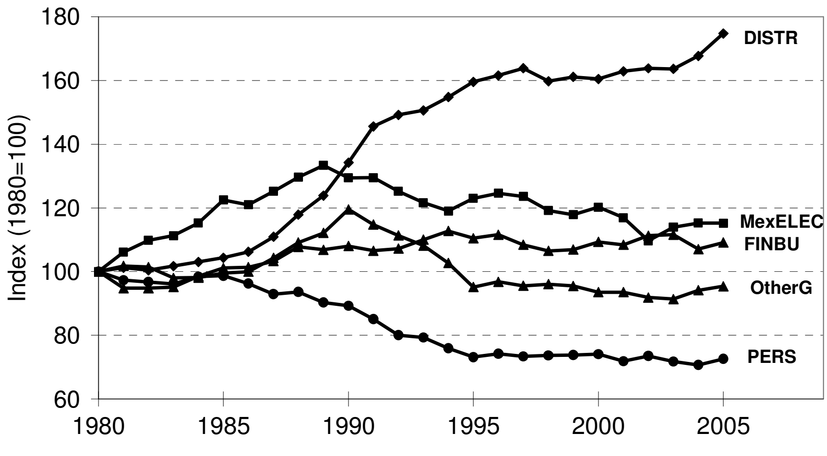
A. European Union



B. United States



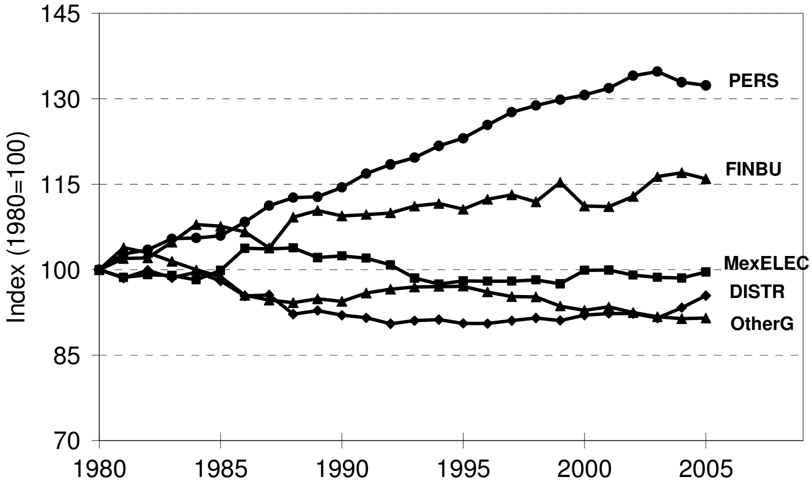
C. Japan



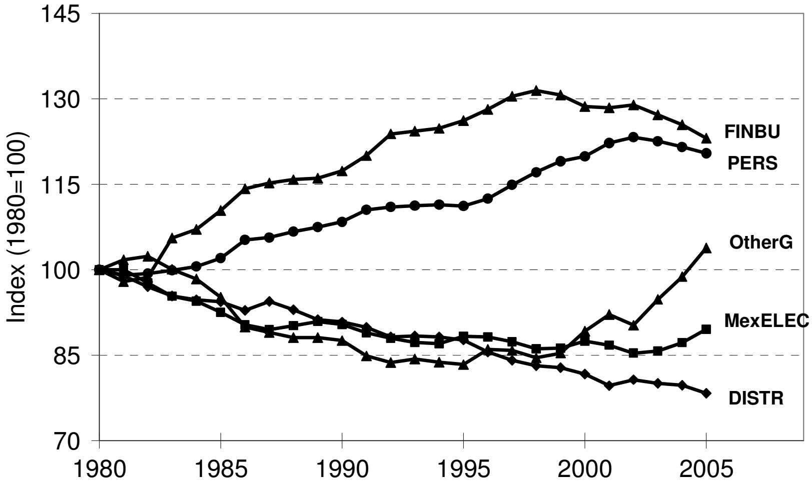
Source: Based on EU KLEMS Database, March 2008, see O'Mahony and Timmer (2009).

Figure 5 Output prices (1980=100)

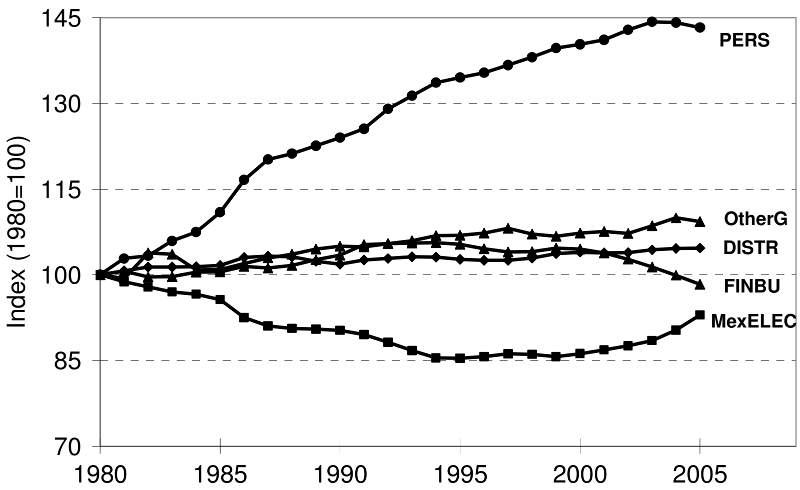
A. European Union



B. United States



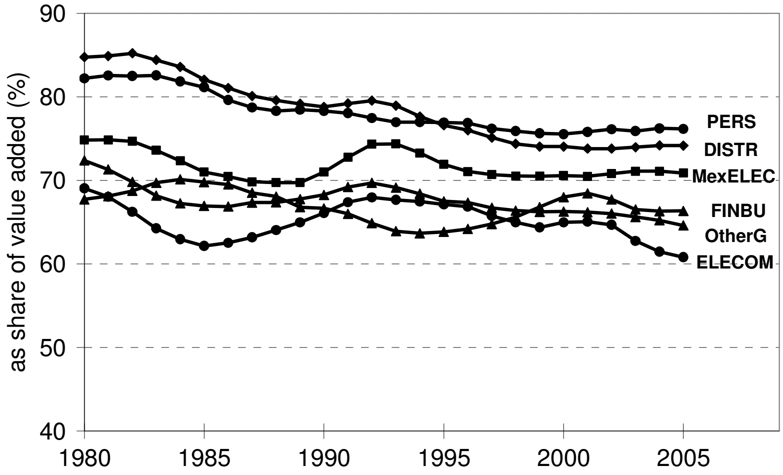
C. Japan



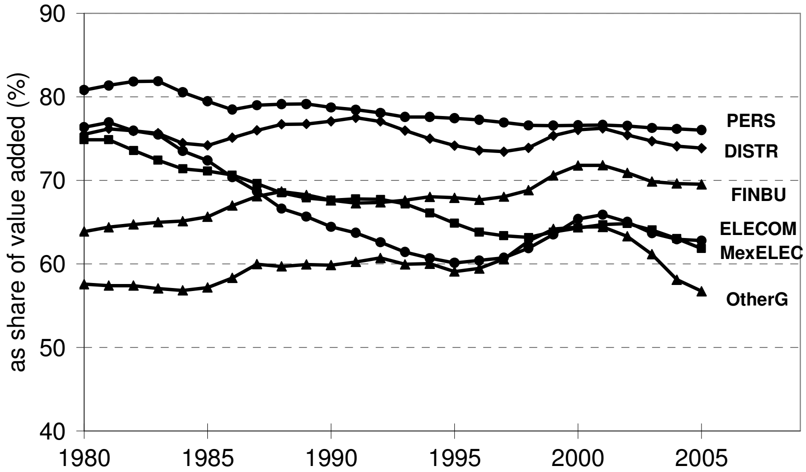
Source: Based on EU KLEMS Database, March 2008, see O'Mahony and Timmer (2009).

Figure 6 Compensation of workers as share of value added

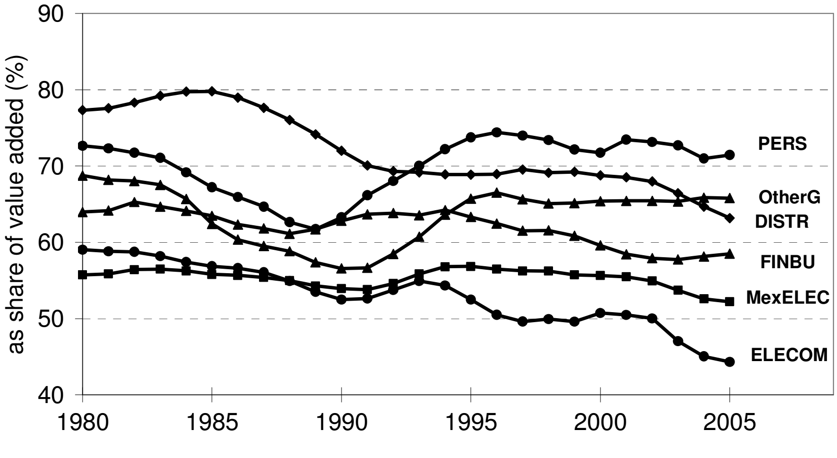
A. European Union



B. United States



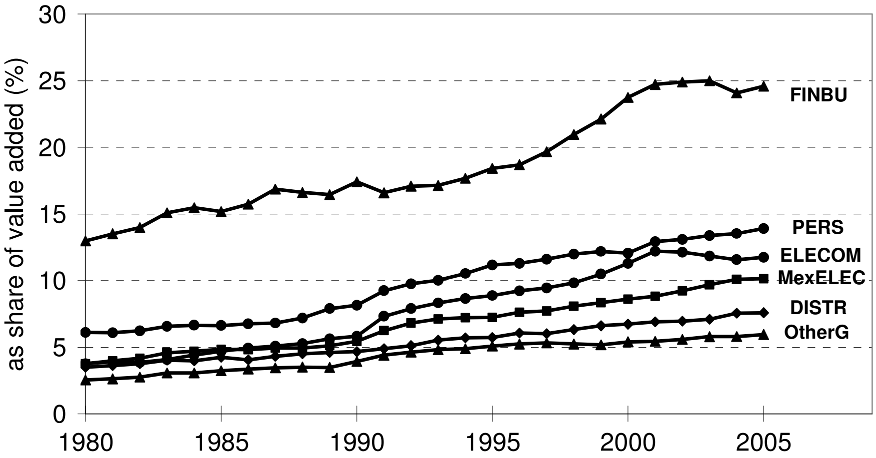
C. Japan



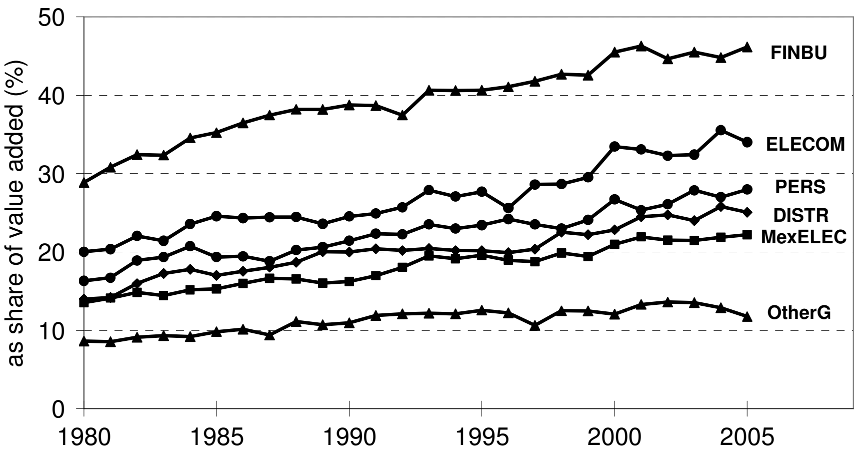
Source: Share of labour compensation in gross value added, 3-year moving average. Based on EU KLEMS Database, March 2008, see O'Mahony and Timmer (2009).

Figure 7 Compensation of high-skilled workers as share of value added

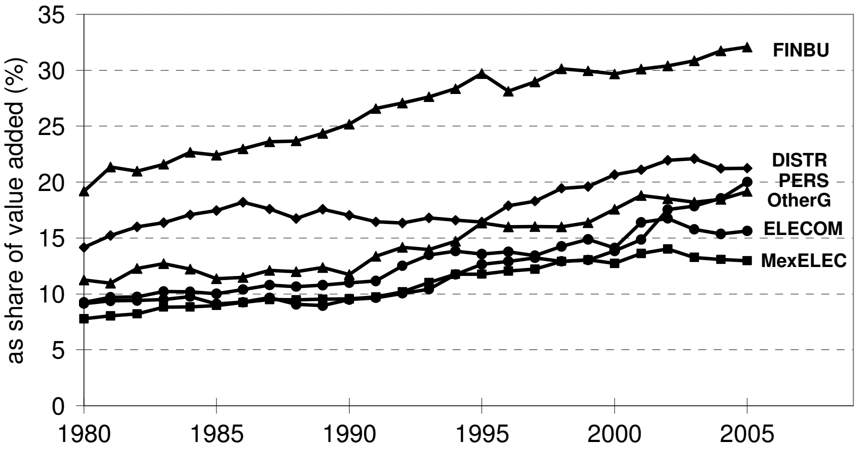
A. European Union



B. United States



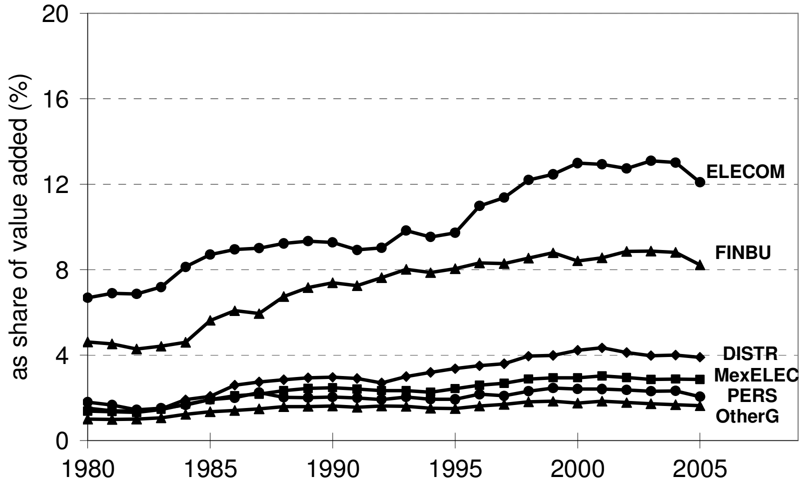
C. Japan



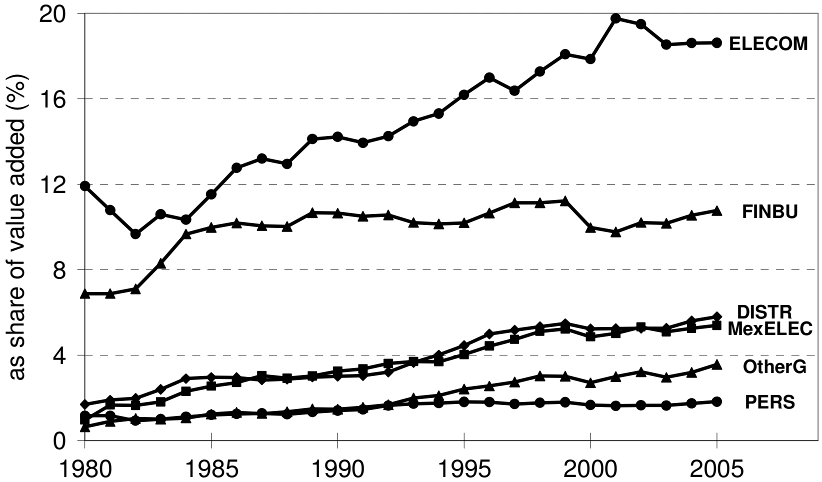
Source: Based on EU KLEMS Database, March 2008, see O'Mahony and Timmer (2009).

Figure 8 Compensation of ICT-capital as share of value added

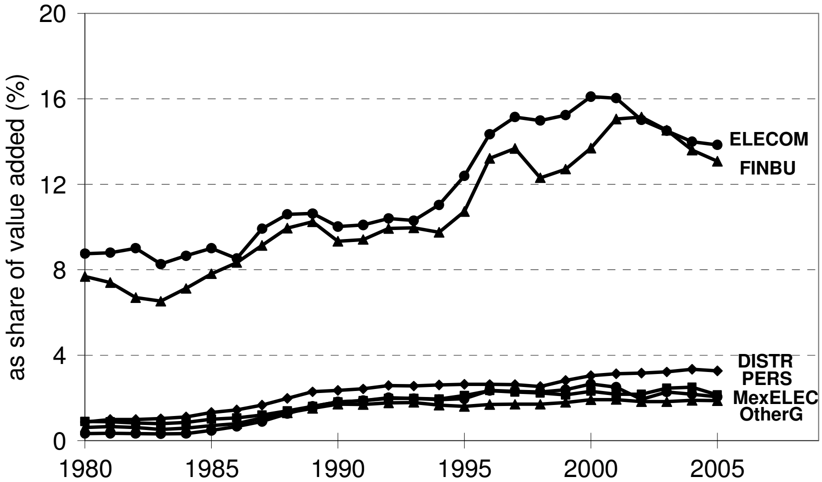
A. European Union



B. United States



C. Japan



Source: Based on EU KLEMS Database, March 2008, see O'Mahony and Timmer (2009).

Table 1 Description of sectors

Description	Abbre-viation	NACE rev. 1 -code
ICT-PRODUCTION (incl. electrical machinery manufacturing & post and communication services)	ELECOM	30-33 and 64
MANUFACTURING (excl. electrical machinery)	MexElec	15-29 and 34-37
OTHER PRODUCTION (incl. agriculture, mining, utilities and construction)	OtherG	A-C and E-F
DISTRIBUTION (incl. trade and transportation)	DISTR	50-52 and 60-63
FINANCE AND BUSINESS SERVICES (excl. Real estate)	FINBU	J and 71-74
PERSONAL SERVICES (incl. hotels, restaurants, community, social and personal services)	PERS	H, O and P
NON-MARKET SERVICES (incl. public administration, education, health and real estate)	NONMAR	70 and L-N
GOODS PRODUCTION	ELECOM+ MexElec+OtherG	
MARKET SERVICES	DISTR + FINBU + PERS	
SERVICES	NONMAR +MARKET SERVICES	

Table 2 Gross value added by sector as a percentage of GDP

	EU		US		Japan	
	1980	2005	1980	2005	1980	2005
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
…ICT PRODUCTION	4.9	4.6	6.1	4.7	5.2	5.7
...GOODS	36.1	25.9	31.5	22.0	40.2	26.8
......Manufacturing	21.1	15.7	19.2	12.0	24.6	17.2
......Other goods	14.9	10.2	12.4	10.1	15.5	9.7
...SERVICES	59.0	69.5	62.4	73.3	54.7	67.5
......Market services	30.6	39.3	32.9	40.2	34.8	40.0
.........Distribution	15.6	15.1	16.9	14.5	18.7	18.1
.........Finance & Business	10.3	17.7	11.2	19.5	9.2	14.4
.........Personal	4.7	6.5	4.8	6.3	6.9	7.6
......Non-market services	28.4	30.2	29.5	33.1	19.9	27.5

Source: Calculations based on EU KLEMS Database, March 2008, see O'Mahony and Timmer (2009). For sector definitions, see Table 1.

Table 3 Hours worked by sector as a percentage of total hours worked

	EU		US		Japan	
	1980	2005	1980	2005	1980	2005
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
…ICT PRODUCTION	4.4	3.1	5.1	3.3	4.0	4.0
...GOODS	43.5	27.3	29.4	20.8	43.5	31.5
......Manufacturing	23.2	14.4	18.8	10.9	20.2	15.7
......Other goods	20.2	12.9	10.6	9.9	23.4	15.8
...SERVICES	52.1	69.6	65.4	75.9	52.4	64.5
......Market services	34.4	47.7	40.3	47.3	41.7	48.5
.........Distribution	19.7	20.2	20.4	19.3	23.9	21.3
.........Finance & Business	7.3	15.6	10.5	16.8	6.3	12.6
.........Personal	7.3	11.9	9.4	11.2	11.4	14.6
......Non-market services	17.7	21.9	25.2	28.7	10.8	16.0

Source: see Table 2.

Table 4 Real value added per hour worked (average annual compound growth rates), 1980-2005

	EU	US	Japan
TOTAL	1.9	1.7	3.2
…ICT PRODUCTION	5.5	7.5	10.0
...GOODS	2.7	1.8	3.0
......Manufacturing	2.7	2.4	3.3
......Other goods	2.7	0.9	2.3
...SERVICES	1.2	1.4	2.6
......Market services	1.3	2.1	2.9
.........Distribution	2.2	3.2	3.5
.........Finance & Business	0.3	0.9	2.7
.........Personal	-0.4	1.2	0.7
......Non-market services	1.0	0.1	1.4

Source: see Table 2.

Table 5 Multi-factor productivity (average annual compound growth rates)

	EU	US	Japan
TOTAL	0.6	0.4	0.7
…ICT PRODUCTION	3.2	5.0	6.4
...GOODS	1.2	0.7	0.3
......Manufacturing	1.3	1.0	0.6
......Other goods	1.1	0.4	-0.2
...SERVICES	0.1	-0.1	0.3
......Market services	0.0	0.5	0.9
.........Distribution	1.1	2.2	2.2
.........Finance & Business	-0.9	-1.4	0.3
.........Personal	-1.0	0.7	-1.3
......Non-market services	0.3	-0.8	-0.7

Source: MFP is on value-added basis, see Table 2.

Table 6 Sectoral contributions to aggregate labour-productivity growth (%-points), 1980-2005

	EU	US	Jap
MARKET ECONOMY	2.1	2.3	3.5
of which			
ICT Production	0.4	0.6	0.7
Manufacturing	0.7	0.5	0.9
Other goods	0.5	0.2	0.4
Distribution	0.5	0.7	0.9
Finance & Business	0.1	0.2	0.4
Personal	0.0	0.1	0.1
Reallocation effect	0.1	0.0	0.2

Note: Contribution of a sector to aggregate labour-productivity growth is calculated as the sectoral labour-productivity growth weighted by its period-average share in aggregate value added. The reallocation term is calculated as the difference between weighted and aggregate growth. Figures may not add due to rounding.

Source: see Table 2.

Table 7 Output prices (average annual compound growth rates), 1980-2005

	EU	US	Japan
TOTAL	0.0	0.0	0.0
…ICT PRODUCTION	-1.8	-3.6	-2.9
...GOODS	-0.1	-0.2	-0.1
......Manufacturing	0.0	-0.4	-0.3
......Other goods	-0.4	0.2	0.4
...SERVICES	0.3	0.6	0.7
......Market services	0.3	0.0	0.4
.........Distribution	-0.2	-1.0	0.2
.........Finance & Business	0.6	0.8	-0.1
.........Personal	1.1	0.7	1.4
......Non-market services	0.2	1.4	1.2

Note: growth in gross output price in sector minus relative to total economy price change.

Source: see Table 2.

Table 8 Compensation of all workers as share of value added (%)

	EU		US		Japan	
	1980	2005	1980	2005	1980	2005
TOTAL	72.1	66.2	66.8	63.2	62.7	53.5
…ICT PRODUCTION	69.8	61.0	77.5	62.6	59.1	44.4
...GOODS	73.4	68.2	68.9	58.6	61.3	57.4
......Manufacturing	74.0	70.6	75.5	61.1	55.6	52.1
......Other goods	72.6	64.5	58.7	55.6	70.4	66.8
...SERVICES	71.5	65.7	64.6	64.7	64.0	52.7
......Market services	77.9	71.5	72.3	71.9	72.2	62.9
.........Distribution	83.9	74.4	75.8	73.5	77.1	62.5
.........Finance & Business	67.1	66.9	63.6	69.5	61.3	58.7
.........Personal	82.0	77.5	80.0	75.9	73.3	71.8
......Non-market services	64.7	58.2	56.1	55.9	49.7	37.8

Note: Labour compensation as a percentage of value added, including employees and self-employed persons, see equation (6).

Source: see Table 2.

Table 9 Compensation of high-skilled workers as share of value added (%)

	EU		US		Japan	
	1980	2005	1980	2005	1980	2005
TOTAL	8.3	16.0	18.5	30.4	12.8	19.9
…ICT PRODUCTION	3.8	11.7	20.0	34.0	9.2	15.6
...GOODS	3.3	8.5	11.5	17.7	9.1	15.2
......Manufacturing	3.8	10.1	13.5	22.2	7.8	13.0
......Other goods	2.5	6.0	8.6	11.8	11.3	19.2
...SERVICES	11.2	19.0	22.2	34.1	15.8	22.1
......Market services	7.1	16.3	19.0	35.5	14.5	24.9
.........Distribution	3.5	7.6	14.0	25.1	14.2	21.2
.........Finance & Business	13.0	24.6	28.9	46.2	19.2	32.1
.........Personal	6.1	13.9	16.3	28.0	9.1	20.0
......Non-market services	15.6	22.6	25.8	32.4	18.2	18.0

Note: Compensation of high-skilled workers as a percentage of value added, see equation (7). Skill definitions differ across countries (see discussion in section IV) and figures can only be used for intertemporal analysis.

Source: see Table 2.

Table 10 Compensation of ICT-capital as share of value added (%)

	EU		US		Japan	
	1980	2005	1980	2005	1980	2005
TOTAL	1.8	3.8	2.4	5.6	2.0	4.5
…ICT PRODUCTION	6.7	12.1	11.9	18.6	8.8	13.8
...GOODS	1.2	2.4	0.8	4.6	0.8	2.0
......Manufacturing	1.4	2.9	1.0	5.4	0.9	2.1
......Other goods	1.0	1.6	0.6	3.6	0.6	1.9
...SERVICES	1.7	3.7	2.1	5.1	2.0	4.6
......Market services	2.6	5.5	3.4	7.6	2.6	6.6
.........Distribution	1.5	3.9	1.7	5.8	0.9	3.3
.........Finance & Business	4.6	8.2	6.9	10.8	7.7	13.1
.........Personal	1.8	2.1	1.2	1.8	0.3	2.1
......Non-market services	0.8	1.4	0.7	2.1	1.0	1.6

Note: Compensation of ICT-capital as a percentage of value added, see equation (8). ICT-capital includes computers, telecommunication equipment and software.

Source: see Table 2.