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# Germany's Continued Productivity Slump: An Industry Analysis

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**Abstract**

US productivity growth surged twice post 1995 and post 2000. In contrast Germany registered two successive productivity reductions during that same period of time. Previous analysis of the post-2000 decline has been limited, however, by the short time series of the available data. In this paper we extend the *Ifo Industry Growth Accounting Database* that provides detailed industry-level investment information up to 2004. While much attention has focused on the reduction in German labor hours, our post-2000 data shows that a fledgling recovery in German non-ICT investment was offset by a widespread collapse in German total factor productivity. Almost half of German industries (accounting for over 45 percent of German output) did not experience positive TFP growth post 2000. Industries that constitute over a quarter of Germany's value-added exhibited negative labor productivity growth during the same period. The negative German productivity trend is thus continuing, which accelerates the country's departure from the productivity frontier.

**JEL Classification**: O14, O47, L60, L80.

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## 1. Introduction

While the US experienced dual productivity surges post 1995 and then again post 2000, Germany experienced dual productivity reductions during the same time periods (see Figure 1). The dual US productivity surges have been extensively analyzed in Jorgenson, Ho, Samuels and Stiroh (2006), who document a tight correlation between the sectoral information technology content and growth. Eicher and Roehn (2007) document the productivity declines in Germany and identify the "drivers" of Germany's productivity demise. However, the second productivity decline could only be examined for a short time series, due to data limitation. Given that productivity can exhibit large cyclical swings, it was unclear whether the second German decline was indeed as strong and significant or perhaps simply the result of business cycle fluctuations. In this paper we extend the Eicher and Roehn (2007) dataset to examine a now robust productivity trend from 2000 to 2004.

A broad consensus attributes the first US productivity surge to strong IT investment, much of it originating in ICT-Intensive industries.[1] The thought is that ICT-Producing industries implemented rapid technological advances to enhance efficiency in production. The second productivity surge in the US seems to have been driven, however, by ICT-Using industries that absorbed the technological advances which originated in the mid-1990s in ICT-Producing industries. Eicher and Roehn (2007) document that ICT investment also increased in Germany in the mid-1990s, but that the increase was too small to offset a dramatic productivity collapse in Non-ICT industries. Post 2000, the picture was weaker with decelerations in productivity for both ICT and Non-ICT industries. With our extended time series, we hope to better pinpoint the sources of Germany's post-2000 productivity demise.

Using the *Ifo Industry Growth Accounting Database,* which provides detailed information on 12 investment assets for 52 German industries,[2] we find a strong decline in post-2000 TFP growth in ICT-Producing and Non-ICT industries' together with a decline in ICT capital deepening. 30 out of 52 German industries did not experience positive TFP contributions to output growth, accounting for over 45 percent in German value-added. Only five industries, with 7.2 percent of German value-added, experienced labor productivity increases post 1995 and post 2000. Successive declines in labor productivity occurred in 12 industries with almost 24 percent

[1] Jorgenson and Stiroh (2000), Oliner and Sichel (2000), Stiroh (2002), Jorgenson, Ho and Stiroh (2005a).

[2] This level of detail is not provided by official German statistics. Roehn et al. (2007) derive the database from the *ifo Investorenrechnung*, which gathers investment micro data on over 100 assets for 52 German industries and aggregates them to 12 major industry investments (see Roehn et al., 2007 for details). Roehn et al. (2007) also calculate capital stocks and services, which then allows for the first analysis of productivity and information, communication and technology (ICT) contributions to aggregate German productivity at the 52-industries level.

in total value-added. The individual industry performance and comparisons to the results derived of the shorter dataset in Eicher and Roehn (2007) are provided below.

## 2. Data

A full description and documentation of the data is available in Roehn et al. (2007) and the data is available at faculty.washington.edu/te/growthaccounting. It is based on data for unified Germany (post 1990) with information on industry-level value-added, investment, capital stocks and services, and quality adjusted labor hours for 52 German industries and 12 different assets from 1991 to 2004. The 52 industries span the entire German economy (with the exception of household services). The *Ifo Industry Growth Accounting Database* has three unique features. First, it provides information on an unusually large number of capital stocks and capital services at the industry level. Second, the industry-level assets include three different ICT assets (Computer and Office Equipment, Communication Equipment and Software), which are of particular interest to understand the productivity performance of industries in the past decade. Third, the detailed disaggregation of the different asset types and marginal productivities (measured as user costs) allows us to construct the most accurate measures of ICT and Non-ICT capital services.

The *Ifo Industry Growth Accounting Database* allows us to separate industries into ICT-Producing, ICT-Using, and Non-ICT (or "Other") industries. A broad US literature has established categories for ICT-Intensive and Non-ICT-Intensive industries by using the shares of ICT capital in total capital services.[3] To further differentiate ICT-Intensive industries into ICT-Using and ICT-Producing, the literature follows the lead of the US Bureau of Economic Analysis' ICT-Producing industry definition. ICT-Using industries constitute the residual group.

A number of alternative papers examine the effects of ICT-Intensive industries in the EU (e.g. van Ark, Inklaar, McGuckin, 2003a, b, O'Mahony and van Ark, 2003). We use Stiroh's (2002, 2006) definition for ICT-Intensive industries (those whose ICT shares exceed the median). To separate ICT-Producing from ICT-Intensive industries, we adopt the German Statistical Office (GSO, 2006) definition and classify the following industries as ICT-Producing: Office Machinery and Computers (NACE 30); Radio, TV and Communication Equipment (NACE 32); Instruments (NACE 33); Communication Services (NACE 64) and Computer and Related Services (NACE 72).[4]

[3] See, for example, Stiroh (2002, 2006), Jorgenson, Ho, Stiroh (2005b), Bailey and Lawrence (2001), and Triplett and Bosworth (2004).
[4] For a full list of our ICT-classification scheme for the 52 industries, compare Table A1 in the appendix.

A similar productivity database exists at the Groningen Growth and Development Centre, which focuses on international productivity comparisons. Differences between the *Ifo Industry Growth Accounting Database* and the *Groningen Industry Growth Accounting Database* are fourfold. First, Groningen reports 26 industries, while Roehn et al. (2007) report data for 52 industries. Second, ICT assets are said to include Computers and Peripherals, Software and Communication Equipment. Roehn et al. include Office Equipment in ICT assets, since Office Equipment and Computers cannot be separated at the German industry-level. A third difference arises in the asset class entitled "Buildings and Structures". Our data includes Residential and Non-Residential Buildings and Structures while Groningen includes only Non-Residential Buildings and Structures. A breakdown into Residential and Non-Residential Buildings on the industry-level is not provided by GSO.

Finally, and perhaps most importantly, since German Software investments are not reported by GSO, the Groningen database assumes that a fixed fraction of Intangible Assets is Software. Groningen then generates German industry-level Software investment by using a ratio of Software to IT-equipment investment that was obtained from an average of French, Dutch and US data. Instead, the *Ifo Industry Growth Accounting Database* obtains data on Software investment shares in total Intangible Assets, and industry-level Software investment from a study (Herrmann and Mueller, 1997) and surveys conducted by the *Ifo Investment Survey*.[5] As detailed in Herrmann and Mueller (1997) the Software estimates are based on specific questions that solicited information on industry level investment in Purchased and Own Account Software in 1995, 1998, 1999 and 2000.

## 3. Deriving Industry Contributions to Labor Productivity Growth

### 3.1 Methodology

We follow the methodology chosen by Eicher and Roehn (2007) to assure comparability of the results. In order to uncover the sources of Germany's aggregate productivity demise, we trace the aggregate origins to the differences in German-US industry-level labor productivity. To quantify the industry contributions to aggregate productivity, we apply the *aggregation over industries* method developed by Jorgenson, Gallop and Fraumeni (1987).[6] Industry-level gross output

[5] The *Ifo Investment Survey* follows the EU guidelines for harmonized business surveys and contains 70,000 German firms, 5000 of which are surveyed for each sample period. It is established as an excellent leading indicator of German investment; it is also incorporated in a number of other leading indicators, most prominently the European Commission's *Economic Indicators of the Euro Zone*.

[6] For recent industry studies applying this method, see, for example, Jorgenson, Ho and Stiroh (2005a), Jorgenson, Ho, Samuels and Stiroh (2006) and Inklaar, O'Mahony and Timmer (2005).

growth can be decomposed into input and TFP contributions according to

$$\Delta \ln Y_i = \bar{v}_{K,i}^{IT} \Delta \ln K_i^{IT} + \bar{v}_{K,i}^{NON} \Delta \ln K_i^{NON} + \bar{v}_{L,i} \Delta \ln L_i + \bar{v}_{X,i} \Delta \ln X_i + TFP_i, \qquad (1)$$

where for industry $i$ $Y_i$ is gross output, $K_i^{IT}$ are ICT capital services, $K_i^{NON}$ are non-ICT capital services, $L_i$ represents labor services and $X_i$ are intermediate inputs. The $\bar{v}$'s are the two period-average nominal input shares. Labor services are defined as $\Delta \ln L_i = \sum_j \bar{\varpi}_{j,i} \Delta \ln H_{j,i}$, where $H_{j,i}$ are hours worked of labor (skill) type $j$ in industry $i$ and $\bar{\varpi}_{j,i}$ is the two period average compensation share of labor type $j$ in total labor compensation of industry $i$.

To relate industry gross output to value-added we rewrite equation (1) as

$$\Delta \ln Y_i = \bar{v}_{V,i} \Delta \ln V_i + \bar{v}_{X,i} \Delta X_i, \qquad (2)$$

where $V_i$ is value-added and $\bar{v}_{V,i}$ is the nominal share of value-added in gross output of industry $i$. Combining equations (1) and (2), allows us to write industry value-added growth as

$$\Delta \ln V_i = \frac{\bar{v}_{K,i}^{IT}}{\bar{v}_{V,i}} \Delta \ln K_i^{IT} + \frac{\bar{v}_{K,i}^{NON}}{\bar{v}_{V,i}} \Delta \ln K_i^{NON} + \frac{\bar{v}_{L,i}}{\bar{v}_{V,i}} \Delta \ln L_i + \frac{1}{\bar{v}_{V,i}} TFP_i, \qquad (3)$$

Defining aggregate output as the weighted average of industry value-added, $\Delta \ln V \equiv \sum_i \bar{w}_i \Delta \ln V_i$ (where $\bar{w}_i$ is the average share of industry value-added in aggregate value-added) and combining this expression with equation (3), we obtain

$$\sum_i \bar{w}_i \Delta \ln V_i = \sum_i \left( \bar{w}_i \frac{\bar{v}_{K,i}^{IT}}{\bar{v}_{V,i}} \Delta \ln K_i^{IT} + \bar{w}_i \frac{\bar{v}_{K,i}^{NON}}{\bar{v}_{V,i}} \Delta \ln K_i^{NON} + \bar{w}_i \frac{\bar{v}_{L,i}}{\bar{v}_{V,i}} \Delta \ln L_i + \bar{w}_i \frac{1}{\bar{v}_{V,i}} \Delta \ln TFP_i \right) \qquad (4)$$

where $\left(\bar{w}_i \Delta \ln TFP_i\right) / \bar{v}_{V,i}$ represents the "Domar-weighted" industry-level TFP growth with "Domar-weights" being the quotient of the share of industry value-added in aggregate value-added, and the share of industry value-added in industry gross output.

We are specifically interested in the industry contributions to average labor productivity (ALP), which is conventionally defined as $\Delta \ln ALP = \Delta \ln V - \Delta \ln H$, where $\Delta \ln V$ is the Tornqvist index of weighted industry value-added defined in equation (4) and $H$ is the unweighted sum of industry hours $H_i$. $H_i$ is in turn the unweighted sum of hours worked over different labor types $H_i = \sum_j H_{j,i}$. Following Stiroh (2002) ALP can then be decomposed as:

$$\Delta \ln ALP = \sum_i \bar{w}_i \Delta \ln ALP_i + \left( \sum_i \bar{w}_i \Delta \ln H_i - \Delta \ln H \right) = \sum_i \bar{w}_i \Delta \ln ALP_i + R^H. \qquad (5)$$

The first term on the right hand side represents direct industry contributions to APL growth and $R^H$ reflects the reallocation of hours.[7] Defining $\Delta \ln k_i^{IT}$, $\Delta \ln k_i^{NON}$, and $\Delta \ln q_i$ as ICT capital deepening, non-ICT capital deepening and labor quality growth, (4) and (5) yield

$$\Delta \ln ALP = \sum_i \overline{w}_i \left( \frac{\overline{v}_{K,i}^{IT}}{\overline{v}_{V,i}} \Delta \ln k_i^{IT} + \frac{\overline{v}_{K,i}^{NON}}{\overline{v}_{V,i}} \Delta \ln k_i^{NON} + \frac{\overline{v}_{L,i}}{\overline{v}_{V,i}} \Delta \ln q_i + \frac{1}{\overline{v}_{V,i}} \Delta \ln TFP_i \right) + R^H . \quad (6)$$ [8]

The APL decomposition in (6) has the advantage that input contributions or TFP contributions to APL from any industry subset simply equal the (weighted) sum of contributions from all industries in the subset.

### 3.2 Growth Accounting Results

We decompose APL growth into contributions from ICT capital deepening, non-ICT capital deepening, labor quality growth, TFP growth, and the reallocation of hours. Table 1 displays the results for the three sample periods (1991–1995, 1995–2000, 2000–2004) as well as the differences in contributions between the two break points (1995, 2000).[9] The decomposition highlights the Eicher and Roehn result that value-added, as well as hours worked, increased between 1995 and 2000; it also provides solid evidence that this trend continued post 2000. However, the decrease in hours growth post 2000 is less severe (-0.69 percent) as compared to the results based on shorter time series in Eicher and Roehn (-1.11 percent). The same is true for value-added, which declined strongly: -1.30 percent (Eicher and Roehn, -1.58 percent). The sharp decline in value-added post 2000 negated any ALP enhancing effects generated by increases in production efficiency (fewer hours worked) to generate even lower ALP growth (1.43 percent) than previously observed in the shorter time series (1.57 percent).

According to Table 1, capital deepening contributes the greatest share to German average labor productivity throughout all periods. The average annual increase in capital deepening post 2000 is less intensive than previously thought (0.96 percent) as compared to Eicher and Roehn (2007) 1.14 percent. Concerning the decomposition of capital deepening into ICT and non-ICT capital deepening, our findings also verify previous results on the importance of ICT and non-ICT capital contributions. While the gap between both kinds of capital contributions narrowed substantially in 1995–2000, the gap widened in 2000–2004. Post 2000, especially ICT capital

[7] The contribution of an industry to aggregate reallocation of hours is approximately the growth in total hours worked and the difference between the two-period average industry value-added share and the two-period average employment share. Thus, the contribution is positive if an industry with an ALP level above (below) the aggregate average level experiences positive (negative) growth in hours.

[8] The growth rate of labor quality is defined as: $\Delta \ln q_i = \Delta \ln L_i - \Delta \ln H_i = \sum_j \overline{\omega}_{j,i} \Delta \ln H_{j,i} - \Delta \ln H_i$

[9] To compare our results to the US we choose time periods that coincide best with Stiroh (2006).

deepening decreased by -0.11 percent. This diminishing in ICT capital deepening is a greater reduction than measured by Eicher and Roehn (2007) where the decrease in ICT capital deepening accounted for only -0.04 percent.

Table 1 also indicates that the main drivers of the German investment dynamics have been ICT-Using industries which increased their IT investments. Non-ICT industries also increased their IT investments and thus contributed to an aggregate positive ICT capital deepening post 1995. In general, ICT capital deepening surged and non-ICT capital deepening declined, displaying changes of 0.11 and -0.25 percent, respectively. Jorgenson, Ho and Stiroh (2005a) point out that this substitution from non-ICT to ICT capital in the post-1995 period was triggered by a sharp decline in IT prices. Taking a closer look at the IT investment behavior of ICT-Using industries post 2000, we find a stronger decline as compared to the results in Eicher and Roehn (2007): -0.11 and -0.08 percent, respectively. This induced a stronger drag on ICT capital deepening and total capital deepening (a change of 0.07 compared to 0.26 percent). In summary this implies a continuing turn down in the substitution of labor toward more productive ICT capital in these industries.

Non-ICT capital deepening is about three times greater in Germany than ICT capital deepening. Therefore the weak non-ICT capital deepening post 2000 of only 0.17 percent (as compared to 0.30 percent in Eicher and Roehn 2007) had especially detrimental effects. The decrease in non-ICT capital deepening during this period is mainly due to a smaller increase in Non-ICT industries' capital deepening, accounting for only 0.16 percent in contrast to the 0.24 percent discovered by Eicher and Roehn (2007).

The muted increase in non-ICT capital deepening, primarily generated in Non-ICT industries together with the stagnating ICT capital deepening in Non-ICT industries, underlines Germany's transition towards the New Economy. The problem is that Germany's New Economy is significantly weaker than in the US (where it created an increase in overall productivity), which therefore generates an overall productivity decline. Non-ICT industries make up 50 percent of German industries and are located to a great extent in the manufacturing sector (more than 60 percent of Non-ICT industries are manufacturing industries, 16 out of 26 Non-ICT industries), but these Non-ICT manufacturing sectors generate only about 13 percent of value-added. The remaining Non-ICT industries, which are located in the service sector, generate almost 37 percent of value-added.

Much of the continued German productivity demise is reflected in the falling TFP contributions of industries post 2000, which *decreased* 0.34 percent. Table 1 shows the origins of the TFP contributions by industries (ICT-Producing, ICT-Using, and Non-ICT industries), to indicate that it was German's ICT-Using industries that experienced the most dramatic TFP slump of -0.23 percent post 2000. ICT-Producing industries also could not hold on to their positive TFP contributions from the previous period and Non-ICT industries' TFP growth continued to decline secularly since 1995. Due to these across-the-board reductions in industry TFP contributions, total TFP collapsed from 0.47 percent in 1995–2000 to 0.13 percent in 2000–2004. Below we examine the industry level labor and total factor productivity closer and compare them to the same industries in the US.

## 4. The Evolution of ICT Industries in Germany and the U.S.

### 4.1 German Labor Productivity Contributions by Industry

In this section we identify the industries that drove Germany's productivity performance. Figures 2a-c are modified Harberger (1998) diagrams that display each industry's contribution to cumulative value-added on the horizontal axis, while the vertical axis plots the contributions to cumulative total industry labor productivity growth.[10] Industries with positive slopes contribute positively to labor productivity and those along the negatively sloped part of the curve generated a drag on productivity growth. The importance of a certain industry's contribution (or drag) depends on the horizontal distance between points.

Figures 2a-c highlight the heterogeneity of labor productivity contributions across industries. In our data we find a continued increase in numbers of industries that contributed negatively to German labor productivity before the first and after the second break point. While there were 14 industries that contributed negatively from 1991–1995, in 2000–2004 its number increased to 20 industries. More remarkable is the large, persistent share of total value-added comprised by firms that had negative labor productivity growth. Industries that contributed negatively to productivity growth constituted between 27 and 39 percent of German value-added throughout all periods. Although there was a smaller number of negatively contributing industries during 1995–2000, they induced an aggregated drag on productivity of -0.72 percent.

As top positive contributors to total industry labor productivity growth we identify in all periods the Communications and Wholesale Trade industries, whereas Other Business Services exerted strong drags on German labor productivity growth and belonged to the top negative contributors throughout all periods.[11] Notable are also the performances of industries like Office

[10] A complete listing of each industry's contribution to aggregate ALP growth is provided in Table A1.

[11] Other Business Services comprise such diverse services as legal, accounting, book keeping and auditing services; tax consultancy; market research and public opinion polling; business and management consultancy; holdings; architectural and engineering activities and related technical consultancy; technical testing and analysis; advertising; labor recruitment and provision of personnel; investigation and security activities, industrial cleaning as well as miscellaneous business activities not otherwise mentioned.

Machinery & Computers and Financial Intermediation. These industries made strong contributions during the second period, but lost their strength post 2000. Real Estate and Motor Vehicles were among the weakest performers during 1995–2000 but regained productivity post 2000. Both sectors made the largest contributions to APL growth post 2000 with 0.39 percent and 0.22 percent, respectively.

To shed further light on the evolution of Germany's productivity performance and the drivers of the continued German productivity demise we examine the *changes* in productivity contributions over time. Table 2 identifies those industries that contributed directly to the decline in productivity observed after 1995 and 2000. Only two industries with value-added shares greater than one percent saw successive increases in their contributions to labor productivity (Construction and Vehicle Sales & Repair). Only five industries showed positive productivity contributions in both periods accounting for only 7.2 percent of German value-added. Much more disconcerting is the large number of industries with secularly declining contributions to labor productivity (twelve industries with a cumulative share value-added share of 23.6 percent). Here the largest decliners are Health & Social Work, Public Administration, Machinery, Land Transport, and Other Services.

Only 12 out of 52 German industries were able to reverse their productivity slump from the mid–1990s to generate productivity increased post 2000. Table 2 reveals the main negative contributors of the post–1995 slowdown are Real Estate, Other Business Services and Motor Vehicles, accounting for an aggregate drag on labor productivity by -0.50 percent. But all three industries reversed their performances and contributed strongly to productivity post 2000.[12] These industries belong to a group of five industries with a value-added share greater than one percent. More troubling is that 23 industries experienced a negative reversal of fortunes and saw their positive contributions evaporate post 2000. Industries that were largely responsible for the second productivity slowdown (but showed positive contributions post 1995) are Education, Wholesale and Retail Trade, and Financial Intermediation. These industries belong to a group of 14 industries whose aggregate value-added share is 33.3 percent that were responsible for an aggregate slowing in labor productivity by -0.82 percent. Especially the industries Wholesale and Retail Trade, and Financial Intermediation draw attention, as they are ICT-Using services industries with a high-value-added share. Neither industry could maintain its productivity gains beyond 2000.

[12] Note that we know from Figure 2c that the absolute productivity contribution from Other Business Services was negative, hence this industry contributed only by reducing its drag on productivity.

### 4.2 German-US Labor Productivity Comparisons by Industry Contributions

In this section we examine the sources of the diverging labor productivity experiences of Germany and the US. Using the Stiroh (2006) industry data[13], we compare the US/German industry contributions to the countries' labor productivity performances (see Figures 3a,b). Figure 3a shows that post 1995 only a few ICT-Intensive industries are responsible for most of the German-US differences. Computer & Electronics Equipment, Wholesale Trade, and Retail Trade made positive contributions in both countries, but the respective contributions were two to three times greater in the US. Finance & Insurance made large contributions to the first productivity surge in the US while their contributions in Germany were negligibly small. Most surprising is the strong divergence in the productivity performance of Other Business Services. While this industry contributed 14 percent to the productivity surge in the US post 1995, it exerted the largest drag on German productivity growth with a reduction of more than 25 percent. Furthermore, it is surprising that key industries that were traditionally beacons of German productivity – Machinery and Motor Vehicles – contributed significantly to the productivity slowdown in Germany, but added to the productivity surge in the US.

Post 2000 twice as many industries constituted a drag on German productivity than in the US. Interestingly, a completely different set of industries explains the widening productivity gap post 2000. For example, German Computer & Electrical Equipment, Computer Services, Wholesale and Retail Trade, and Utilities were among the largest positive contributors post 1995, mitigating the productivity divergence between Germany and the US but all had negative productivity contributions post 2000. In the US, Computer & Electrical Equipment, Other Business Services, Wholesale and Retail Trade, Finance & Insurance and Health & Social Assistance fueled labor productivity post 1995 and most of these industries (except Computer & Electrical Equipment and Finance & Insurance), maintained their positive contributions post 2000.

Our German-US comparisons share similarities with the US-EU comparisons of van Ark and Inklaar (2005). In their study, similar industries contributed to the US-EU divergence (especially Trade and Finance) post 1995, which may indicate that the US pulled away from all of Europe and not only from Germany. Novel in our results is that the origins of this divergence changed dramatically post 2000.

[13] Since US and German industry classifications differ, we merge 51 German and 60 US industries into 37 industries to achieve a consistent harmonization. The German Public Administration, Defense and Social Security sector is excluded due to the US focus on the private sector. The considered periods only differ in so far as Stiroh's first period begins in 1988.

### 4.3 German TFP Contributions by Industry

Figures 2d-f plot modified Harberger (1998) diagrams that show industry TFP growth contributions for 1991–1995, 1995–2000 and 2000–2004. The vertical axis displays the cumulative industry contributions to aggregate TFP growth, while the horizontal axis plots the cumulative industry output share in total value-added (Domar-weights). The steep slopes on the ascent and the descent indicate the strong heterogeneity of Germany's industry TFP growth contributions. Overall we observe a bifurcated economy with either strong productivity gains or sharp productivity losses.

Comparing the periods 1995–2000 to 2000–2004 (Figures 2e,f), we observe an increase in the number of industries with negative TFP contributions (from 17 to 25 industries), with large contractions in Other Business Services, Motor Vehicles and Insurance. 71 percent of these industries (12 out of 17 industries) are located in the service sector. Post 2000, 25 industries showed negative TFP growth. These industries accounted for almost 40 percent in aggregate value-added, while the number of negatively contributing manufacturing and service sectors converged with 44 (11 out of 25 industries) to 56 (14 out of 25 industries) percent, respectively.

Comparing the first two periods in Figures 2d,e, it is striking that Wholesale Trade and Financial Intermediation (both ICT-Using) increased their TFP contributions substantially. Retail Trade, another ICT-Using industry, which contributed negatively in 1991–1995, enhanced its TFP performance towards positive contributions in 1995–2000. This assumes that efficiency gains generated in ICT-Producing industries initially affected Wholesale Trade and than dispersed along the value chain into Retail Trade. But neither Wholesale nor Retail Trade were able to hold on to their strong TFP contributions post 2000. Besides this we also detected a slowdown in Financial Intermediation post 2000. A substantial increase of TFP contributions post 1995 occurred in Office Machinery & Computers and Communications industries (both ICT-Producing), but only Communications managed to increase its TFP growth contribution further post 2000.

These results widely confirm the findings in Eicher and Roehn (2007) where only Wholesale Trade instead of Communications enhanced its productivity performance. Contributions from the Insurance, Machinery and the Government sector steadily declined over the three periods, being in line with previous findings. Notable differences to Eicher and Roehn (2007) occurred as Machinery still continually weakened its contributions in our results but contributed positively post 2000, whereas it experienced a negative contribution in the shorter time series from 2000–2003. It seems as if most of these ICT-Using industries were not able to prolong productivity spillovers from ICT-Producing industries sufficiently post 2000.[14]

## 5. ICT and Productivity Growth

So far we have focused on the industry *productivity contributions* to aggregate labor productivity. In this section, we investigate formally whether industries that invested heavily in ICT can be shown to exhibit significantly higher *productivity growth rates*. Table 1 seems to imply a strong relationship between the two, at least for the period 1995–2000, when ICT-Intensive industries saw strong TFP increases at the time during which they also experienced a surge in ICT capital deepening. To identify the link between ICT intensity and productivity, we follow the methodology of Stiroh (2006) and apply a difference-in-difference estimator to compare industry productivity pre and post our 1995 and 2000 break years:

$$\Delta \ln prod_{i,t} = \alpha + \beta * Post_T + \gamma * ICT_T + \delta * Post_T * ICT_T + \varepsilon_{i,t} \quad , \qquad (7)$$

where the change in the log of labor productivity in industry $i$ at time $t$ is given by $\Delta \ln prod_{i,t}$ and $Post_T$ is a dummy identifying observations after a given break year $T$. $ICT_T$ is a dummy for ICT-Intensive industries at time $T$. Our measure of productivity is labor productivity measured as value-added per hour worked.[15]

The interpretation of the coefficients in equation (7) is that $\beta$ represents the acceleration in ALP growth for our control group (Non-ICT industries) after a break year. Relative ALP growth rates of ICT-Intensive industries prior to the break year are given by $\gamma$, and $\delta$ indicates the ALP acceleration of ICT-Intensive relative to non-ICT-Intensive industries after the break year. We estimate (7) using OLS, where we allow the error term $\varepsilon_{i,t}$ to be correlated within industries over time (see Stiroh, 2006). Table 3 reports the estimation results with value-added labor productivity growth as the dependent variable. The first column includes only the post–1995 dummy and shows that on average all industries saw a 0.23 percent deceleration of labor productivity growth post 1995. It is not surprising that the coefficient is not significant since we have not accounted for the opposite experiences of ICT and Non-ICT industries documented extensively above.

The second column displays results for the complete specification in equation (7). Post 1995 Non-ICT industries saw a statistically significant 1.77 percent deceleration of their labor

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[14] A summary of each industry's TFP contribution is provided in Table A1.

[15] Industry TFP as the dependent variable generates qualitatively similar results. We drop an extreme outlier in all specifications: the Petroleum and Coke industry, which constitutes 0.2 percent of German value-added. It reports labor productivity swings of over 100 percent.

productivity growth, while ICT-Intensive industries experienced a statistically significant 3.01 percent higher acceleration. This result is consistent with our summary statistics above, where we find that the first productivity slowdown is caused by a deceleration of productivity in Non-ICT industries that was mitigated by ICT-Intensive industries. Going one step further, we drop ICT-Producing industries from the sample and examine only ICT-Using and Non-ICT-Using industries. In this case the positive impact of ICT is smaller (1.82 percent) and statistically insignificant. These findings are also consistent with our above results where most of the ICT-productivity contributions resulted in ICT-Producing industries.

The last three columns replicate the same analysis for the second productivity slowdown. The break year is now set to 2000, and industries are classified as ICT-Intensive based on their ICT-capital share in 2000. Now the picture changes as non-ICT-Intensive industries again saw a significant labor productivity deceleration (1.47 percent). However, ICT-Intensive industries did not experience significantly higher productivity growth. Moreover, if we drop ICT-Producing industries from the sample, labor productivity growth for ICT-Using industries decelerated even faster (0.63 percent) – albeit not significantly – than in Non-ICT industries. This confirms our earlier finding that ICT-Using industries were a drag on German productivity growth due to their TFP growth declines post 2000.

In sum, we find strong evidence that ICT-Intensive industries had significantly higher labor productivity growth than the Non-ICT industries post 1995. These gains originated, however, largely in the small category of ICT-Producing industries. The productivity advantage of ICT-Intensive industries was, however, only transitory. For the post 2000 period, ICT-Intensive industries did not experience higher productivity growth compared to Non-ICT industries. If anything, our results suggest that productivity growth in ICT-Using industries decelerated even stronger than in Non-ICT industries post 2000.

## 6. Summary and Conclusions

Labor productivity experienced two strong surges in the US, post 1995 and post 2000. Over the same time periods German labor productivity experienced two successive productivity reductions. Compared to previous analysis of the German productivity divergence, we find, using an extended dataset, that the divergence is continuing and that German productivity growth is continuing to decline. We compare our results to US industry performances to identify significant differences in industry contributions.

In the US, ICT-Intensive industries substitute ICT capital for non-ICT capital post 1995, to generate surging productivity through accelerated ICT captial deepening and TFP growth. In

Germany, productivity gains in these ICT-Intensive industries were too small to offset the large productivity reductions in Non-ICT industries. Post 2000, the positive productivity impact of ICT-Intensive industries vanished in Germany. Since non-ICT productivity never recovered in Germany, we can only surmise that ICT diffusion was significantly smaller in Germany than in the US. A recovery in non-ICT-capital deepening post 2000 was too weak to offset productivity losses in industries that constitute 40 percent of Germany's value added.

Compared to previous analyses of German productivity, we find a greater number of industries experiencing negative TFP contributions post 2000 (25 out of 52 industries accounting for almost 40 percent in aggregate value-added) and relatively more German industries that contributed to German's labor productivity decline (17 industries contributed to the first productivity divergence post 1995, while its number increased to 24 industries post 2000).

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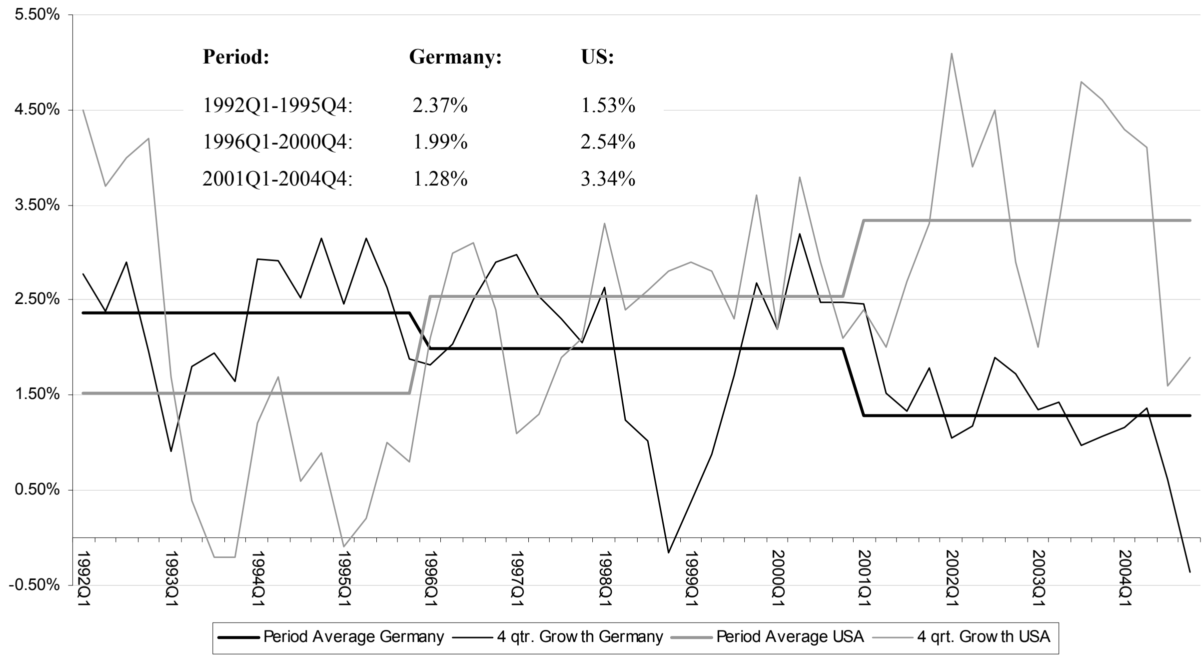
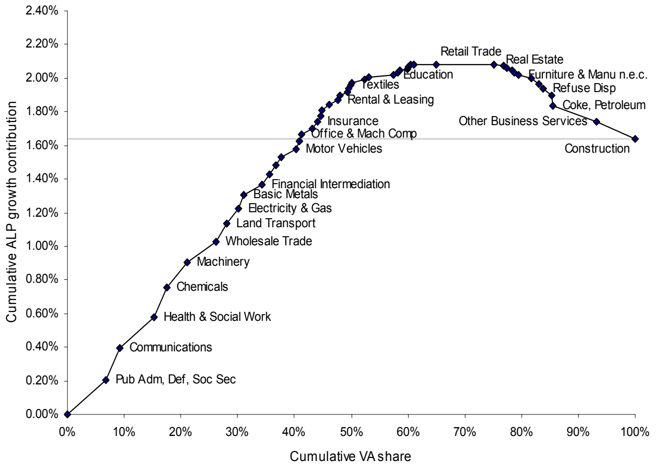
**Figure 1: Labor Productivity Growth: Germany-US**



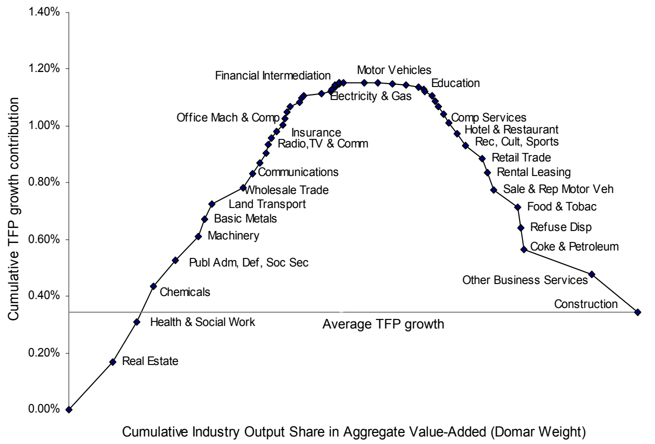

Sources: US is Nonfarm Business Sector (US Bureau of Labor Statistics), Germany: Total Economy (German Statistical Office). All estimates are annualized growth rates of quarterly data, in percentages.

**Figure 2:**
**Industry ALP and TFP Contributions to German Total Labor Productivity Growth**

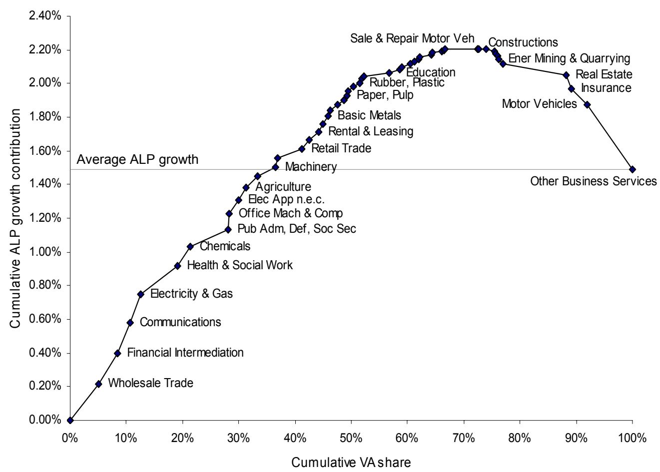
### a) ALP, 1991–1995



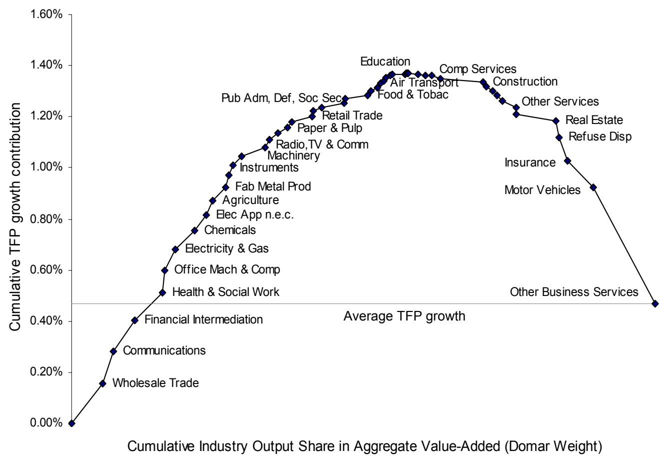

### d) TFP, 1991–1995



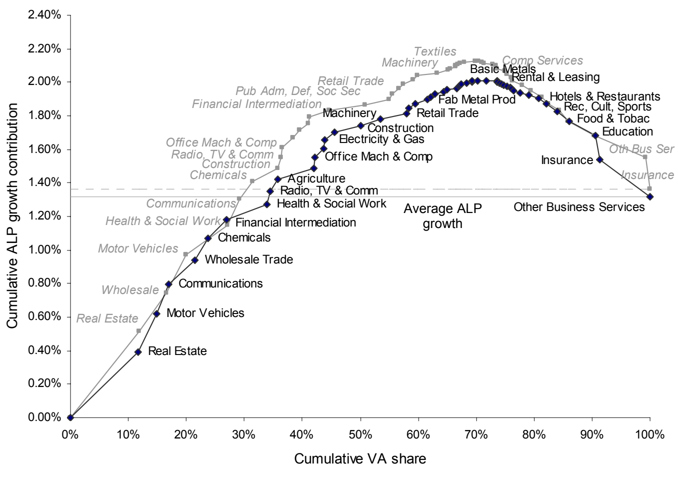

### b) ALP, 1995–2000




### e) TFP, 1995–2000




### c) ALP, 2000–2004 *(ALP, 2000–2003)*




### f) TFP, 2000–2004 *(TFP, 2000–2003)*

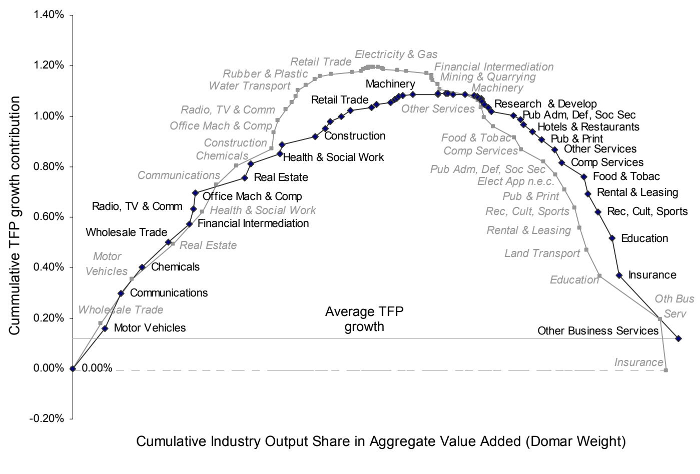
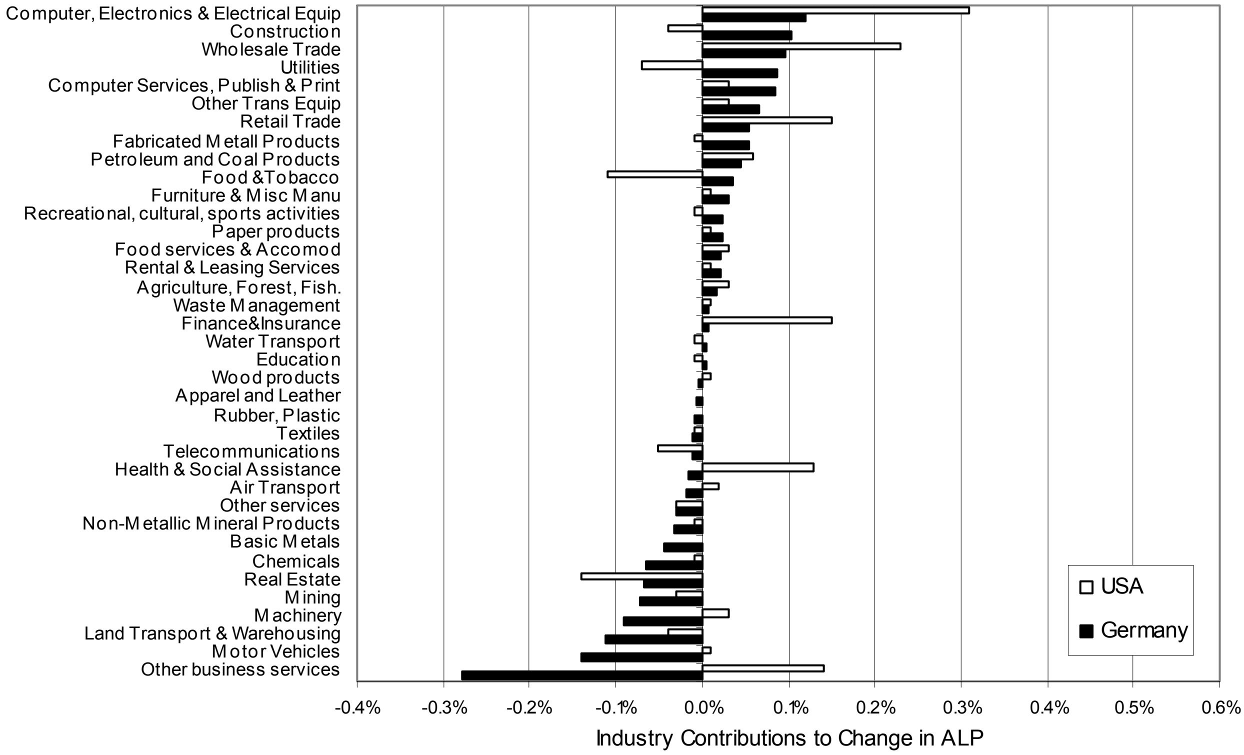
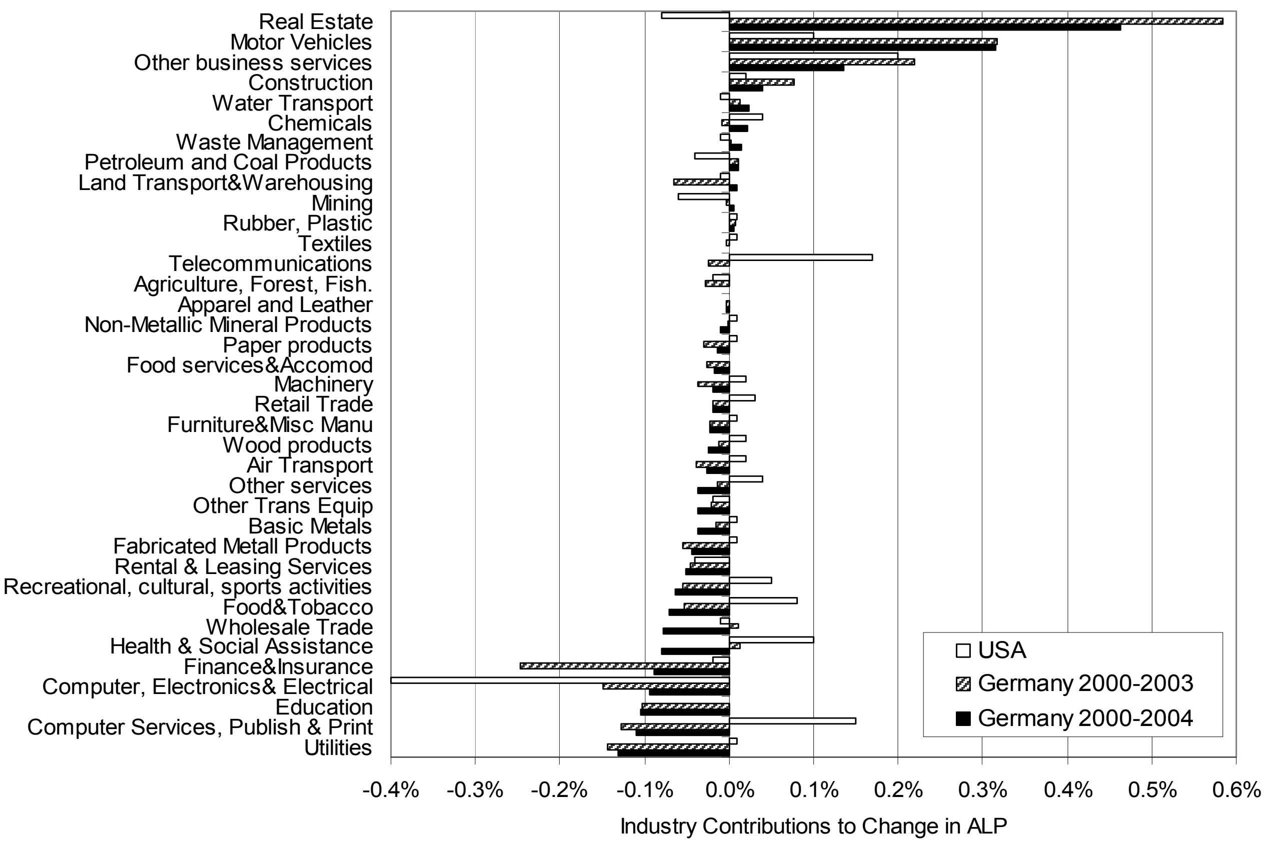


**Figure 3a: Industry Contributions to Change in Labor Productivity, Post 1995**




Source: Stiroh (2006) and authors' calculations.

**Figure 3b: Industry Contributions to Change in Labor Productivity, Post 2000**




Source: Stiroh (2006) and authors' calculations.

**Table 1: Sources of German Labor Productivity Growth, Germany 1991-2004**

| | 1991 – 1995 | 1995 – 2000 | 2000 – 2004 | 1995–2000 Less 1991–1995 | 2000–2004 Less 1995–2000 |
|---|---|---|---|---|---|
| **Total Economy Labor Productivity Growth** | **2.31** | **2.04** | **1.43** | **-0.27** | **-0.61** |
| Aggregate Value Added Growth | 1.37 | 2.01 | 0.71 | 0.64 | -1.30 |
| Aggregate Hours Growth | -0.93 | -0.03 | -0.72 | 0.90 | -0.69 |
| | | | | | |
| ***Contributions*** **to Total Economy Labor Productivity:** | | | | | |
| **1) Capital Deepening (Total)** | **1.02** | **0.89** | **0.96** | **-0.13** | **0.07** |
| 1.1) *of which* ICT capital deepening | *0.23* | *0.34* | *0.24* | *0.11* | *-0.11* |
| 1.1.1)*Generated in ICT-Producing industries* | 0.07 | 0.05 | 0.05 | -0.02 | 0.00 |
| 1.1.2) *Generated in ICT-Using industries* | 0.12 | 0.21 | 0.10 | 0.09 | -0.11 |
| 1.1.3) *Generated in Non-ICT industries* | 0.04 | 0.08 | 0.09 | 0.05 | 0.00 |
| 1.2) *of which* Non-ICT capital deepening | *0.79* | *0.55* | *0.72* | *-0.25* | *0.17* |
| 1.2.1) *Generated in ICT-Producing industries* | 0.11 | 0.04 | 0.02 | -0.07 | -0.02 |
| 1.2.1) *Generated in ICT-Using industries* | 0.39 | 0.20 | 0.24 | -0.18 | 0.03 |
| 1.2.3) *Generated in Non-ICT industries* | 0.30 | 0.30 | 0.46 | 0.00 | 0.16 |
| **2) Total Factor Productivity Growth (Total)** | **0.34** | **0.47** | **0.13** | **0.13** | **-0.34** |
| 2.1) *Generated in ICT-Producing industries* | 0.07 | 0.27 | 0.21 | 0.21 | -0.06 |
| 2.2) *Generated in ICT-Using industries* | -0.04 | 0.37 | 0.14 | 0.40 | -0.23 |
| 2.3) *Generated in Non-ICT industries* | 0.31 | -0.17 | -0.22 | -0.48 | -0.05 |
| **3) Labor Quality Growth** | **0.27** | **0.13** | **0.23** | **-0.14** | **0.10** |
| **4) Hours Reallocation** | **0.67** | **0.56** | **0.11** | **-0.12** | **-0.44** |

Notes: All figures are average annual percentages. The contributions of inputs are growth rates multiplied by average input shares. TFP refers to Domar-weighted TFP. ICT-Producing industries defined according to GSO (2006). ICT-Using industries are Non-ICT-Producing industries whose ICT capital share exceeded the median in 1995.

**Table 2: Changes in Industry Contributions to Labor Productivity**

| | VA (%) | 1st Change < 0 | 2nd Change >= 0 | | VA (%) | 1st Change >= 0 | 2nd Change > =0 |
|---|---|---|---|---|---|---|---|
| Real Estate | 11.8 | -0.07 | 0.46 | Construction | 4.2 | 0.10 | 0.04 |
| Other Business Services | 8.6 | -0.29 | 0.16 | Sale/Repair Vehicles | 1.8 | 0.05 | 0.00 |
| Motor Vehicles | 3.2 | -0.14 | 0.31 | Sewage Refuse Disp. | 0.7 | 0.01 | 0.02 |
| Chemicals | 2.3 | -0.07 | 0.02 | Water Transport | 0.3 | 0.01 | 0.02 |
| Communications | 2.2 | -0.01 | 0.00 | Coke, Petroleum, | 0.2 | 0.05 | 0.01 |
| Auxiliaries Transport | 1.6 | -0.02 | 0.03 | | | | |
| Plastic & Rubber | 1.1 | -0.01 | 0.00 | | | | |
| Aux. Fin./ Insur. Intermed. | 0.7 | 0.00 | 0.04 | | | | |
| Radio, TV, Comm. Equip. | 0.6 | -0.01 | 0.04 | | | | |
| Textiles | 0.2 | -0.01 | 0.00 | | | | |
| Energy Mining & Quarrying | 0.1 | -0.06 | 0.02 | | | | |
| Leather | 0.1 | -0.01 | 0.00 | | | | |
| **Count** | **12** | | | **Count** | **5** | | |
| **Sum** | **32.6** | **-0.69** | **1.10** | **Sum** | **7.2** | **0.21** | **0.09** |

| | VA (%) | 1st Change < 0 | 2nd Change < 0 | | VA (%) | 1st Change >=0 | 2nd Change < 0 |
|---|---|---|---|---|---|---|---|
| Health & Social Work | 7.1 | -0.02 | -0.08 | Education | 4.5 | 0.00 | -0.10 |
| Pub. Adm., Def., Social Sec. | 6.1 | -0.10 | -0.04 | Wholesale Trade | 4.5 | 0.10 | -0.08 |
| Machinery | 3.4 | -0.09 | -0.02 | Retail Trade | 4.2 | 0.05 | -0.02 |
| Land Transport | 1.4 | -0.09 | -0.02 | Fin. Intermediation | 3.5 | 0.12 | -0.07 |
| Other Services | 1.4 | -0.03 | -0.02 | Fab. Metal Products | 2.0 | 0.05 | -0.04 |
| Basic Metals | 0.9 | -0.04 | -0.04 | Food & Tobacco | 2.0 | 0.03 | -0.07 |
| Insurance | 0.9 | -0.11 | -0.06 | Rental & Leas. Serv. | 1.9 | 0.02 | -0.05 |
| Organizations, n.e.c. | 0.8 | 0.00 | -0.01 | Rec., Cultural, Sports | 1.8 | 0.02 | -0.06 |
| Non-Metallic Min. Prod. | 0.7 | -0.03 | -0.01 | Electricity, Gas | 1.8 | 0.08 | -0.13 |
| Wood Products | 0.4 | -0.01 | -0.02 | Electr. Apparatus n.e.c. | 1.6 | 0.04 | -0.07 |
| Air Transport | 0.3 | -0.02 | -0.03 | Hotels & Restaurants | 1.6 | 0.02 | -0.02 |
| Mining/Quarry, ex. Energy | 0.1 | -0.01 | -0.01 | Computer Services | 1.5 | 0.04 | -0.05 |
| | | | | Ag., Forestry, Fishing | 1.2 | 0.02 | 0.00 |
| | | | | Publishing, Printing | 1.1 | 0.04 | -0.06 |
| | | | | Instruments | 0.9 | 0.03 | -0.04 |
| | | | | Furn. /Misc. Manuf. | 0.5 | 0.03 | -0.02 |
| | | | | Paper, Pulp | 0.5 | 0.02 | -0.01 |
| | | | | Other Transp. Equip. | 0.4 | 0.07 | -0.04 |
| | | | | R&D | 0.4 | 0.01 | -0.03 |
| | | | | Office Mach. & Comp. | 0.2 | 0.05 | -0.03 |
| | | | | Water Supply | 0.2 | 0.01 | 0.00 |
| | | | | Apparel | 0.1 | 0.00 | 0.00 |
| | | | | Recycling | 0.1 | 0.00 | 0.00 |
| **Count** | **12** | | | **Count** | **23** | | |
| **Sum** | **23.6** | **-0.56** | **-0.36** | **Sum** | **36.6** | **0.88** | **-1.00** |

Notes: VA is the value-added share of an industry in 2004. 1st Change is the difference of an industry ALP contribution between 1991–1995 and 1995–2000. 2nd Change is the 1995–2000 and 2000–2004 difference.

**Table 3: Labor Productivity Accelerations 1991-2004**

| | Dependent variable: Average Labor Productivity Growth (Value-Added) | | | | | |
|---|---|---|---|---|---|---|
| **Dummy_Post1995** | -0.23<br>(0.80) | -1.77**<br>(0.82) | -1.80**<br>(0.82) | | | |
| **Dummy_ICT1995** | | -0.83<br>(1.15) | -1.60<br>(1.10) | | | |
| **Post1995*ICT1995** | | 3.01*<br>(1.53) | 1.82<br>(1.41) | | | |
| **Dummy_Post2000** | | | | -1.30**<br>(0.64) | -1.47*<br>(0.84) | -1.47*<br>(0.84) |
| **Dummy_ICT2000** | | | | | 0.79<br>(1.36) | -0.63<br>(1.02) |
| **Post2000*ICT2000** | | | | | 0.34<br>(1.28) | -0.36<br>(1.35) |
| **Drop ICT-Producing Industries** | | | yes | | | yes |
| No. Obs | 663 | 663 | 598 | 663 | 663 | 598 |
| No. Industries | 51 | 51 | 46 | 51 | 51 | 46 |
| $R^2$ | 0.00 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 |

Notes: Robust standard errors allow for correlation within industries over time in parentheses. ***, **, * indicate 1 percent, 5 percent, 10 percent significance levels.

## Appendix

**Table A1: Value-Added Share and ALP, TFP Contributions by Industry**

| Industry | | VA share 2004 | ALP Contributions 1991-1995 | ALP Contributions 1995-2000 | ALP Contributions 2000-2004 | TFP Contributions 1991-1995 | TFP Contributions 1995-2000 | TFP Contributions 2000-2004 |
|---|---|---|---|---|---|---|---|---|
| **Communications** [a)] | S | 2.2 | 0.19 | 0.18 | 0.18 | 0.05 | 0.13 | 0.14 |
| **Computer & Related Services** [a)] | S | 1.5 | -0.01 | 0.03 | -0.02 | -0.03 | 0.00 | -0.05 |
| **Instruments** [a)] | M | 0.9 | 0.01 | 0.05 | 0.01 | 0.00 | 0.04 | 0.00 |
| **Radio, TV & Comm. Equipment** [a)] | M | 0.6 | 0.05 | 0.04 | 0.08 | 0.03 | 0.03 | 0.06 |
| **Office Machinery & Computers** [a)] | M | 0.2 | 0.04 | 0.09 | 0.06 | 0.02 | 0.09 | 0.06 |
| **Health, Social Work** [b)] | S | 7.1 | 0.18 | 0.17 | 0.09 | 0.14 | 0.11 | 0.04 |
| **Wholesale Trade** [b)] | S | 4.5 | 0.12 | 0.22 | 0.14 | 0.05 | 0.16 | 0.10 |
| **Retail Trade** [b)] | S | 4.2 | 0.00 | 0.05 | 0.03 | -0.05 | 0.02 | 0.01 |
| **Construction** [b)] | M | 4.2 | -0.10 | 0.00 | 0.04 | -0.13 | -0.01 | 0.03 |
| **Financial Intermediation** [b)] | S | 3.5 | 0.06 | 0.18 | 0.11 | 0.01 | 0.12 | 0.07 |
| **Machinery** [b)] | M | 3.4 | 0.15 | 0.06 | 0.04 | 0.08 | 0.04 | 0.00 |
| **Motor Vehicles** [d)] | M | 3.2 | 0.05 | -0.09 | 0.22 | 0.00 | -0.11 | 0.16 |
| **Rental. Leasing Services** [b)] | S | 1.9 | 0.03 | 0.05 | 0.00 | -0.05 | -0.02 | -0.07 |
| **Sale, Repair Motor Vehicles** [b)] | S | 1.8 | -0.04 | 0.01 | 0.01 | -0.06 | 0.00 | 0.00 |
| **Rec., Cultural, & Sports Activities** [b)] | S | 1.8 | -0.01 | 0.02 | -0.05 | -0.04 | 0.00 | -0.07 |
| **Electrical Apparatus n.e.c.** [b)] | M | 1.6 | 0.04 | 0.08 | 0.01 | 0.00 | 0.06 | 0.00 |
| **Other Services** [b)] | S | 1.4 | 0.02 | -0.01 | -0.03 | 0.00 | -0.02 | -0.04 |
| **Rubber, Plastic** [b)] | M | 1.1 | 0.03 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 |
| **Publishing, Printing** [b)] | M | 1.1 | 0.01 | 0.05 | -0.01 | -0.01 | 0.03 | -0.03 |
| **Insurance** [b)] | S | 0.9 | 0.04 | -0.08 | -0.14 | 0.02 | -0.09 | -0.15 |
| **Organizations, n.e.c**[b)] | S | 0.8 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.00 |
| **Aux. Fin. & Ins. Intermediation** [b)] | S | 0.7 | -0.01 | -0.02 | 0.03 | -0.02 | -0.02 | 0.03 |
| **Other Transport Equipment** [b)] | M | 0.4 | -0.01 | 0.05 | 0.02 | -0.02 | 0.05 | 0.01 |
| **Research & Development** [b)] | S | 0.4 | 0.01 | 0.02 | -0.01 | 0.01 | 0.02 | -0.01 |
| **Water Transport** [b)] | S | 0.3 | 0.02 | 0.03 | 0.05 | 0.01 | 0.02 | 0.04 |
| **Recycling** [b)] | M | 0.1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Real Estate** [c)] | S | 11.8 | 0.00 | -0.07 | 0.39 | 0.17 | -0.03 | 0.06 |
| **Other Business Services** [e)] | S | 8.6 | -0.09 | -0.39 | -0.22 | -0.09 | -0.45 | -0.25 |
| **Pub. Admin., Defense, Soc. Security** [c)] | S | 6.1 | 0.20 | 0.11 | 0.07 | 0.09 | 0.02 | -0.02 |
| **Education** [c)] | S | 4.5 | 0.01 | 0.02 | -0.09 | -0.01 | 0.00 | -0.10 |
| **Chemicals** [c)] | M | 2.3 | 0.18 | 0.11 | 0.13 | 0.13 | 0.07 | 0.11 |
| **Fabricated Metal Products** [c)] | M | 2.0 | 0.02 | 0.07 | 0.02 | -0.01 | 0.05 | 0.01 |
| **Food, Tobacco** [c)] | M | 2.0 | -0.02 | 0.01 | -0.06 | -0.06 | 0.02 | -0.06 |
| **Electricity, Gas** [c)] | M | 1.8 | 0.09 | 0.17 | 0.04 | 0.01 | 0.08 | 0.03 |
| **Auxiliary Transport Activities** [c)] | S | 1.6 | 0.05 | 0.03 | 0.06 | 0.03 | 0.02 | 0.02 |
| **Hotels, Restaurants** [c)] | S | 1.6 | -0.03 | -0.01 | -0.02 | -0.04 | -0.01 | -0.03 |
| **Land Transport** [c)] | S | 1.4 | 0.11 | 0.02 | 0.00 | 0.06 | -0.02 | -0.02 |
| **Agriculture, Forestry, Fishing** [c)] | A | 1.2 | 0.06 | 0.07 | 0.07 | 0.02 | 0.05 | 0.06 |
| **Basic Metals** [c)] | M | 0.9 | 0.09 | 0.04 | 0.01 | 0.06 | 0.04 | 0.00 |
| **Non-Metallic Mineral Products** [c)] | M | 0.7 | 0.06 | 0.02 | 0.01 | 0.04 | 0.01 | 0.01 |
| **Sewage & Refuse Disposal** [c)] | S | 0.7 | -0.03 | -0.03 | -0.01 | -0.07 | -0.07 | -0.02 |
| **Furniture & Misc. Manufacturing** [c)] | M | 0.5 | -0.01 | 0.02 | -0.01 | -0.03 | 0.01 | -0.01 |
| **Paper, Pulp** [c)] | M | 0.5 | 0.00 | 0.03 | 0.01 | -0.01 | 0.02 | 0.00 |
| **Wood Products** [c)] | M | 0.4 | 0.02 | 0.02 | 0.00 | 0.02 | 0.01 | 0.00 |
| **Air Transport** [c)] | S | 0.3 | 0.04 | 0.02 | -0.01 | 0.03 | 0.01 | -0.01 |
| **Textiles** [c)] | M | 0.2 | 0.02 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 |
| **Coke, Petroleum, Nuclear Fuels** [c)] | M | 0.2 | -0.06 | -0.02 | -0.01 | -0.07 | -0.02 | 0.00 |
| **Water Supply** [c)] | M | 0.2 | 0.01 | 0.01 | 0.01 | -0.01 | 0.00 | 0.00 |
| **Apparel** [c)] | M | 0.1 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| **Energy Mining & Quarrying** [c)] | M | 0.1 | 0.02 | 0.00 | -0.01 | 0.01 | 0.00 | -0.01 |
| **Mining & Quarrying, exc. Energy** [c)] | M | 0.1 | 0.04 | -0.02 | 0.00 | 0.02 | -0.02 | 0.00 |
| **Leather** [c)] | M | 0.1 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

a) ICT-Producing industry, b) ICT-Using industry in 1995 and 2000, c) Non-ICT-Intensive industry d) ICT-Using industry in 1995, e) ICT-Using Industry in 2000. M = Manufacturing industries, S = Services sectors.

Notes: Average annual percentages. ALP contributions are labor productivity growth rates multiplied by average value-added shares. Contributions of TFP are industry TFP growth rates multiplied by industry output share in aggregate value-added (Domar-weight). ICT-Using are Non-ICT-Producing industries whose ICT capital share exceeds the median. ICT-Producing industries are defined according to GSO (2006).

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