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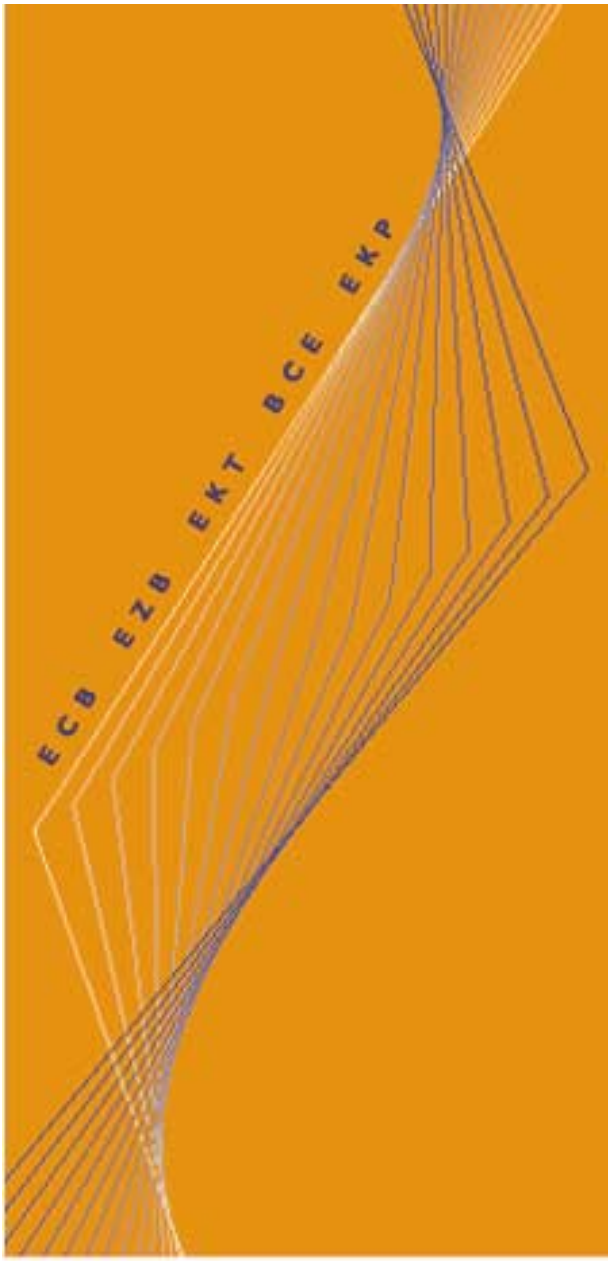

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BY TILL VON WACHTER

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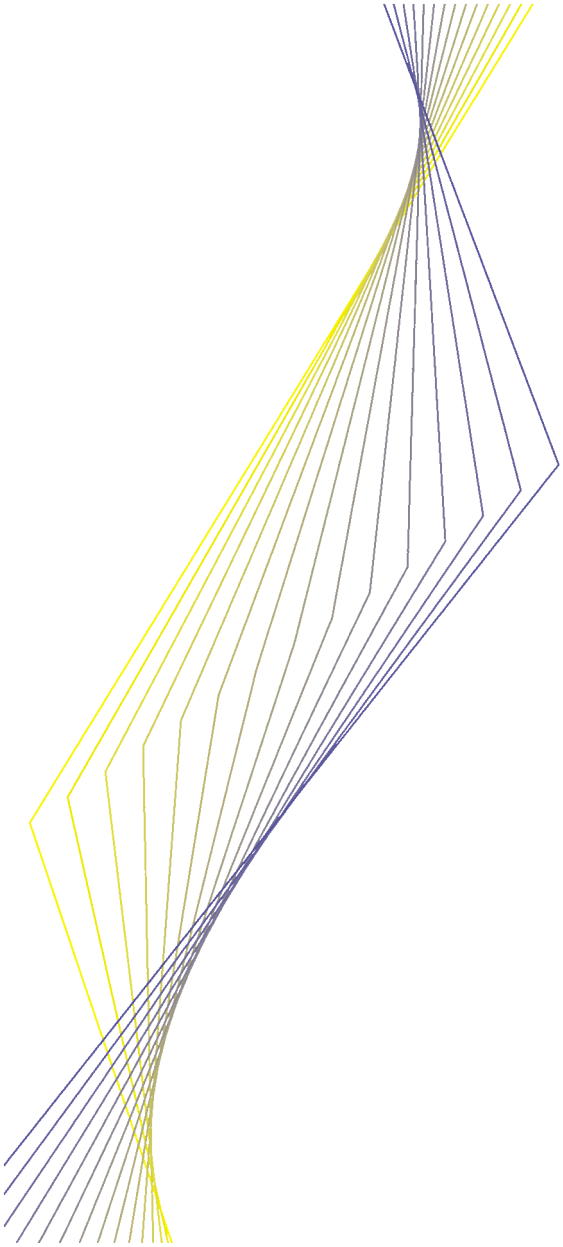

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BY TILL VON WACHTER*

March 2001

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Abstract

While labour productivity grew faster in France and Germany than in the US, employment growth in the two Euro-area countries was much weaker since the early 1970s. This paper starts out from the observation that the growth patterns of service sectors can explain most of these differences. Manufacturing sectors on the other hand grew in a similar manner in all three countries. From a shift-share analysis it turns out that structural differences do matter, in the sense that there is a lag in structural change in the European countries with respect to the US. But the main fraction of aggregate growth differences derives from differences in sectoral rates of growth.

The high growth rates in service sectors' labour productivity in France and Germany seem to be partly driven by convergence to American levels of productivity. Using a growth accounting approach consistent with the incidence of biased technological change, the paper shows how differences in capital-accumulation can only explain around 50% of the catch-up. It then looks for the mechanisms behind these growth patterns by comparing the evolution of single, large service sectors. If productivity growth in services slows down as convergence of labour productivity is attained, increases in service sector employment in France and Germany may have to sustain output growth in the future. The paper concludes by noting that in a framework of unbalanced growth, such an increase in service employment is indeed predicted to occur.

1 Introduction

The post-war period was characterised by a continuing decline in American productivity growth, as measured by GDP per worker. During the same time productivity in France and Germany rose. After the early seventies, this trend was accompanied by a decline in employment in the European countries, and a rise in employment in the United States. A frequently cited explanation for these growth patterns is that these countries reacted differently to similar changes in the economic environment, such as changes in production technologies or a rise in competition by increased trade. The differences in outcomes are often explained by the prevalence of different institutional and regulatory environments in the labour market (Krugman 1994). Yet, it has been notoriously difficult to relate differences in institutions to differences in aggregate employment and productivity performance in empirical work (Nickell and Layard 2000).[1]

It is the differences in the growth of service sectors that seem to have the potential to explain the divergence of aggregate growth rates in employment *and* productivity. First, service sectors in France and Germany had much higher labour productivity growth than the US, while they created much less jobs. Second, manufacturing sectors grew very similarly across countries, shedding workers and increasing productivity everywhere. Given these differences at the sectoral level, approaches based on aggregate evidence alone may yield only incomplete explanations.

The differing patterns of productivity and employment growth in services and manufacturing will be the focus of the present paper. In particular, the analysis concentrates on the sources of the exceptionally high productivity growth of French and German service sectors and its relation to low employment growth. It presents new estimates of the contribution of capital growth to differences in sectoral labour productivity growth, taking into account the information on the factor-bias of technological change implicit in the labour share. This is an important, previously neglected problem, as the labour share of service sectors has evolved very differently across countries. The paper then discusses the role of convergence in labour productivity and the joint evolution of employment and labour productivity in services.

Sectoral growth does not determine aggregate growth rates directly, as the sectors' employment and output shares affect its impact. Changes and differences in these shares across countries may therefore confound the importance of differences in sectoral growth rates. For a preliminary analysis the paper thus proceeds to separate the effects of sectoral growth rates and sector shares on aggregate growth patterns. Thereby, it helps to shed light on the different timing of structural change across countries.[2] The main analysis concentrates on broad sectors; yet, aware of the heterogeneity among service sectors, it also discusses the evolution of single large service sectors.[3]

[1] This holds even when differences in institutions are interacted with explicit measures of economic shocks (Blanchard and Wolfers 2000).

[2] Structural change here and in the following refers to a shift in sectors' shares in aggregate employment and output.

[3] Due to the focus on long-term development of employment *and* productivity across coun-

The hypothesis regarding the sources of sectoral growth in France and Germany finally entertained is does not invoke the occurrence of economic disturbances, nor is it only based on institutional characteristics of the labour markets. Instead, it may be that service sectors in France and Germany follow a similar development as services in the US, but with a time lag. The differences in growth rates could thus be partly due to an initial backwardness of service sectors in the European countries in terms of productivity and size. Over time, as labour productivity in French and German services converges to the American level, its growth rate will slow down. This in turn may lead to an increase in service employment, as predicted by an extension of the model of unbalanced growth by Baumol (1967). If this holds against further scrutiny, employment shares and employment itself should continue to rise in French and German services, and fall in manufacturing. Such an increase in employment could occur despite real wage rigidities. Of course, other institutional peculiarities of the French and German labour markets may still negatively affect service sector growth.

Labour market reforms are one of the most urgent policy recommendations by the ECB. Its president and members of its executive board have emphasised repeatedly that the "full benefits of the single currency will come only if there is appropriate support from other stability-oriented policies, specially fiscal and labour market policies, and if structural reforms are carried out in these areas."[4] The liberalisation of labour markets in the Euro-area would improve the functioning of the Euro-area economy and ease the conduct of monetary policy by the European Central Bank. However, the medium- to long-term impact of structural reforms on economic growth is uncertain. It is thus important to understand the economic environment in which they would take effect, and the present paper aims to make a contribution in this respect.

The next section provides a brief overview of the related literature. The third and fourth section describe the evolution of sectoral growth rates and sector shares, and examine the role of structural change in labour productivity and employment growth within and cross countries. The fifth section discusses the problems biased technological change pose for growth accounting, and proposes and implements a parsimonious measure of technological change. An overview of other sources of differences in labour productivity concludes the section. The sixth section discusses the growth patterns of single large service sectors. The seventh section briefly reviews evidence on catch-up growth in labour productivity in service sectors, and discusses implications of the stylised facts gathered in previous sections in this light. The last section concludes.

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tries, analysing broad sectors minimises problems of data availability. The OECD (2000) provides an analysis of employment in more detailed service sectors.

[4] Willem F. Duisenberg in a speech at the Global Economy Conference, April 1999. More generally, Dr. Duisenberg continues, the "[...] true benefits of EMU derive from the fact that it is a unique opportunity to shape a macroeconomic environment conducive to stability, growth and employment, and to foster structural change [...]." Reform of labour markets has also been featured in policy recommendations by the OECD or by the European Commission (see OECD 1996 for a prominent example)

2 A Sectoral Perspective on Employment and Productivity Growth

For a better understanding of the empirical analysis that follows, it is beneficial to keep in mind potential theoretical implications of a sectoral approach. The model by Baumol (1967) and its extension by Baumol et Al. (1985) directly address the question of the evolution of service sector employment. In a simple model of two sectors, in which one has a permanently higher growth rate of productivity and wages are forced to increase in line with its productivity, Baumol shows how the less productive sector must vanish. Unless, of course, a high elasticity of income keeps demand for low- and high-productivity goods or services at a fixed ratio, in which case all employment must eventually concentrate in the sector with low-productivity growth to maintain its output growth rate. The model suggests that a potential reason for the lack of employment growth of service sectors in some European countries is their high current growth rate in labour productivity. If labour productivity converges in services to the American level, then eventually the mechanism described in the model will affect employment growth and thus lead to increases in service employment.

In a series of recent papers, Blanchard (1997,1998) has argued that the different developments of employment and the capital share in the United States and continental Europe is a good starting point for analysing the sources of dismal employment performance in the latter. Based on the aggregate growth patterns, he suggests a combination of negative productivity shocks in the 1970s and negative demand shocks in the 1980s (e.g. due to foreign competition or capital biased technological change) as an explanation.

The evidence at the sectoral level assembled in the paper could help to tell a more refined story regarding the sources and future development of employment. Blanchard's approach turns out to yield a potential explanation for growth of manufacturing sectors.[5] Yet, the question within Blanchard's framework remains why in some European countries service sectors were not able or willing to absorb the workers freed from manufacturing. Aside from institutional 'rigidities' in the labour market affecting service employment (Baily 1993), this paper suggests that the high growth rate of labour productivity due to convergence may matter.

The paper is related to a large literature on cross-country growth, and to a less extensive literature on sectoral growth. For brevity, and given excellent surveys, we don't attempt to summarise the literature on aggregate developments.[6] The

[5] It is in line with an empirical literature documenting both the decline in manufacturing employment due to the productivity shocks in the early 70s and due to skill-biased technological change and international trade since the early 80s in all three countries. On the effects of skill-biased technological change and international trade on manufacturing employment, see Freeman (1997), Wood (1997), Autor et Al. (1997), Berman et Al. (1998). On the evolution of manufacturing and service employment, see OECD (1996).

[6] Both the patterns in labour productivity and employment growth have been subject of a large literature. The former has been reviewed by Maddison (1987), Crafts (1992) and Temple (1999). The developments of labour productivity have been examined under the perspective of long-run growth patterns (Maddison 1987, Toniolo and Crafts 1996), under the perspective of convergence (Barro and Sala-I-Martin 1994, De Long 1986, and most recently Jorgenson and Yip 1999 and Jorgenson and Dougherty 1997), or with emphasis on the role of new information

patterns of sectoral growth discussed in the following have received less attention in the literature.[7] To compare the evolution of manufacturing and service sectors, the OECD (1996) analyses the different speed of shifts in employment and output shares across sectors and across countries. OECD (2000) concentrates on employment developments in detailed service sectors. Recently, Broadberry (1998) and van Ark (1996) have considered the importance of differences in sector shares for comparisons of aggregate labour productivity among the industrialised countries. In an exercise similar to the one in this paper, Bernard and Jones (1996b) suggest that compositional changes within economies may help explain part of the observed convergence in aggregate labour productivity.[8]

Yet, as pointed out in Nickell and Layard (2000), most of the literature on aggregate growth tends to treat the growth in labour productivity and employment separately.[9] Similarly, while services are often acknowledged to be the potential source of future employment in European countries, the importance of service growth patterns in employment *and* productivity for aggregate developments and differences across countries usually finds less emphasis.[10] This is subject of the following sections.

3 Growth of Service and Manufacturing Sectors

The data used in this paper are mainly drawn from the 1999 edition of the International Sectoral Data Base of the OECD. Few of the sectoral series begin

technologies (Griliches 1994, Greenwood and Yorukoglu 1997, Triplett 1999). The literature on differences in employment growth in Europe and the U.S. is as vast. Bean (1994), Nickell (1997), Krueger and Pischke (1997), among others, give an overview of the issues. Some important contributions are Bruno and Sachs (1987), Layard, Nickell and Jackman (1991), Dreze and Bean (1991), Phelps (1994), and Blanchard (1998).

[7] Temple (1999) suggests a lack of policy implications as a potential reason for the disinterest of macroeconomists in structural change. Often also discussions of labour markets and employment in Europe do not directly address the development of service sector employment (see for example Nickell 1997). In recent attempts to explain widening income dispersion in the US and higher unemployment among the low-skilled in Europe as a reaction to trade with low-wage countries or skill-biased technological change, the idea that low-productivity service jobs were not created in Europe due to wage rigidities surfaces (Freeman 1988, Card et Al. 2000, Krueger and Pischke 1997), but is not addressed explicitly.

[8] The role of structural change and sectoral growth rates for developments within countries has found more attention in the literature. For example, the impacts of shifts out of agriculture on productivity growth has been examined extensively (Denison 1967, Tolley and Smidt 1964). If the pace of these shifts is not synchronous across countries, the differences in sector shares that arise help to explain differences in aggregate growth rates. Nordhaus (1972) has decomposed the change in American productivity into changes of sector shares and sectoral growth rates.

[9] A considerable literature has dealt with the decline in employment of manufacturing industries. The growth of service sectors has been under scrutiny as a potential source of the productivity slowdown in the United States since the early 1970s (see for example Fuchs 1967, Baumol 1967 and Nordhaus 1972), as well as a potential source of employment growth in some European countries (European Commission 1995, OECD 1996, McGuckin and van Ark 1999). For an analysis of the market structure and growth of service sectors see Baily (1993).

[10] The question of the 'quality' of service sector jobs and its relation to employment growth in service sectors will be the focus of a study to be published in the 2001 issue of the employment outlook. The notion of productivity is a narrower concept than quality.

prior to 1973 and end after 1993, and for most of the paper we will adhere to this limitation.[11] The data on total and working age population are from the U.S. Bureau of Labour Statistics. The service sector aggregate includes the standard 'service sectors' (retail and wholesale trade, communication and transportation, restaurants and hotels, financial services and real estate, and business and personal services) as well as utilities (electricity, gas and water) and construction.[12] Exclusion of construction and utilities would not alter the basic patterns. Thus, for expositional simplicity, they are included in the service aggregate. In either case, the service sector aggregate includes very heterogeneous sectors, and so its components are considered separately later in the paper.

Labour productivity is defined as value added in 1990 US Dollars per worker. The exchange rate obtained imposing Purchasing Power Parity (PPP) is used for conversion. Ideally, one would use output per hour worked, but a measure of labour hours worked by sector is hard to obtain. Figures published by the European Community (European Commission 1995) suggest that hours worked in service sectors tend to be lower than in manufacturing in most countries, in which case the measure of labour productivity used here would understate productivity relative to manufacturing. There are important measurement problems related to output in service sectors. To the extent that these are of a similar nature in similar sectors across countries, they don't affect the sectors relative position. Comparison of aggregate data may be problematic if 'measurement resistant' sectors have different shares in output and employment. Recent studies found that while present, this effect can only account for a small fraction of differences in labour productivity growth (van Ark 1999, Sichel 1997).[13]

The employment-population ratio is defined as total employment over the population *at working age*, and is thus invariant to changes in labour force participation. The capital-labour ratio is total capital in 1990 US PPP Dollars over total employment. GDP per capita is total value added in 1990 US PPP Dollars over total population.[14]

3.1 Growth of Sectors since 1973

Table 1 shows the development relative to 1973 of GDP per capita, labour productivity the employment-population ratio and the capital-labour ratio of France, Germany, and the US from 1973 until 1993. One can see that GDP per capita in both services and manufacturing sectors grew at similar rates across Europe

[11] Data for Germany are for West Germany only. West German data is not available separately from the ISDB after 1993.

[12] The service aggregate used can thus be thought of as the non-manufacturing private sector excluding mining and agriculture. A similar strategy of aggregation is used by Gordon (1997).

[13] Among others, Baily and Gordon (1988), Gordon (1995), and a volume edited by Griliches (1992) address the measurement issues affecting service sectors. Measurement problems in services also affect the assessment of developments in aggregate labour productivity, and this has been subject of a large literature (e.g. Nordhaus 1972, Baily and Gordon 1991a,b, Petit 1986).

[14] 'Employment' in the ISDB is defined as full-time equivalent employees and self-employed. Total capital includes estimates made by the OECD. See the documentation for the ISDB data base available under http://www.oecd.org.

and the US. In addition, labour productivity growth and employment per capita growth in manufacturing sectors was similar across countries, too.

The real difference across countries occurs in the service sectors. As seen in Table 1, employment growth in services was higher in the US than in France and Germany, whereas labour productivity growth was substantially lower. Thus, for these two European countries, services reflect the aggregate differences in growth with respect to the US, whereas manufacturing does not.

These differences across countries are also shown in Figures 1 to 3, which show the levels of the respective variables. The figures show how in all countries growth of GDP per capita and of employment is higher in service than in manufacturing sectors. On the other hand, labour productivity growth is higher in manufacturing than in service sectors in the US and France, but not in Germany.

The growth patterns of the capital-labour ratio is also shown in Table 1. One can see how those sectors with high labour productivity growth simultaneously had strong increases in the capital-labour ratio. This is true for manufacturing sectors in all countries, and for service sectors in France and Germany. However, only in Germany was capital-accumulation in service sectors as high as in manufacturing sectors. This is due both to a high accumulation in service sectors and a low growth rate of capital per worker in German manufacturing.

The growth patterns described suggest that to explain cross-country differences in growth, at least in the case of France and Germany, the focus should to be on the developments in service sectors. This impression could only be mitigated by the role of sector shares, since these constitute the weights on the sector-specific growth rates in aggregate employment. It may be that small differences are accentuated, or big differences are mitigated by the differences of sectors' employment and output shares across countries. The numbers shown contain another message. Note how the panels of employment and labour productivity growth appear to be mirror images along the horizontal line at one. There seem to be two ways of generating similar growth rates of GDP per capita, either by employment growth or by labour productivity growth. To assess employment policies, it is important to know how a country enters and sustains growth on either path. The paper comes back to the question of a trade-off in labour productivity and employment growth in Section 6, when it analyses the growth experience of single service sectors, and in Section 7, when it discusses the effects of convergence in labour productivity across countries.

4 Growth Rates vs. Economic Structure

Table 2 shows the employment and output shares in 1973 and 1993.[15] One can see how substantial differences in both output and employment shares exist across countries in manufacturing as well as services. Overall the US has much larger

[15] The table shows the shares of sectors in total private non-mining employment and value added (in 1990 prices). If we compare nominal instead of real output shares, service sector shares start from lower levels but increase faster in all countries, while the reverse is the case in manufacturing. This is consistent with the idea that the price level in service sectors must rise faster to maintain profitability in face of rising wage costs (Baumol 1967, further discussed below).

employment and output shares in the service sector, while the opposite holds in manufacturing. These differences are quite persistent over time. The employment and output shares in services have been rising almost everywhere since the mid eighties (not shown), mostly at the expense of the manufacturing sectors. While the rise has been strongest in European countries, it was not strong enough to bridge significant portions of the large gaps in services sectors' employment and output shares. The same pattern for the development of employment shares in single service sectors is noted by the OECD (2000).

4.1 Employment and Output Growth

Consider the percentage each broad sector contributed to growth in employment and output per capita since 1973, shown in Table 3. These numbers offer a first insight how sector shares affect the impact of sectoral growth rates on aggregate growth. The entries of the Table are just the single sectors' growth rates weighted by their sector shares relative to the aggregate growth rate.[16]

The table highlights several points. First, the weighed contribution of sectors to growth differs across countries. In particular, while the contribution of service sectors to output growth is large and not very different in magnitude across countries, their role in employment growth varies substantially. Although the contribution of services tends to raise employment everywhere, it is much larger in the US. An exception is the contribution of services to German employment growth since 1983, but this is due to the very low aggregate growth rate.

Second, the aggregate growth rate can mask a considerable degree of structural shifts across sectors. The movements between sectors are evident particularly when the aggregate growth rates are low. In this case, the developments at the sectoral level tend to be much more dynamic than the aggregate.

Third, the evidence in Table 3 gives some (albeit weak) support the idea that the impact of European sectors on aggregate output per capita growth follows a similar patterns as in the U.S., but with a time-lag, as is suggested in OECD (1996, Ch.4). The contribution of the manufacturing sector is negative in France and has fallen in Germany since 1983, whereas the contribution of services has risen. In the US on the other hand, the decline in manufacturing and the increase in services had already begun in 1973 to 1983.[17]

Last, note that at current growth rates manufacturing's employment share in France and Germany is bound to decline further. As manufacturing's employment share is still higher in these countries, this will tend to mechanically improve aggregate employment growth relative to the US. So long as the employment growth rates and employment shares in US services are higher, however, the

[16] The growth rates shown are average compound growth rates, i.e. they solve the equation $x_T = (1+g)^T x_0$ approximately to yield $g = T^{-1}\ln(x_T/x_0)$.

[17] Along the same lines, in the US the role of services has declined relative to manufacturing in 1983 to 1993, a pattern opposite to that of France and Germany in that period. Results in OECD (2000) suggest that service employment shares have been converging throughout the OECD countries, although the conclusion is weaker for more detailed definition of service sectors. For further discussion of structural change in Europe, see the contributions in Amin and Dietrich (1991).

overall effect of these 'mechanical' changes is not clear. The following shift-share analysis will help to shed some light on these magnitudes, too.

4.2 Shift-Share Decomposition

The differences in sector shares just described might act as a confounding factor in assessing the relevance of sectoral growth rates and their sources in explaining aggregate growth.[18] To see this, and to examine the within and cross-country effects of shifts and differences in sector shares on aggregate growth rates, consider the following decomposition of the difference of two weighted sums. Denote the growth rate of a variable by a 'hat'. The growth rate of a sum can be written as the weighted average of the growth rate of its components, i.e. if $Y_t = \sum_{i=1}^{N} Y_{it}$, then $\widehat{Y}_t = \sum_{i=1}^{N} \widehat{Y}_{it} s_{it-1}$, where $s_{it} \equiv \frac{Y_{it}}{Y_t}$. In our case, $\widehat{Y}_t$ is the aggregate, $\widehat{Y}_{it}$ are the sectoral growth rates, and s_{it} are the sector shares. Then if we take the difference of the weighted sum over time or across countries, we obtain

$$\begin{aligned}
\Delta Y_t &= \sum_{i=1}^{N} Y_{it} s_{it-1} - \sum_{i=1}^{N} Y_{it}^0 s_{it-1}^0 \\
&\Leftrightarrow \quad \Delta Y_t = \sum_{i=1}^{N} \left[\Delta Y_{it} s_{it-1} + Y_{it}^0 \Delta s_{it-1} \right] \\
&\Leftrightarrow \quad \Delta Y_t = \sum_{i=1}^{N} \underbrace{\left\{ \Delta Y_{it} s_{it-1}^0 + Y_{it}^0 \Delta s_{it-1} + \Delta Y_{it} \Delta s_{it} \right\}}_{Contribution\ of\ i-th\ sector} \qquad (1) \\
&\Leftrightarrow \quad \Delta Y_t = \underbrace{\sum_{i=1}^{N} \Delta Y_{it} s_{it-1}^0}_{\substack{Growth \\ Effect}} + \underbrace{\sum_{i=1}^{N} Y_{it}^0 \Delta s_{it-1}}_{\substack{Shift \\ Effect}} + \underbrace{\sum_{i=1}^{N} \Delta Y_{it} \Delta s_{it}}_{\substack{Interaction \\ Effect}}, \qquad (2)
\end{aligned}$$

This is often referred to as a shift-share decomposition of an aggregate growth rate. If, for example, we want to decompose the changes in labour productivity over time within a country, as is usually done in the shift-share literature, Y_t and Y_{it} denote the log of labour productivity (real output per worker), s_{it} denotes the $i-th$ sectors labour share, and Δ takes differences across time.[19] Here, we

[18] If, for example, productivity growth in a particular sector were low everywhere, then a country with a high share of employment in that sector would tend to have a lower aggregate labour productivity growth rate. We would like to be able to distinguish this case from the alternative that the sector in the country in question had comparatively weak productivity growth. Economists have been well-aware of this problem (see the literature overview).

[19] In fact, the decomposition of the growth rate of labour productivity is slightly more complicated, since

$$\widehat{y}_t = \sum_{i=1}^{N} \left(\widehat{y}_{it} + \hat{s}_{it} + \hat{s}_{it} \widehat{y}_{it} \right) r_{it-1},$$

where y_{it} denotes labour productivity in the $i-th$ sector, and s_{it} and r_{it} be the $i-th$ sectors share in total employment and output, respectively. The interpretation of the main terms is the same.

will also decompose the differences across countries of the growth of output per capita, employment per capita, and the capital labour ratio. This is done with the aim of analysing the developments of labour productivity and employment together, and with an eye on the growth accounting analysis in later sections.

The first summand in Equation 2 measures the fraction of the difference in aggregate growth rates that is due to differences in sector-specific growth rates at constant sector shares. This term, henceforth 'growth effect', is often taken as the counterfactual growth rate in the absence of changes in sector-shares.[20] The second summand measures the role of differences in sector shares (the weights of sectors' growth rates) with growth rates held at the level of the US in the previous period (henceforth 'shift effect'). The last term is a residual capturing the fraction of growth due to the interaction of these terms (thus from now on referred to as 'interaction effect'). Summing up the separate components by sector we obtain the contribution of all developments within single sector to growth (see Equation 1).

Note that the weights are such that a higher weight is placed on those sectors that have a bigger impact on aggregate growth, either due to their size or due to the magnitude (or difference) of their growth rates. For interpretation of the results, if the sign of either component is positive (negative), this implies that it has increased (decreased) the growth rate within countries or the growth-difference across countries.

4.3 Sector-Shifts *Within* Countries

Table 4 shows the decomposition of the growth rates of labour productivity by components (left panel, as in Equation 2), by sectors (middle panel, as in Equation 1) and by single components (bottom panel). The comparisons are shown for the two decades from 1973 to 1983, and from 1983 to 1993, as well as for the entire period. Due to limitations of space and scope, the focus will be on the main patterns that are common across countries, leaving aside some important differences across time periods or countries.[21] With this caveat in mind, the results important for this paper can be summarised into three points.

First, the contribution of sector-specific growth rates (the total growth-effect) was much higher than that of changes in sector shares for all countries and time periods. Moreover, while there is structural change, it does not seem to contribute much to growth. This confirms the results of van Ark (1996). It is in part due to the fact that shifts out of the manufacturing sectors have offset the positive effects on labour productivity growth from increases in the share of services (the single components are shown in the bottom panel). The negative shift-effect in manufacturing also diminishes the manufacturing sector's total

[20] See for example Maddison (1987). This is problematic since it is possible that the size of a sector may influence its productivity growth rate (see Broadberry (1998), who with reference to Denison (1967) proposes a modified approach).

[21] For example, we will not devote a lot of attention to the rise of importance of service sectors in Germany since 1983, or the developments in agriculture in general. The OECD (2000) compares a shift-share analysis of broad sectors with that of more detailed sectors, and comes to the conclusion that the results are not significantly altered by consideration of more detailed sectors.

contribution to growth, leaving developments in service sector as the main positive driving force of growth in France, Germany and the US. This is shown in the middle panel.

Second, sectors contribute to the total growth- and shift-effects differently across countries. Most importantly, the contribution of growth in the service sector to improvements in aggregate labour productivity was higher in France and Germany (see bottom panel). In the US, the impact of labour productivity growth in manufacturing was dominant. In addition, both the shift-effect into services and out of manufacturing was bigger in the US over the whole period.[22] This could support the idea that the US has undergone a more active transformation of the economy since the early 1970es.

Third, the change in the shift-effect since 1983 could again be suggestive of a delayed pattern of structural change, which was also observed in the case of GDP per capita. Since 1983 the impact of changes in employment shares of both manufacturing and service sectors on growth has diminished in the US and increased in France and Germany.[23] These patterns tend to make the contributions of services more equal across countries (see upper right hand). This, as well as the dominant role of labour productivity growth in French and German service sectors noted above, is also subject of the last section, where the issue of convergence is briefly taken up.

Without going into much detail, growth of capital per worker, shown in Table 1 in the Appendix, is also driven to a large extent by the contribution of growth (as opposed to the change in employment shares) in manufacturing and service sectors. Another interesting result is that in France and Germany, the contribution of capital-accumulation in service sectors is bigger than that in manufacturing, whereas in the US it is the other way around. This has found little emphasis in the literature (with the exception of van Ark 1999). These developments mirror that of labour productivity, and suggest that differences in capital-growth may be a potential explanation for differences in labour productivity growth in services. This is the subject of the growth accounting exercise in Section 5.

4.4 Sector Shifts *Across* Countries

This section looks directly at the growth patterns in service sectors and at their contribution to differences in cross-country growth in productivity and employment. Again, the following discussion limits itself to the main patterns of similarities and differences across countries. The results for output and capital are not shown but briefly discussed.

Consider first the decomposition of differences in *labour productivity growth* across countries shown in Table 5. As shown in the upper left hand panel, differences in labour productivity growth across countries in manufacturing and service sectors together explain more than 70% of the aggregate difference (the 'growth effect', see Equation 2). More than two thirds of this 'growth-effect' is

[22] In the US, this reversed the positive effect of growth in manufacturing's productivity.

[23] Note, however, that since 1983 the *growth* effect in manufacturing and services increases in all countries.

explained by services in each period.[24] Differences in sector shares are present, but their impact is small. The faster decline of employment shares in American manufacturing sectors has also led to a positive shift-effect from manufacturing in some cases.

Table 6 shows the decomposition of differences in *employment per capita growth* across countries. Again, the difference in service sectors' growth patterns is the largest component of the decomposition (see bottom panel). This is also reflected in high values of the total growth-effect and total services' contribution. However, differences in sector shares over the entire and earlier period matter more than in the case of labour productivity, specially for Germany. This may be due to a bigger difference in employment shares in services. In Germany, it also derives from a higher shift out of manufacturing. There, the higher employment share relative to the US and the decline in employment tends to increase the difference in aggregate growth rates of employment.[25]

Summarising, the patterns confirm first, the dominant role of sectoral growth rates (as opposed to sector shares) in explaining difference in cross-country growth. Second, they support the important role of the service sectors. Although the magnitudes vary over time and across countries, it is differences in service sectors driving a large fraction of cross-country differences. Third, the shift-share analysis lends support to the hypothesis that the contribution of services tends to rise and that of manufacturing tends to fall at a different pace across the three countries.

The results of this section point towards the directions of further enquiry pursued in the paper. First, the differences and the decomposition of the growth in the capital-labour ratio mirror those of labour productivity. This correlation suggests that differences in capital accumulation may account for the differentials in labour productivity growth. This is addressed in the next section. Second, the size of the service component makes it important to consider the growth patterns of single service sector in more detail. This is done in Section 6. Third, the decompositions point towards a delay in structural change in Germany and France with respect to the US, and it may be that this reflects a movement towards convergence of economic structures across these countries. The last section takes up the question of convergence, and gives a first take at the comparison of levels of productivity, production and employment across countries.

[24] Note also that something changed after 1983. The US starts to lead productivity growth in manufacturing. The difference in aggregate labour productivity growth between the US and France and Germany declined substantially, and from 1983 on, the fraction of this difference in labour productivity growth accounted for by service sectors increased considerably.

[25] For the *capital-labour ratio* (not shown), the same patterns hold. Differences in service sectors and differences in sector-specific growth rates explain more than two thirds of aggregate differences in France and Germany. Moreover, the difference in services' rate of capital-accumulation is the largest single component in the former countries. For *output per capita*(not shown), although the contribution from manufacturing growth is considerable, service sectors' contribution still tends to be much bigger than that in manufacturing. The patterns tend to be more variable over time and countries, but the differences in aggregate growth rates are quite small.

5 The Sources of Labour Productivity Growth

As mentioned in the previous section sectors that have a high growth rate of labour productivity also tend to have high growth rates of the capital-labour ratio. It is thus natural to ask to what extent differences in the growth rates of capital can account for differences in the growth of labour productivity across countries. An alternative source for labour productivity growth is technological progress, or general improvements in efficiency. A common approach to disentangle these two sources is growth accounting. Section 5.1 discusses the measurement of capital's contribution to labour productivity growth in more detail. Sections 5.2 and 5.3 present and discuss the results.

5.1 Growth Accounting and Biased Technological Change

To analyse the sources of labour productivity growth, the paper assumes that the economies' and sectors' production processes can be captured by a production function with constant returns to scale of the type

$$Y_t = A_t F(a_{Kt}K_t, a_{Lt}L_t), \tag{3}$$

where a_{Lt} and a_{Kt} denote technical coefficients capturing increases in the effectiveness of inputs, Y_t, K_t, L_t are the levels of value added, capital, and labour, respectively, and A_t captures improvements in technology affecting capital and labour equally.[26] Sector-subscripts are dropped for simplicity.[27] If this function is written in its intensive form, the instantaneous growth rate of labour productivity, $y_t = \frac{Y_t}{L_t}$, can be expressed as

$$\widehat{y}_t = \widehat{A}_t + \alpha_t \widehat{a}_{Kt} + (1-\alpha_t)\widehat{a}_{Lt} + \alpha_t \widehat{k}_t \equiv \widehat{TFP}_t + \alpha_t \widehat{k}_t \tag{4}$$

where $\widehat{x} = \frac{\partial x}{\partial t}$ is the instantaneous rate of change, α_t denotes the capital share, and the sum of all technological improvements is labelled $\widehat{TFP}_t$. If the production function in 3 is a good description of the production process, then differences in capital-accumulation, differences in TFP-growth, and differences in capital shares should explain differences in labour productivity growth across countries reasonably well. As no direct measure of technological change is available, the standard approach is to obtain TFP-growth as a residual after accounting for differences in capital growth and capital shares.

Given this approach, if technological change is believed to occur incrementally over time, the theoretical measure of technological change over an interval $[0, T]$ on which most approaches in the literature are based is

$$\widehat{TFP}_T = \int_0^T \widehat{TFP}_t dt = \int_0^T \left[\widehat{y}_t - \alpha_t \widehat{k}_t\right] dt. \tag{5}$$

[26] Note that constant returns to scale are imposed by statistical accounting practices. The measure of factor returns available is the total compensation of employees. This, adjusted for self-employed persons and divided by GDP is the measure of labour's share in income. One minus this share is the measure of the capital income share used here.

[27] To what extent which components of technology are sector-specific and to what extent they are the same for the entire economy is debatable. Here we assume that both 'total' technological change, $\widehat{A}_t + \alpha_t \widehat{a}_{Kt} + (1-\alpha_t)\widehat{a}_{Lt}$, and $\widehat{a}_{Kt}$ and $\widehat{a}_{Lt}$ can vary by sectors.

In the following, this will be referred to as the 'ideal' measure of technological change. This measure of technological change is usually implemented in discrete time by approximating the integral by

$$\widehat{TFP}_T = \widehat{y}_T - \overline{\alpha}_T \widehat{k}_T, \tag{6}$$

where $\widehat{y}_T = \ln y_T - \ln y_0$ (similarly for $\widehat{k}_T$) and $\overline{\alpha}_T = \frac{1}{2}(\alpha_0 + \alpha_T)$. This approach is particularly useful if there is no data available within the time interval $[0, T]$. The approximation is exact if the production function is translogarithmic. Since the translog production function is a second order approximation to any production function, this is the functional form usually assumed in the literature.[28]

Note that anything that has an effect on labour productivity growth not captured by the measures of the inputs will enter $\widehat{TFP}_T$. This measure is therefore often referred to as a measure of "what we do not know" rather then a measure of technological change. Since we are interested in the role of capital growth as a source for differences in labour productivity growth, the 'residual'-interpretation of TFP-growth works well in the present context as long as the contribution of capital is captured accurately.

5.1.1 Factor-Biased Technological Change

The contribution of capital is measured accurately by Equation (6) only if technological change does not affect the relative effectiveness of input factors. If it does, technological change may also affect the relative choice of input factors used in production and it may alter the capital share. In this case, $\overline{\alpha}_T \widehat{k}_T$ does not approximate the growth of labour productivity *only* due to capital-accumulation. If, for example, in a given interval technological change raises the capital share, then the measure in (5) would understate the contribution of technological change, and overestimate that of capital.

In the notation above, factor-biased (or non-neutral) technological change occurs when $\widehat{a}_L \neq \widehat{a}_K$. It is called labour-saving, or capital-biased, if $\widehat{a}_{Lt} > \widehat{a}_{Kt}$. To see how biased technological change (BTC) can affect the capital share, one can write its instantaneous rate of change as

$$\hat{\alpha}_t = \frac{1-\sigma}{\sigma}(1-\alpha_{t-1}) \left[\widehat{a}_{Lt} - \widehat{a}_{Kt} - \widehat{k}_t\right], \tag{7}$$

where σ is the elasticity of substitution between capital and labour. Changes in the capital share thus may indicate that technological progress has a bias. These changes also imply that the elasticity of substitution is not equal to one. Suppose we assume that $\sigma < 1$, which according to labour market studies is a plausible assumption (Rowthorn 1998). Then if rates of capital-accumulation are positive, increases in the capital share imply a labour-saving bias in technological change.

[28] This is the standard approach introduced by Griliches and Jorgenson (1967) and discussed in detail by Jorgenson (see for example Jorgenson (1980)). See Jorgenson et Al. (1980) for an application to the international context and Conrad and Jorgenson (1985) for an application to the sectoral level. Young (1995) has applied this approach to the East-Asian growth experience. A recent assessment of the benefits and drawbacks of growth accounting is given by Temple (1999).

We will argue below that this is the relevant case for French and German service sectors.

In this case, the approximation of TFP-growth in Equation 6 yields a distorted picture of technological change.[29] The alternative proposed by the literature has been to use the formula in (7) to find a counterfactual for the capital share in the absence of technological change (Hsieh 1997, Rodrik 1998, Young 1998). The idea is to calculate a growth-path of the capital share given the actual evolution of the capital-labour ratio under the assumption that $\widehat{a}_L = \widehat{a}_K = 0$. However, there is disagreement over the appropriate choice of the base year from which the projection of the capital share is made (i.e. given the counterfactual growth rates, should the counterfactual *levels* be calculated starting from the initial or last capital share available in the data). Young (1998) shows how this can make a considerable difference.[30]

To minimise the effect due to BTC, the empirical analysis of the differences in labour productivity in this paper uses annual data. Thus, the approximation for TFP-growth in period $[0, T]$ used instead of expression $(refapprox)$ is

$$\widehat{TFP}_T \simeq \sum_{t=0}^{T} \widehat{TFP}_t.$$

The 'new' measure is a more accurate approximation to the 'ideal' measure of TFP-growth in Equation 5. It reduces the error by dividing up the integral over the entire period $[0, T]$ into integrals spanning one year, and then approximating each of the separate integrals using Equation 6. Thereby, it minimises the intervals of time in which BTC could affect the capital share.[31] One can not predict the exact way in which the new measure will deviate from the standard one in the case of biased technological change. However, as will become evident shortly, the remaining bias is indeed small, and is minimal compared to the large bias arising when data is only available for long time intervals. How to deal with the bias when data is only available for intervals of time is subject of a related paper (von Wachter 1999).

5.1.2 Capital-Accumulation, Changes in the Capital Share and Biased Technological Change

From the first sections we know that capital-accumulation was positive in all sectors and countries. It was particularly strong in manufacturing sectors, and in French and German service sectors. Equation 7 shows how this should have a depressing effect on the capital share. However, Figure 4 shows that the capital share has not fallen as suggested by capital-accumulation, and in many cases has

[29] See for example Rodrik (1998) for a derivation of the bias.

[30] A more detailed discussion of the different measures of technological change is omitted here for brevity. An overview is contained in von Wachter (1999).

[31] To further minimise approximation errors, the actual rowth rate was calculated from $1 + \widehat{TFP}_T = \prod_{t=1}^{T}(1 + \widehat{TFP}_t)$. Taking natural logarithms of both sides and using that for small values of x, $log(1 + x) \simeq x$ by a first order Taylor expansion, we obtain the expression in the text.

increased. The levels and changes of the capital share are shown in Table 7.[32]

To obtain an insight what the patterns of capital accumulation and the changes in capital shares may imply for biased technological change, Equation 7 can be solved for $\Delta\widehat{a} \equiv \widehat{a}_{Lt} - \widehat{a}_{Kt}$. For different values of σ (here we choose 0.3, 0.8, and 1.4) one can then obtain alternative time series for the bias in technological change. The results for the period from 1973 to 1993 are also shown in Table 7. The evolution of capital shares and the capital-labour ratio imply that in some countries and sectors there may be considerable bias in technological change.

Specifically, if we think that the elasticity of substitution is smaller one, Table 7 shows how there is a particularly strong bias in technological change towards capital in German and French service sectors. In the US the bias is much smaller, if not trivial. For manufacturing sectors, capital biased technological change was even bigger than in service sectors in all countries but Germany (who experienced declining capital shares in manufacturing). The aggregate reflects the same pattern as in service sectors.

5.1.3 Alternative Estimates of TFP-Growth

To assess the potential impact of non-neutral technological change, Table 8 shows the average annual compound growth rate of TFP estimated in the 'standard' way using the approximation in Equation 6, plus the alternative measures. The one proposed by Hsieh (1997) and Rodrik (1998) calculates a counterfactual capital share assuming its growth rate is unaffected by technological change beginning from the last period (henceforth the 'end-of-period' measure). Young's measure (1998) on the other hand calculates the counterfactual capital share starting from the first period (henceforth the 'beginning-of-period' measure).[33] In addition, the Table shows the total accumulated difference over a period of twenty years implied by the discrepancies between the different measures.

It is clear that the alternative methods can have very different results. The end-of-period measure tends to exceed the standard measure, while the beginning-of-period measure is smaller.[34] Most importantly for our purposes, the discrepancies in the measures tend to be quite big. For example, over 20 years German TFP would have increased by 16% using the end-of-period instead of the stan-

[32] Note that most likely the changes of the aggregate capital share are driven by developments in the services sectors across countries (no simple formal decomposition exists). This is clear in the case of Germany, where manufacturing's capital share has declined, and in the case of the US, where the capital share of manufacturing has been increasing but that of services has not.

[33] These labels refer to the assumptions made regarding the path of technological change made by the two approaches..

[34] This makes sense regarding expression 7, since in the absence of technological change and in the case of a low elasticity of substitution ($\sigma < 1$), capital-accumulation depresses the capital share. Thus, to reach the actually observed level of the capital share at the end of the period (obtained *with* technological change), the hypothetical initial capital share has to be higher, which implies lower TFP-growth. Similarly, starting from the beginning of the period with the assumption of no technological change, the capital share tends to fall quickly in face, reducing the impact of capital-accumulation on growth and therefore increasing measured productivity growth.

dard measure. On the other hand, using the beginning-of-period measure would have reduced estimated TFP-growth in Germany by 19% over the same period.

These are large differences. However, if we have annual observations the additional amount of information provided helps to reduce these discrepancies considerably. This is shown in Table 9. The first three columns of the table show the average compound growth rates for the entire period, but this time calculated as the sum of the annual growth rates. The annual rates themselves have been obtained by applying the alternative approximations to yearly intervals. In addition, the last three columns show the total accumulated discrepancy in TFP-growth over 20 years implied by the different measures.

Note first, how the new ('annual') estimates of TFP-growth compare to the 'conventional' ones in Table 8. The differences are small and don't deviate in any systematic way. Second, while some differences between the standard and the alternative measures persist, these are very small. Over a period of 20 years, the accumulated difference in TFP-growth is smaller than 1% in most cases, and never bigger than 1.5%.

Thus, while the conceptual uncertainty with regards to the true measure of TFP-growth persists in the case of annual data, the actual discrepancies are small. Small enough, at least, to obtain a reasonably accurate impression of the differences in TFP-growth across countries and their contribution to explaining differences in labour productivity growth.

5.2 The Role of Capital in Explaining Cross-Country Differences in Growth

As can be seen from the third column in Table 9 (headed 'Annual'), capital–investments explain a significant fraction of labour productivity growth in most sectors and countries. Nevertheless, differences in capital-accumulation cannot explain all the differences in labour productivity across countries. Specially in service sectors, the difference in TFP-growth between the US and France and Germany is large. The TFP-growth in the US service sectors is very small relative to that of its manufacturing sectors and given the size of the service sector, this implies a low aggregate rate of TFP-growth. The remaining differences in productivity may derive from quality differences in input factors, different use of human capital, or genuine differences in technologies or efficiency. These and other factors affecting productivity are briefly discussed in Section 5.3.

To directly see to what extent the differences in labour productivity growth between the US and the European countries can be accounted for by differences in capital accumulation, Table 10 decomposes these differences into fractions due to TFP-growth and due to the growth rate of the capital-labour-ratio weighed by the capital-share. In the aggregate, differences in capital-accumulation can account for only roughly one-third of the differences in labour productivity growth. In service sectors and French manufacturing, the differences in capital-accumulation can account for roughly 50% of differences in labour productivity growth. For German manufacturing the figures imply that the US obtained its thin lead in

labour productivity growth by higher capital accumulation.[35]

5.3 Discussion

While patterns of capital-accumulation go some way to explain labour productivity differences across countries, they seem to only constitute a part of the story. In particular, only 50% of the differences in service sector's labour productivity growth can be explained by the divide in the patterns of capital accumulation. To obtain an impression about what factors could be driving the remaining differences, the section concludes by pointing out potential explanations.

First, differences in TFP-growth could indeed reflect differences in technological progress. Actual differences in technological change would also be supported by the patterns of biased technological change discussed above. Whether this is a sensible interpretation depends on the definition of 'technology.' If technology is the sum of all 'blueprints' accessible and written knowledge (i.e. 'technology' contains the 'menu' of available production methods), then it should be indeed similar across developed countries. If 'technology' instead is the result of the actual choices made by producers from this menu, it might be reasonable to assume that these choices should be among others a function of factor prices. In this case, technology and its rate of change may well differ across countries.[36] Technology transfers, or catch-up may be another reason why the rates of technological change may differ.

Second, the differences in TFP-growth may be driven by the differences in quality of input factors used. Jorgenson and Yip (1999) applied this approach, pioneered by Griliches and Jorgenson (1967), recently to the G7 countries. They show that there are considerable and persistent differences in the quality of input factors used across countries. This raises the same question as above, namely, why should the quality of input factors be different among the industrialised countries. Since the empirical work behind this approach is based on more detailed information than the usual growth accounting study, this result is a bigger challenge to the idea that finding differences in 'technology' is only an empirical oddity. On the sectoral level, the varying degree of bias in technological change shown above could be interpreted as a sign of differences in quality of input factors.[37]

Third, the differences could result from difference in human capital utilisation. This is related to the issue of skill-biased technological change and its

[35] Note that, as discussed below, there seems to be catch-up growth in service sectors but not in manufacturing sectors. Thus, the variation in manufacturing may be due to the absence of a push for convergence from capital-accumulation.

[36] Greenwood and Yorukoglu (1997) develop a model in which adoption costs in terms of learning affect instalment of available implementation of available technologies and therefore determine the growth of TFP. Temple (1999) reviews the debate regarding differences in technology growth. On technological change in the service sectors, see Petit and Soete (1997) and Baily (1993). Van Ark et Al. (1999) gives an overview of data sets on innovation in service sectors. For a discussion of technology differences in manufacturing sectors see Harrigan (1999).

[37] In fact, increases in the quality of inputs could be one way in which changes in the input coefficients a_{Lt} and a_{Kt} manifest themselves in the data. David and van de Klundert (1965) discuss the relation of quality improvements in input factors and biased technological change.

incidence across countries. While there has been a lot of work comparing skill-intensity across the manufacturing sectors, work on service sectors along similar lines stands out.[38] This question could be addressed within a growth accounting framework with data on the skill-decomposition of service sector employment in different countries recently published by the OECD (1999). However, this data is available only for time intervals, thus making the application of a growth accounting approach prone to the problem of biased technological change. Nevertheless, it may be very interesting to see how skill-intensity of service sectors compares across countries and how this matters in a modified growth accounting framework.

Fourth, there could be differences in organisation, infrastructure, institutions, or social norms across countries, affecting sectors differently. Broadberry (1998) suggests differences in the scale of production and the reliance on networks as explanation for the evolution of service productivity in the UK and the US. From an empirical perspective, it would be very interesting to compare the structure of service sectors across countries. One could for example begin to compare the degree of unionisation, the size of establishments, the extent of competition, or the tightness of regulations. A first step is done in Baily (1993), who gives an overview of the different regulatory regimes relevant for services and discusses their impact on productivity for Germany, Japan, the UK and the US.

Last, the differences in labour productivity and TFP-growth may be due to differences in particular sectors. If this is the case, the comparison of these sectors and of their shares in output and employment will help to better understand the differences in growth patterns. The dis-aggregation by sectors is also likely to be fruitful, since the 'service' sector usually combines a very heterogeneous set of activities. An extensive comparison of single sectors is limited by the scarce availability of dis-aggregated data for sectors. Nevertheless, a first insight can be gained from aggregate data, and this is done in the next section.[39]

6 Comparing Single Sectors

Since the services sector aggregate combines some very large and very heterogeneous sectors, it is natural to look for differences in the growth of single sectors across countries. In particular, one would like to know to what extent the differences in growth patterns and sector shares of services documented above are driven by differences in a few sectors. Moreover, it would be interesting to see whether the negative correlation between employment and productivity growth observed is maintained in single service sectors.[40]

Table 11 shows the growth rates of output per capita, labour productivity, and

[38] A first important step in this direction is done in OECD (2000). Berman et Al. (1998) compare skill-intensity (and skill-biased technological change) in manufacturing sectors across countries. For the case of service sectors in the US, see Autor et Al. (1994).

[39] As mentioned at the outset, measurement problems could also matter for explaining the differences in TFP-growth, in particular if they have varying impacts across countries.

[40] A more detailed analysis of the employment patterns in single service sectors by themselves is presented in OECD (2000). However, they use a slightly different classification of service sectors, focus on a more recent period. They also examine more detailed services.

employment per capita by single sectors, as well as employment and output shares in 1973 and 1993. Two first impressions arise. First, sectors grow quite differently within and across countries.[41] Moreover, it doesn't look like employment or output shares have moved considerably closer since 1973.[42] Second, it is not the case that *all* service sectors have had higher employment and lower productivity growth rates in the United States. Neither is it the case that service sectors in France and Germany grew alike.

Nevertheless, a closer look reveals that with some notable exceptions, employment indeed tended to grow faster in the US than in France and Germany. The differences are strongest in construction, followed by financial services and wholesale and retail trade. The exceptions are personal and business services and communications, whose employment growth rate were greater or equal in France and Germany compared to the US. The picture tends to be more uniform in the case of labour productivity, where most of the European service sectors considered had higher productivity growth. In addition, the differences across countries appear to be greater than in the case of employment growth. For all three countries they are particularly strong in communication and transport. In France, personal and business services had much higher productivity growth, whereas this is not the case in Germany. Another important exception is the sector of wholesale and retail trade, where the US labour productivity growth exceeds that in France and almost equals that in Germany.

Regarding the sectors' employment and output shares, it is clear that the sectors whose differences across countries matter most for aggregate growth are the personal and business service sector, whose employment shares varied between 7% and 27% across countries in 1993, the wholesale and retail trade sector (14% and 21%) and the construction sector (5.3% and 7.4%). Figures 5 to 7 show the developments relative to 1973 of the variables discussed in the previous sections for these three sectors.

From these figures, it is evident that there is no single sector that drives differences in aggregate developments within and differences across countries. Instead, the growth patterns of employment and productivity of the service aggregate derive from separate sectors. The differences in employment growth seem to be driven by different rates of job creation in wholesale and retail trade. The effect of this difference is augmented by the higher US employment share in trade. The differences in labour productivity growth could be driven to some extent by differences in the growth rates of personal and business services. The higher employment share of this sector in the US mitigates the role of these differences.

We do not observe a uniform pattern of 'trade-off' between employment and labour productivity growth for all sectors across countries. There was a negative correlation between employment and productivity growth in the American personal and business services. A similar pattern of trade-off was observed in German and French wholesale and retail trade. However, in trade, the US seems

[41] With regard to labour productivity growth, Gordon (1997) shows that sectors tend to be more heterogeneous with respect to other sectors within than compared to same sectors across countries. The OECD (1996) also gives a detailed overview of sector growth.

[42] The shares in the table do not add up to one since services provided by the government and mining are excluded.

to have experienced both increases in labour productivity and employment. The same has occurred for Germany and France in personal and business services. Only in construction do we see that the US grew both more labour intensively and less productively than the European countries (at output growth rates of a similar order of magnitude). Thus, the 'trade-off' observed at the aggregate tends to originate in different sectors across different countries

Concluding, while it does not hold uniformly, for most service sectors employment growth in the US is higher than in Germany and France. In addition, labour productivity growth in the US tends to be lower than in the two European countries. This helps to explain different developments of aggregate employment and labour productivity growth across countries. If one considers the single most influential sectors, it turns out that high employment and low labour productivity growth can, but need not go together. It seems that the difference in aggregate *employment growth* is driven at least in part by differences in wholesale and retail trade, and differences in *labour productivity growth* by differences in personal and business services.

7 Catch-Up as a Mechanism?

The last determinant of growth rates in the French and German service sector considered here is the role of catch-up growth in labour productivity. Figure 2 shows the levels of labour productivity since 1973 for France, Germany, and the US.[43] German and French levels of labour productivity in services seem to be converging to that of the US. This is the result of Bernard and Jones (1996a,b). They establish it by running convergence regressions for the industrialised countries using both cross-sectional and time-series data (the same data used in this paper). According to their results, convergence of labour productivity in service sectors seems to affect a large group of countries beyond those under study here. However, there is little evidence of convergence in manufacturing sectors. Therefore, given the results of the shift-share decomposition in Section 4, it is the developments in service sectors who drive the weak aggregate convergence observed for aggregate output per worker observed in Figure 2.

Note that if we compare the levels of employment per capita in Figure 3, there seems to be no convergence at all in service sectors or in the aggregate. Differences in output per capita in service sectors and in the aggregate can thus be explained to a large extent by differences in employment per capita. Given these patterns, there seems to be ample scope for increases in service employment in France and Germany (European Commission 1995).

Yet raising employment in services may be more than just a good opportunity. As labour productivity in services converges to the American rate, its growth rate is likely to slow down further. Given the size of the service sector, this will tend to reduce the aggregate rate of labour productivity growth, too. The growth rate

[43] The levels of output are deflated by sector-specific price indices calculated by the OECD. On the issues and difficulties with comparing sectoral output levels across countries see Hooper (1995). See Broadberry (1998) and O'Mahony et Al. (1996) for a international comparisons of labour productivity level in services using more accurately deflated output measures.

in output per capita in the longer term may then have to be maintained mainly by increases in employment.[44] Thus, as employment in the manufacturing sector is shrinking, it is developments in service employment who are likely to be a key determinant of future output growth.[45]

Independently of whether one believes future productivity growth is bound by convergence in services, it is crucial to understand what determines the size and development of service sectors. First, what are the mechanisms determining growth of labour productivity at the sectoral level? The growth accounting results of the previous sections suggest that at least part of the catch up in labour productivity has taken place by a higher rate of capital-accumulation. The development of the capital share suggests that part of the residual may be due to labour saving technological improvements. Further analysis along these lines may help to determine where there may be further productivity improvements in services.

A second question regards the determination of the steady state (or long run) level of employment and productivity by sector. While the forces determining the steady state at the aggregate level are well explored, the mechanisms at the sectoral level are unclear. Yet, it is important to find out what may cause a permanent increase in service employment in the future, or what could be preventing it today. The question regarding the determination of the steady-state levels in employment and productivity in the service sector is closely related to that of structural change.

7.1 Service Employment in the Long-Run

A model trying to explain the degree of structural change in employment and its implications for productivity is that by Baumol (1967). Baumol's stylised model is meant to explain the evolution of employment in a world were one of two sectors has a permanently lower productivity growth rate than the other, but has to pay similar wages. Over time, the less productive sector must vanish, unless for some reason demand for its products remains high despite rising prices (an often-suggested explanation for service sectors is a high elasticity of income). If the latter is the case, the less productive sector will absorb more and more employment over time, whereas the more productive experiences continuous reductions in employment. As this process continues, the employment shares of the less productive sectors increases and the aggregate growth rate of productivity approaches that of the least productive sector.[46]

[44] Remember that output per capita growth can be expressed as $\widehat{\left(\frac{Y}{P}\right)} = \widehat{\left(\frac{Y}{L}\right)} + \widehat{\left(\frac{L}{P}\right)}$.

[45] From the figures one can see how the US manufacturing sector had a recent surge in productivity and output per capita growth. However, given the size of the American manufacturing sector, this has only led to a small impact on aggregate output growth. Moreover, the main source of employment growth in the US has been the service sector. Given the tendency of manufacturing sectors to decline documented in Section 4, it is unlikely that a growth strategy mainly based on manufacturing will have large effects on employment and output in France and Germany, too.

[46] Baumol et Al. (1985) expanded the model to include sectors that grow very fast in the short or medium run, but who have a fixed component of human input. If the potential for productivity improvement is bounded for the human input, then eventually, so the authors,

In light of convergence in labour productivity, this has the following implications for employment in European countries like France and Germany. As labour productivity growth in service sectors slows down permanently to grow at the American rate, those service sectors with a low growth rate in productivity, and who do not have high income elasticity of demand (or who are not subsidised or maintained otherwise), will vanish. The other service sectors will experience increases in employment, despite of the fact that wages can't adjust to the lower productivity levels in services. At the same time, as the share of sectors with low-productivity growth in the economy increases, aggregate productivity growth will slow down.

A formalisation of this intuitive application of the Baumol-model to an environment of rigid wages in the service sector and unemployment is presented in von Wachter (2000). According to this model, the lower growth rate of service employment in France and Germany is due to the backwardness of service productivity relative to the US. Once the catch-up is completed, the European countries will embark on a path of higher employment and low productivity growth, more similar to the path the US has followed in the last two decades. In this case, the differences in labour productivity growth *and* employment growth observed today across countries should vanish.

These are predictions of a very simple model, and therefore should be taken with the necessary reservations. The developments in the US show that the patterns predicted by the model can indeed be observed, but the mechanisms work very slowly. Thus, while the share in manufacturing has been declining, and the aggregate rate of productivity has slowed down, these changes have occurred over decades.[47] It would be helpful to augment the model with a framework able to capture short-and medium-term dynamics as that of Blanchard mentioned in Section 2. Nevertheless, the model gives an interesting new perspective on European employment growth. It implies that despite at least some rigidity in the labour market, employment in services may rise in the future.

The approach also suggests that if the service sector is not able to absorb employees released from the manufacturing sectors for other reasons than wage rigidities, unemployment will rise steadily. It is therefore important to examine the potential restrictions to employment growth in services (Baily 1993 and McKinsey 1992), keeping in mind that part of the lack of service employment may be caused by the high growth rate of labour productivity due to catch-up

8 Summary and Conclusions

The point of departure of this paper has been the observation that growth patterns of services and manufacturing may help to explain the different evolution of labour productivity between France, Germany, and the US since the early 1970s. The following stylised facts pertaining to the growth of manufacturing and service sectors have been fundamental to the analysis.

this sector will approach a low or constant growth rate of productivity.

[47] Baumol et Al. (1985) review the evidence for the US. It would be very interesting to examine the validity of the model's implications in more detail for Europe.

- Employment growth in American service sectors over this period was stronger than that of services in France and Germany. Conversely, in the latter countries growth of labour productivity and of capital was much higher than in the US.

- Manufacturing sectors have had similar growth patterns of employment (negative) and labour productivity (positive) across countries.

- Services' share of capital in income in France and Germany has increased steadily since the early 1980s, whereas in the US it has stayed almost constant. Manufacturing's capital share was very variable everywhere.

The paper's aim was to assess the role of these sectoral differences in explaining aggregate growth and its difference across countries. To do so, it has examined and compared the impact of structural change on growth *within* countries. In addition, it has assessed the potential of differences in economic structure for explaining differences in growth *across* countries by a shift-share analysis.

The paper has then searched for the sources of the differences in sectoral growth. First, it has examined role of capital-accumulation in explaining diverging sectoral patterns of productivity growth. This has been done in a way consistent with the incidence of non-neutral technological change, whose importance is suggested by the growth patterns of capital shares. Second, the paper has searched for the sources of differences in service sector growth by looking at single service sectors.

The following additional stylised facts have emerged from the analysis.

- It is differences in the growth rates of service sectors that underlie the differences in growth rates of labour productivity, employment, and capital across countries. Differences in sectors' employment and output shares are considerable and persistent, but their role for explaining differences in aggregate growth rates across countries is small.

- Biased-technological change seems to be relevant for both the manufacturing and service sectors in France and Germany, but only for manufacturing in the US. Differences in capital-accumulation can only account for about half of the differences in labour productivity growth across service sectors. Other possible factors are briefly discussed in the paper.

- Although there was a tendency for some service sectors in France and Germany to have lower productivity and higher employment growth in the US, the negative correlation between employment and productivity growth is not observed in large service sectors. Instead, examining these sectors, it seems that an important fraction of differences in employment growth across countries were driven by the wholesale and retail trade sector, whereas large differences in labour productivity growth exist in personal and business services.

Concluding, the paper has reviewed evidence suggesting that labour productivity growth in French and German service sectors may be due to a catch-up

process to the higher level of American service productivity. It then has used an extension of the model of 'unbalanced growth' by Baumol (1967) to speculate about the future development of service employment in Europe once the catch-up process is completed. According to this model, there are circumstances in which a decline in productivity growth in service sectors may lead to higher employment growth despite rigid wages.

The paper has also pointed towards other potential areas of future research. First, while physical capital plays an important role, it would be interesting to examine the role of human capital in labour productivity growth in service sectors. Second, it would be interesting to study particular large service sectors in more detail, since their evolution seems to dominate the growth patterns in the aggregate service sectors. Last, the variation provided in sectoral data could be used to think about the shocks and institutional factors determining the short to medium run dynamics of employment, labour productivity and the capital share. Such an approach would be a useful complement to the long-term perspective discussed here.

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Figure 1

Levels of Output per Capita in 1990 PPP US Dollars

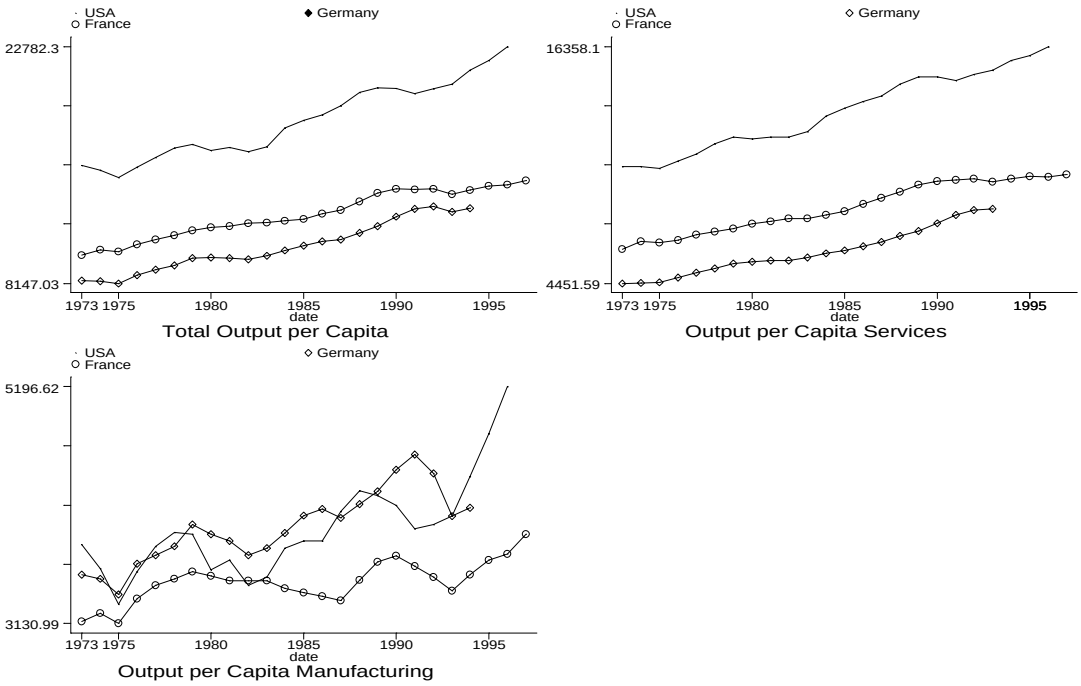

Figure 2

Levels of Labour Productivity in 1990 PPP US Dollars

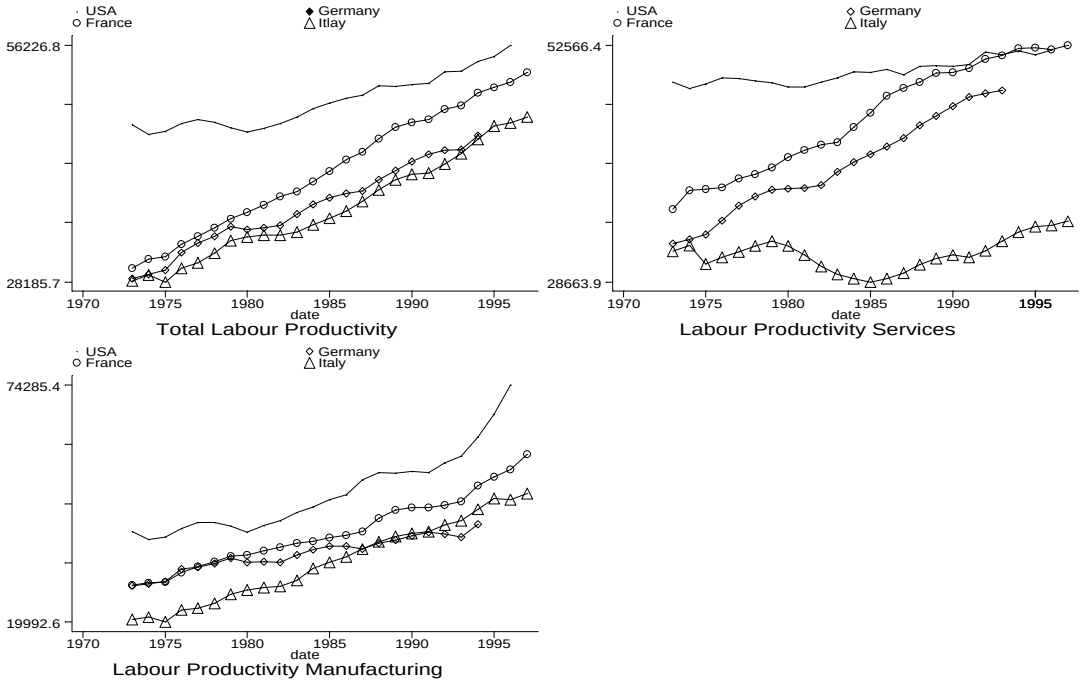

Figure 3

Levels of Employment-Population Ratio

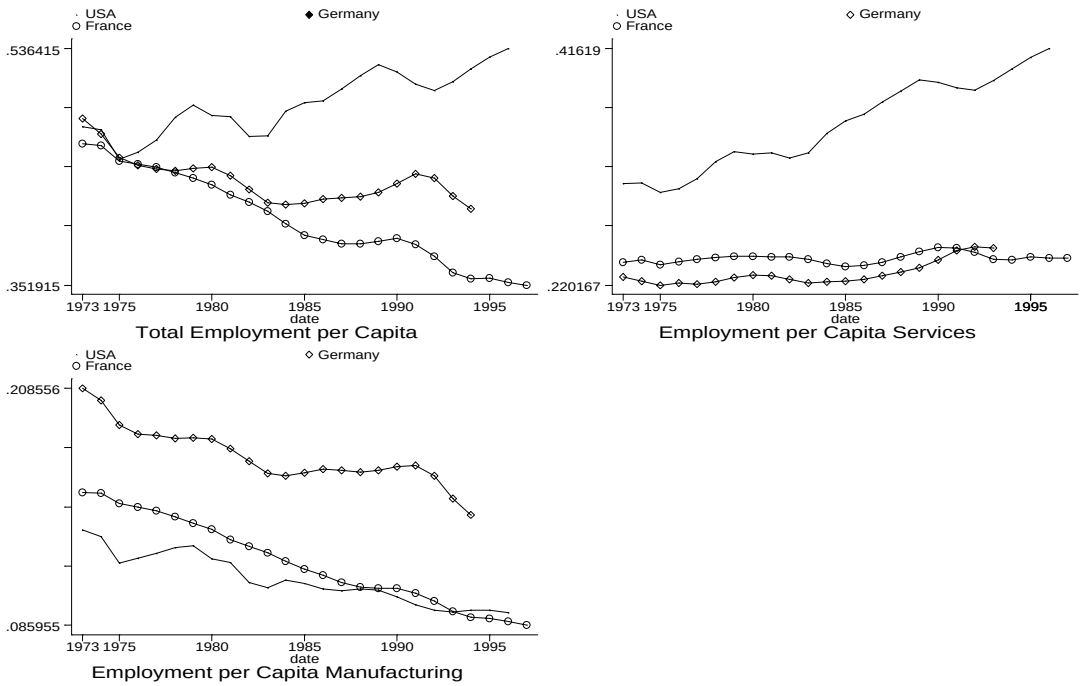

Figure 4

Share of Capital in Value Added

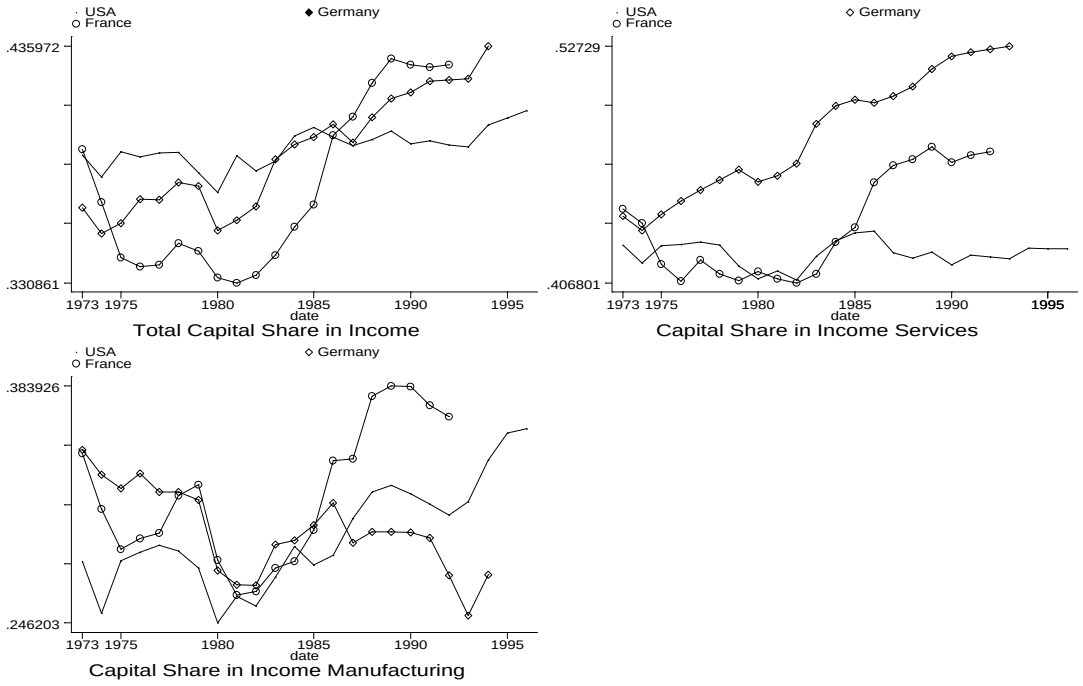

Figure 5

Output per Capita, Employment per Capita, Labour Productivity and Capital per Worker in Personal and Business Services Relative to 1973

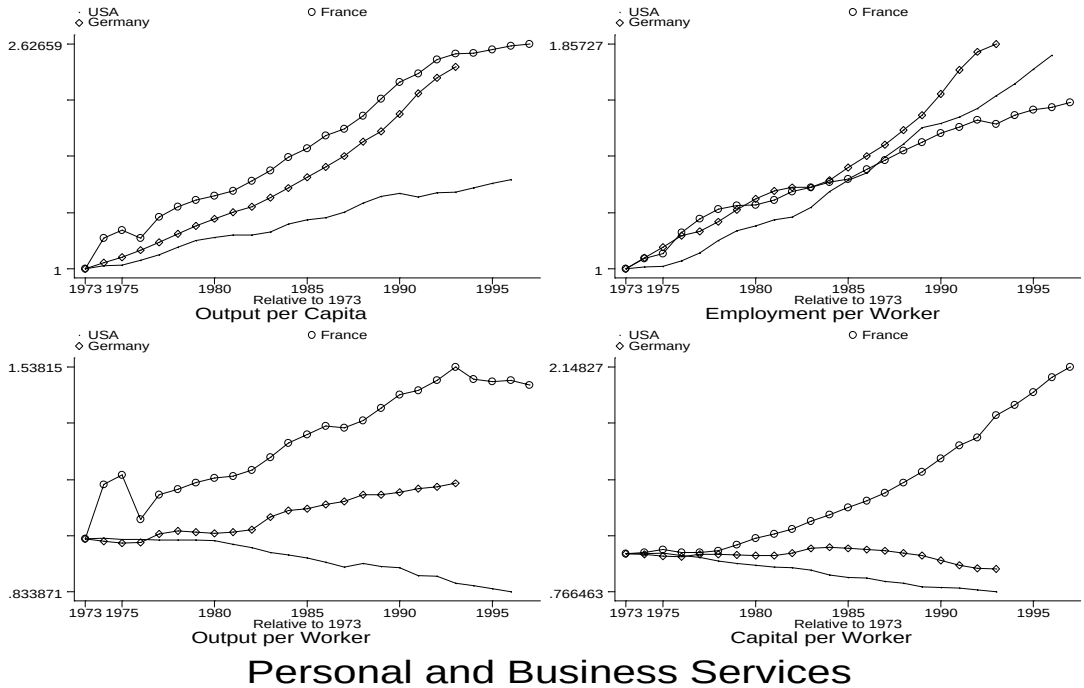

Figure 6

Output per Capita, Employment per Capita, Labour Productivity and Capital per Worker in Wholesale and Retail Trade Relative to 1973

Figure 7

Output per Capita, Employment per Capita, Labour Productivity and Capital per Worker in Construction Relative to 1973

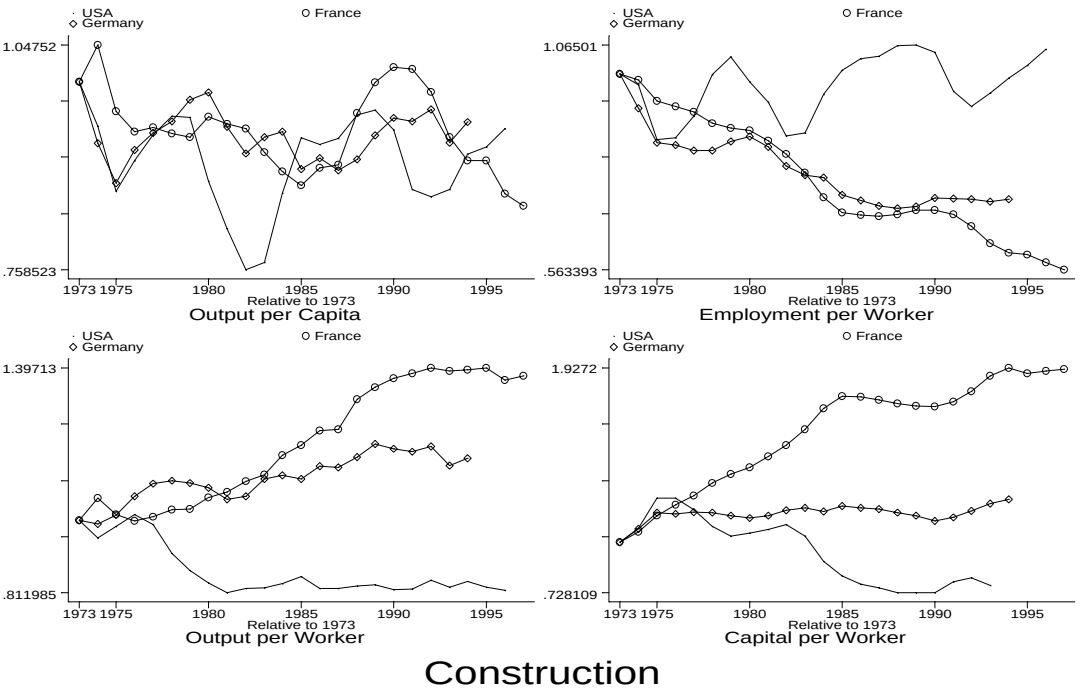

Table 1

Level of Variables Relative to 1973

Country	Period	GDP per Capita				Employment per Capita				Labour Productivity				Capital-Labour Ratio			
		Tot.	Man.	Ser.	Agr.	Tot.	Man.	Ser.	Agr.	Tot.	Man.	Ser.	Agr.	Tot.	Man.	Ser.	Agr.
USA	73-78	108	103	111	88	101	93	106	90	102	105	100	93	106	120	101	123
	73-83	110	93	117	89	98	78	108	86	104	111	101	97	117	158	106	127
	73-88	132	112	140	110	109	78	125	78	112	133	103	131	116	165	103	118
	73-93	136	107	147	133	108	69	128	73	116	142	106	167	125	198	107	109
France	73-78	112	112	114	94	95	92	102	79	116	119	110	117	122	120	117	141
	73-83	120	111	125	107	89	80	101	64	130	134	119	162	144	147	130	182
	73-88	134	112	147	112	83	68	102	51	151	154	136	208	162	181	137	219
	73-93	138	109	155	114	79	60	101	39	164	168	143	271	185	219	149	272
Germany	73-78	112	107	117	107	92	88	98	75	118	118	115	137	126	123	120	137
	73-83	119	106	129	114	86	79	98	61	127	125	122	171	148	140	137	162
	73-88	137	117	153	122	88	79	102	51	142	134	137	219	162	145	148	191
	73-93	152	114	184	130	88	73	110	39	154	139	148	295	174	165	150	234

Source: International Sectoral Data Base (ISDB), OECD; Population and Labour Force Data from Bureau of Labor Statistics (BLS);
Notes: Service sector includes utilities and construction. Government services and mining activities are excluded. GDP per capita, Labour productivity (GDP per worker), and the Capital-Labour ratio (Gross capital per worker) are measured in 1990 PPP US Dollars. Employment per capita is employment divided by population at working age.

Table 2

Shares in Total Private Non-Mining Employment and Output

Output Shares

	Manufacturing		Services		Agriculture	
Country	1973	1993	1973	1993	1973	1993
USA	26.4	23.6	71.4	74.3	2.2	2.1
France	32.1	27.1	62.8	68.8	5.1	4.1
Germany	43.5	32.6	54.4	65.6	2.1	1.8

Employment Shares

	Manufacturing		Services		Agriculture	
Country	1973	1993	1973	1993	1973	1993
USA	29.3	17.6	66	79.2	4.7	3.1
France	33.8	24.6	52.3	69.3	13.9	6.1
Germany	43.8	36.2	47.6	59.9	8.6	3.8

Source: ISDB, OECD;
Notes: Services include utilities and construction. The shares are out of total private non-mining production and employment. Output shares are from output in constant 1990 prices.

Table 3

Fraction of Aggregate Growth Rates Due to Single Sectors

Output per Capita Growth

Country	Period	Growth Rate	Manuf.	Services	Agric.
USA	73-93	1.8	4.8	93.2	2
	73-83	1	-19.3	121.7	-2.4
	83-93	2.4	14.1	82.2	3.7
France	73-93	1.9	7.2	90.9	1.9
	73-83	2	18.4	79.7	1.9
	83-93	1.5	-4.9	103	1.9
Germany	73-93	2.6	11.8	87	1.2
	73-83	1.9	14.7	83.7	1.5
	83-93	2.8	10.1	88.9	1

Employment per Capita Growth

Country	Period	Growth Rate	Manuf.	Services	Agric.
USA	73-93	0.4	-113.1	228.8	-15.7
	73-83	-0.2	393.9	-334.4	40.5
	83-93	1	-27.5	133.7	-6.2
France	73-93	-1.1	62.9	-2.6	39.7
	73-83	-1.1	60.5	-5.4	44.9
	83-93	-1.1	65.6	.4	33.9
Germany	73-93	-0.6	98	-40.9	42.9
	73-83	-1.4	68	7.6	24.3
	83-93	0.2	-195	433.5	-138.6

Notes: The entries in the tables are the single components of the sum $\widehat{Y}_t = \sum_{i=1}^{N} \widehat{Y}_{it} s_{it-1}$ (i.e. the sectors' growth rates weighted by the previous periods' employment or output shares), devided by the total growth rate $\widehat{Y}_t$. Due to rounding errors, some of the rows add up to 99.9 instead of 100.

Table 4

The Effects of Structural Change on Labour Productivity Growth

Country	Period	Tot.	Grw.	Shift	Resid.	Man.	Ser.	Agr.
USA	73-93	0.8	106.3	18	-24.3	-15.7	113.9	1.8
	73-83	0.4	79.1	33	-12	-71.9	179.6	-7.6
	83-93	1.1	102.8	8.8	-11.6	6.3	88.2	5.5
France	73-93	3.2	90.4	12.3	-2.8	14.4	82.7	2.8
	73-83	3	87.1	13.9	-1.1	22.1	75.1	2.7
	83-93	2.6	91.8	9.6	-1.4	7.7	89.4	2.9
Germany	73-93	2.7	87.4	9.9	2.7	12.4	86.4	1.2
	73-83	2.7	89	10.2	.8	22.1	76.2	1.7
	83-93	2.1	87.5	10.6	2	2.3	97.1	.7

		Manufacturing			Services			Agriculture		
Country	Period	Grw.	Shift	Resid.	Grw.	Shift	Resid.	Grw.	Shift	Resid.
USA	73-93	71.2	-61	-25.9	25.6	83.6	4.7	9.5	-4.6	-3.1
	73-83	65.8	-124	-13.7	14.7	163.4	1.5	-1.4	-6.4	.2
	83-93	58	-40.3	-11.4	32.8	52.9	2.5	12	-3.8	-2.7
France	73-93	34.1	-11.7	-8	42.6	28	12.1	13.7	-4	-6.9
	73-83	36.6	-10.8	-3.7	39.9	29.6	5.6	10.6	-4.9	-3
	83-93	28.8	-16.8	-4.3	51.2	31.7	6.5	11.8	-5.3	-3.6
Germany	73-93	31.7	-13.9	-5.4	48	26	12.4	7.7	-2.2	-4.3
	73-83	39.3	-13.8	-3.4	44.2	26.2	5.8	5.5	-2.2	-1.6
	83-93	21.7	-17.4	-2	58.8	31.7	6.6	7	-3.7	-2.6

Notes: The column headed Tot. shows the average growth rate of total private non-mining labour productivity (output per worker).
The columns headed Man., Ser., and Agr. show the total contribution to the growth of labour productivity by Manufacturing, Services, and Agriculture, respectively (see Equation 1).
The columns headed Grw., Shift, and Resid. denote the total Growth, Shift, and Interaction (Residual) effects shown in Equation 2.
The remaining columns show the single components of the shift-share decomposition in Equation 2. See also the Appendix.

Table 5

Decomposition of the Differences of Labour Productivity Growth of France and Germany vs. the USA

Country	Period	Tot.	Man.	Ser.	Agr.	Grw.	Shift	Resid.
FRA	73-93	2.4	24.4	72.4	3.2	74.7	21.2	4.1
	73-83	2.5	38.6	56.6	4.6	80.3	20.7	-1.2
	83-93	1.5	8.6	90.3	1.1	73.1	31.5	-4.6
GER	73-93	1.9	23.8	75.1	1	83.6	25.7	-9.4
	73-83	2.3	40.1	56.5	3.5	89.4	21.8	-11.1
	83-93	1	-2.2	106.6	-4.4	84.8	47.8	-32.6

		Manufacturing				Services				Agriculture			
Country	Period	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
FRA	73-93	14	7.2	-1.1	4.3	55.9	14.8	-4.5	6.2	4.8	-.8	.8	-1.6
	73-83	23.9	11.3	-2.7	6.1	50.7	10.8	-3.8	-1.1	5.7	-1.4	-1.7	2
	83-93	-4.3	7	1.5	4.4	77.9	25.4	-8.5	-4.5	-.5	-.9	6	-3.5
GER	73-93	-2.2	13.2	-4.2	17	78.4	13.8	-11.2	-5.9	7.4	-1.3	0	-5.1
	73-83	15.8	13.8	-8.9	19.4	66.4	9.6	-8.2	-11.3	7.2	-1.6	.1	-2.2
	83-93	-37.3	23.1	5.1	6.9	122.1	27.4	-21.3	-21.6	0	-2.7	.8	-2.5

Notes: The column headed Tot. shows the difference of the average growth rate of total private non-mining employment per capita relative to the USA. The columns headed Man., Ser., and Agr. show the total contribution to the difference in growth by Manufacturing, Services, and Agriculture, respectively (see Equation 2).

The first three columns headed (1), (2), and (3), denote the effect due to different growth rates of labour productivity, different rates of changes of employment shares, and different levels of output shares, respectively. The remaining columns show these components by sectors. Columns headed by (4) denote the Interaction Effect (Residual). See the Appendix for more details.

Table 6

Decomposition of the Cross-Country Differences of Growth in Employment-Population Ratio

Country	Period	Tot.	Man.	Ser.	Agr.	Grw.	Shift	Resid.
France	73-93	-1.5	14.5	61.1	24.5	74.4	26.4	-.7
	73-83	-1	3.4	50.9	45.7	54	36	10
	83-93	-2.1	22.2	62.5	15.2	81	19.4	-.5
Germany	73-93	-1	13.9	66.6	19.5	59.3	52.9	-12.2
	73-83	-1.2	23.3	54.7	22.1	65.3	44.2	-9.4
	83-93	-.8	5.1	75.4	19.5	45.9	68.6	-14.5

		Manufacturing			Services			Agriculture		
Country	Period	Grw.	Shift	Resid.	Grw.	Shift	Resid.	Grw.	Shift	Resid.
France	73-93	8.4	4.8	1.3	60.6	13.1	-12	5.4	8.5	10.6
	73-83	-6.1	10.4	-.9	49.3	11.9	-10.3	10.8	13.7	21.2
	83-93	13.9	4	4.3	62.6	11.2	-11.3	4.5	4.2	6.5
Germany	73-93	-5.6	22.3	-2.8	57.1	25.4	-15.9	7.8	5.2	6.5
	73-83	-2.3	26.8	-1.2	58	12.8	-16.1	9.6	4.6	7.9
	83-93	-10.8	23.7	-7.8	46.1	41.2	-11.9	10.6	3.7	5.2

Notes: The column headed Tot. shows the difference of the average growth rate of total private non-mining employment per capita relative to the USA. The columns headed Man., Ser., and Agr. show the total contribution to the difference in growth by Manufacturing, Services, and Agriculture, respectively (see Equation 1).
The first three columns headed Grw., Shift, and Resid. denote the total Growth, Shift, and Interaction (Residual) effects shown in Equation 2. The remaining columns show the single components of the shift-share decomposition in Equation 2. See the Appendix for more details.

Table 7

Changes of the Capital Share and Biased Technological Change

Total Economy

Country	Capital Share			Period	Biased Techn. Chg.		
	1973	1993	$\hat{cs}^a$	σ^b	.3	.8	1.4
USA	.39	.41	.1	73-93	1.3	1.6	.9
France	.39	.43	.6	73-93	4.6	7.9	1
Germany	.36	.42	.8	73-93	4.2	8.6	-.6

Manufacturing

Country	Capital Share			Period	Biased Techn. Chg.		
	1973	1993	$\hat{cs}$	σ	.3	.8	1.4
USA	.28	.36	.6	73-93	5.3	8.4	1.9
France	.34	.37	.3	73-93	6.2	7.8	4.3
Germany	.35	.25	-1.4	73-93	2.3	-5.3	10.7

Services

Country	Capital Share			Period	Biased Techn. Chg.		
	1973	1993	$\hat{cs}$	σ	.3	.8	1.4
USA	.43	.42	-.1	73-93	.3	-.2	.9
France	.44	.47	.3	73-93	2.7	4.9	.4
Germany	.44	.53	1	73-93	3.2	9.5	-3.7

Notes: The capital share is one minus total labour compensation adjusted for self-employment. The entries under Biased Technological Change are obtained by solving Equation 7. For France, the value of the capital share is from 1992.

[a] Growth in the Capital Share, 1973-1993

[b] Elasticity of substitution in production between capital and labour.

Table 8

The Bias of Conventional TFP-Growth (TFP), 1973–1993

Total Economy

	TFP-Growth			Difference[a]	
Country	Conventional	Beginning	End	Beginning	End
USA	.293	.21	.383	-1.74	1.92
France	1.463	.494	2.156	-23.35	19.5
Germany	1.236	.429	1.833	-18.91	15.96

Service Sectors

	TFP-Growth			Difference	
Country	Conventional	Beginning	End	Beginning	End
USA	.126	.121	.134	-.11	.15
France	1.02	.655	1.359	-8.57	8.48
Germany	1.178	.758	1.588	-10.09	10.64

Manufacturing Sectors

	TFP-Growth			Difference	
Country	Conventional	Beginning	End	Beginning	End
USA	.545	-.674	1.182	-24.13	15
France	1.269	-.385	2.062	-36.1	21.72
Germany	.996	.581	1.235	-9.65	5.9

Notes: All growth rates are annual average compound growth rates, i.e. $g = \frac{1}{T}[log(x_T) - log(x_0)]$ (which is an approximate solution to $x_T = (1+g)^T x_0$).

[a] This is the total cumulated difference after 20 years resulting from the different growth rates, i.e. for two growth rates $\widehat{x}$, $\widehat{y}$, $'Difference' = (1+\widehat{x})^{20} - (1+'Conventional')^{20}$, where $\widehat{x}$ is either of the two alternative measures.

Table 9

Estimates of TFP-Growth Based on Annual Growth Rates, 1973–1993

Total Economy

		TFP-Growth			Difference	
Country	LPRGR[a]	Annual	Beginning	End	Beginning	End
USA	.669	.162	.146	.177	.339	-.333
France	2.596	1.474	1.447	1.455	.765	.546
Germany	2.231	1.172	1.138	1.206	.905	-.888

Manufacturing

		TFP-Growth			Difference	
Country	LPRGR	Annual	Beginning	End	Beginning	End
USA	1.876	.967	.905	1.022	1.554	-1.421
France	2.676	1.434	1.397	1.466	1.037	-.892
Germany	1.806	1.042	1.023	1.06	.488	-.467

Services

		TFP-Growth			Difference	
Country	LPRGR	Annual	Beginning	End	Beginning	End
USA	.292	.164	.157	.17	.143	-.143
France	1.903	1.051	1.036	1.032	.378	.483
Germany	1.95	.993	.969	1.016	.602	-.602

Notes: The total growth rates of TFP shown are the sums of the annual growth rates of TFP. The columns headed 'Difference' show the difference accumulated over 20 years between the measure shown under 'Annual' and the two alternative measures.

[a]Growth rate of labour productivity (=GDP per worker)

Table 10

Decomposition of Difference in Labour Productivity Growth

Total Economy

		Fraction due to	
Country	LPRGR[a]	TFP	Capital
France	1.927	.68	.32
Germany	1.562	.65	.35

Manufacturing

		Fraction due to	
Country	LPRGR	TFP	Capital
France	.8	.58	.42
Germany	-.07	-1.07	2.07

Services

		Fraction due to	
Country	LPRGR	TFP	Capital
France	1.611	.55	.45
Germany	1.658	.5	.5

Source: See text.

[a]Difference of growth rate of labour productivity (=GDP per worker) with respect to U.S.

Table 11

Growth Rates and Sector Shares of Single Service Sectors, 1973–1993

Country	Sector	YPC	EPR	LPR	OS '73	OS '93	ES '73	ES '93
USA	Utilities	1.1	0	.7	3.7	3.3	1.1	1
	Construction	*-.7*	*-.2*	*-.9*	*7.3*	*4.6*	*7.1*	*6.3*
	Hotels and Restaurants	1.8	.3	1.1	.9	1	1.6	1.6
	Wholes. and Ret. Trade	*2.4*	*.6*	*1.7*	*15.6*	*18.4*	*23.9*	*25.1*
	Transport	1.4	0	.7	4.1	4	4.2	3.9
	Communication	4.2	-1.1	3.5	2	3.4	1.6	1.2
	Financial Services	1.8	1.3	1.1	7.3	7.6	4.8	5.7
	Pers. and Bus. Services	*2.2*	*2.5*	*-.7*	*30.5*	*34.8*	*21.8*	*33.4*
	Total	2.4	1.4	.3	71.4	77.2	66	78.2
	Manufacturing	.3	-1.9	1.8	26.4	20.7	29.3	18.6
France	Utilities	4.6	.3	3.9	1.6	2.9	.8	1
	Construction	*-.4*	*-2.4*	*1.6*	*8.9*	*6*	*12*	*9.5*
	Hotels and Restaurants	1.1	.7	1.5	3.8	3.5	3.3	4.7
	Wholes. and Ret. Trade	*1*	*-.6*	*1.4*	*17.3*	*15.4*	*17.2*	*19.4*
	Transport	2.1	-.2	2.4	4.2	4.7	4.3	5.3
	Communication	7	.2	7.4	1	3	2	2.7
	Financial Services	1.3	.5	1.7	5.5	5.2	2.7	3.8
	Pers. and Bus. Services	*4.7*	*2.2*	*2.2*	*4.2*	*7.8*	*4.9*	*9.6*
	Total	2.8	.1	2.2	62.8	70.6	52.3	67.1
	Manufacturing	.4	-2.5	2.6	32.1	25.2	33.8	25.9
Germany	Utilities	2.7	-.1	2.2	2.5	2.9	1.1	1.2
	Construction	*-.4*	*-1.7*	*.7*	*9.9*	*6*	*10.4*	*8.5*
	Hotels and Restaurants	1	1.2	.8	1.9	1.5	3	4.3
	Wholes. and Ret. Trade	*2.1*	*0*	*1.9*	*11*	*11*	*15.2*	*17.2*
	Transport	2.6	-.3	2.4	3.8	4.2	4.5	4.8
	Communication	5.2	-.4	4.9	1.5	2.8	2.1	2.2
	Financial Services	3.8	.9	3.5	4.4	6.1	3	4.1
	Total	4.2	.5	2.4	19.4	31.3	8.3	17.5
	Pers. and Bus. Services	*4.5*	*3.1*	*.8*	*54.4*	*65.6*	*47.6*	*59.9*
	Manufacturing	.7	-1.6	1.7	43.5	32.6	43.8	36.2

Source: ISDB, OECD; BLS;
Notes: YPC denotes value added per capita in 1990 PPP US Dollars. EPR denotes the employment population ratio. LPR denotes labour productivity (=output per worker) in 1990 PPP US Dollars. The columns headed OS show the share in total private non-mining value added in constant 1990 prices. Those headed ES show the share in total private non-mining employment per capita.

The italicised sectors are those whose development is discussed in more detail in the text.

Appendix

A Shift-Share Decompositions

To apply the shift-share decomposition in Equation 2 to the growth of **output per worker** (labour productivty) within countries, note that its growth rate can be written as

$$\widehat{y}_t = \sum_{i\in\{S,M,A\}} \left(\widehat{y}_{it} + \hat{s}_{it} + \hat{s}_{it}\widehat{y}_{it}\right) r_{it-1}, \tag{1}$$

where $y = \frac{Y}{L}$ denotes labour productivity, s denotes the employment share, and r denotes the real output share. The subscript i stands for each of three sectors (Services, Manufacturing and Agriculture). The components shown in Table 4 are $\frac{\widehat{y}_{it}r_{it-1}}{\widehat{y}_t}$, $\frac{\hat{s}_{it}r_{it-1}}{\widehat{y}_t}$, and $\frac{\hat{s}_{it}\widehat{y}_{it}r_{it-1}}{\widehat{y}_t}$. This can be rewritten to yield $\frac{\Delta y_{it}s_{it-1}}{\Delta y_t}$, $\frac{\Delta s_{it}y_{it-1}}{\Delta y_t}$, and $\frac{\Delta y_{it}\Delta s_{it}}{\Delta y_t}$, which is another representation of the components of shift-share decomposition often found in the literature.

Since the growth rate of the **capital-labour ratio** is

$$\hat{k}_t = \sum_{i\in\{S,M,A\}} \left[\hat{k}_{it} + \hat{s}_{it} + \hat{s}_{it}\hat{k}_{it}\right] \frac{K_{it-1}}{K_{t-1}}, \tag{2}$$

we obtain the components shown in Table 1 in the Appendix in a similar fashion (i.e. replacing the real output share r_{it} by $\frac{K_{it-1}}{K_{t-1}}$).

The decomposition of differences in growth of the **employment-population ratio** L across countries is obtained by straight forward application of Equation 2 to

$$\widehat{L}_t = \sum_{i\in\{S,M,A\}} \widehat{L}_{it}s_{it-1}.$$

If we let a superscript of '0' denote the USA, the components shown in Table 6 relative to the total difference $\Delta\hat{L}_t$ are the summands in the following equation

$$\Delta\hat{L}_t = \sum_{i\in\{S,M,A\}} \left[\Delta\hat{L}_{it}s^0_{it-1} + \Delta s_{it-1}\hat{L}^0_{it} + \Delta s_{it-1}\Delta\hat{L}_{it}\right]. \tag{3}$$

Since the growth rate of real output per capita Y is $\widehat{Y}_t = \sum_{i\in\{S,M,A\}} \widehat{Y}_{it}r_{it-1}$,we obtain the decomposition of differences of growth across countries (not shown, available upon request) by applying Equation 3 and making the appropriate replacements.

To derive the formulas used to calculate the shift-share decomposition of differences of output per worker **across countries**, we obtain that[1]

$$\begin{aligned}\Delta\widehat{y}_t \;=\; & \sum_{i\in\{S,M,A\}} \Delta\left(\widehat{y}_{it} + \hat{s}_{it} + \hat{s}_{it}\widehat{y}_{it}\right) r^0_{it-1} + \sum_{i\in\{S,M,A\}} \Delta r_{it-1}\left(\widehat{y}^0_{it} + \hat{s}^0_{it} + \hat{s}^0_{it}\widehat{y}^0_{it}\right) \\ & + \sum_{i\in\{S,M,A\}} \Delta r_{it-1}\Delta\left(\widehat{y}_{it} + \hat{s}_{it} + \hat{s}_{it}\widehat{y}^0_{it}\right)\end{aligned}$$

[1]Note that in the general notation from above we have that $\hat{X}_i \equiv \hat{P}_i + \hat{s}_i$, and $z_i \equiv r_i$.

This can be rewritten to yield

$$\begin{aligned}\Delta\widehat{y}_t &= \sum_{i\in\{S,M,A\}} \Delta\widehat{y}_{it} r^0_{it-1} \\ &+ \sum_{i\in\{S,M,A\}} \Delta\hat{s}_{it} r^0_{it-1} \\ &+ \sum_{i\in\{S,M,A\}} \left[\widehat{y}^0_{it} + \hat{s}^0_{it} + \hat{s}^0_{it}\widehat{y}^0_{it}\right] \Delta r_{it-1} \\ &+ \sum_{i\in\{S,M,A\}} \left[\left(\Delta\hat{s}_{it} + \Delta\widehat{y}_{it} + \Delta\left(\hat{s}_{it}\widehat{y}_{it}\right)\right)\Delta r_{it-1} + \Delta\left(\hat{s}_{it}\widehat{y}_{it}\right) r^0_{it-1}\right].\end{aligned} \tag{4}$$

These are the four components reported in Table 5 relative to the total difference $\Delta\widehat{y}_t$.

If we replace $\frac{K_{it-1}}{K_{t-1}}$ for the output share in Equation 4, we obtain the components for the decomposition of the capital-labour ratio.

Table I

The Effects of Structural Change on Growth of the Capital-Labour Ratio

Country	Period	Tot.	Grw.	Shift	Resid.	Man.	Ser.	Agr.
USA	73-93	1.2	78.2	36.9	-15	14	90.3	-4.2
	73-83	1.7	77.6	29.6	-7.1	19	78.6	2.5
	83-93	0.6	67.4	40.5	-7.9	2.3	117.4	-19.7
France	73-93	4.2	81.2	17.3	1.6	16.4	81.9	1.8
	73-83	4.4	80.6	16.5	2.9	14.7	82.4	2.9
	83-93	2.8	80.4	21.3	-1.7	18.2	81.3	.5
Germany	73-93	3.7	77.2	18	4.8	9	90.7	.3
	73-83	4.8	81.5	14.2	4.2	10.7	87.4	1.8
	83-93	1.8	68.4	32.4	-1	5.9	96.4	-2.5

		Manufacturing			Services			Agriculture		
COuntry	Period	Grw.	Shift	Resid.	Grw.	Shift	Resid.	Grw.	Shift	Resid.
USA	73-93	52.3	-19.3	-19	24.4	61.4	4.5	1.5	-5.2	-.5
	73-83	43.9	-15.8	-9.1	27.5	48.3	2.8	6.2	-2.9	-.8
	83-93	56.8	-43.3	-11.2	18.8	97.2	1.4	-8.2	-13.4	1.9
France	73-93	28.7	-5.6	-6.7	44.1	25.3	12.5	8.4	-2.4	-4.2
	73-83	21.4	-4.6	-2.1	51.5	23.7	7.2	7.7	-2.6	-2.2
	83-93	33	-9.9	-4.9	40.8	35.3	5.2	6.6	-4.1	-2
Germany	73-93	16.1	-4.3	-2.8	51	26.5	13.2	10.1	-4.2	-5.6
	73-83	15.5	-3.4	-1.4	58.7	21	7.7	7.3	-3.4	-2.1
	83-93	15.8	-8.4	-1.5	41.7	50.1	4.6	10.9	-9.3	-4.1

Notes: The column headed Tot. shows the average growth rate of total private non-mining capital-labour ratio. The columns headed Man., Ser., and Agr. show the total contribution to the growth of the capital-labour ratio by Manufacturing, Services, and Agriculture, respectively (see Equation 1).

The columns headed Grw., Shift, and Resid. denote the total Growth, Shift, and Interaction (Residual) effects shown in Equation 2.

The remaining columns show the single components of the shift-share decomposition in Equation 2. See also the Appendix.

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