Sources of the German Productivity Demise*

Tracing the Effects of Industry-Level ICT Investment

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Version 2
October 10, 2006

Abstract

While the US experienced two successive productivity surges in 1995 and 2000, Germany's labor productivity declined dramatically during the same period. We examine the sources of Germany's productivity demise using the *ifo productivity database* that provides detailed industry-level investment information. While much attention has focused on the reduction in German labor hours, our data show that Information, Communication and Technology (ICT) investment in Germany was deeply lacking in the mid 1990's as compared to the US. The transition to the new economy mitigated the German productivity slowdown, but did not reverse it. After 2000, we find that German Non-ICT investment surged, but TFP contributions collapsed as more than half of the industries, accounting for almost 50 percent of German output, experienced negative TFP growth. This second major difference between the US and German industry performance explains Germany's continued departure from the technological frontier.

JEL Classification: O14, O47, L60, L80

Keywords: Growth accounting, Industry productivity analysis, Information and Communication Technology

* We thank Elke Kronjäger for sharing ifo industry-level asset-specific investment data, Thomas Fuchs and Andreas Kuhlmann for valuable discussions that led to the development of the *ifo productivity database*, Paul Schreyer for insightful comments on an earlier draft and the German Science Foundation grant #524685 for financial support.

1. Introduction

Labor productivity growth in the US increased remarkably after 1995 and accelerated again after 2000. Stiroh (2006) highlights these dual productivity surges which have been extensively analyzed in Jorgenson, Ho, Samuels and Stiroh (2006). In sharp contrast, we show that German labor productivity growth experienced two successive productivity *decelerations in* the same time periods. Figure 1a plots labor productivity growth from 1991 to 2004 and highlights how US productivity growth outpaced Germany's. While average labor productivity (ALP) growth slowed from 2.4 percent to 2.0 percent in Germany after 1995, it surged from 1.5 percent to 2.5 percent in the US. The productivity gap widened further when US productivity growth rose again by 0.8 percent after 2000, whereas Germany's dropped another 0.7 percent. The divergence is not an artifact of the choice of trend breaks. Figure 1b plots the US and German productivity trends to document the secular divergence. Not only is Germany's absolute decline worrisome, but its decline relative to the US also signals its departure from the technology frontier.

In this paper we analyze the sources of Germany's productivity demise using a new dataset that allows industry-level comparisons with the US. The novelty of the *ifo productivity database* is its detailed information on 12 investment assets for 52 German industries, a level of detail not provided by official German statistics. The *ifo productivity database* is derived from the *ifo investment survey* which has been proven to be a highly accurate assessment of German capital stocks over the past quarter century (for details, see Roehn et al, 2006).[1] It allows for the first analysis of productivity and Information, Communication and Technology (ICT) contributions to aggregate German productivity at the 52-industries level.

A broad consensus attributes the first productivity surge in the US to ICT investment, much of it originating in ICT-Intensive industries.[2] US productivity growth was positively affected by ICT capital deepening, technological advancements in ICT-Producing industries, and productivity gains in ICT-Using industries; we investigate whether these dynamics can also be observed in German industries. To date, the evidence on the industry-level sources of Germany's productivity decline is scarce, especially for the post 2000 slowdown. As Figure 1a suggests, however, this second productivity decline was even more pronounced than first. Therefore we pay special attention to the sources of both productivity slowdowns and dissect the German productivity demise into its proximate causes. We also identify the specific industries that

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[1] 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. The ifo investment survey 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*.

presented the largest drag on German productivity and those whose performance mitigated the aggregate productivity slowdowns.

Our results show that while the first productivity surge in the US was driven by ICT, the post 1995 productivity decline in Germany was driven by a collapse in both the Non-ICT capital deepening and the Non-ICT industries' total factor productivity (TFP) growth. German ICT-Intensive industries' ICT investment and TFP surged 1995-2000, but not to the extent observed in the US. ICT capital deepening in Germany was only one third of the level reached in the US. Therefore, the emergent German information sector was not sufficiently strong to offset productivity losses in other industries.

The second productivity surge in the US after 2000 was not solely driven by ICT. Instead, ICT capital deepening and ICT-Producing industries' TFP growth declined and TFP growth in Non-ICT-Producing industries became the primary driving force.[3] The same decline in ICT capital deepening and TFP growth can be observed in Germany after 2000. However, the decisive difference between the US and Germany's productivity performance was that productivity in Non-ICT-Producing industries did not pick up, but instead collapsed in Germany. 28 out of 52 industries accounting for almost 50 percent of aggregate value added experienced negative TFP growth post 2000.

The remarkable impact of ICT investment on growth and productivity in the US has spurred interest in uncovering the effects of ICT across countries. Colecchia and Schreyer (2002) collect ICT investment data from national sources for nine OECD countries to find that their ICT investment contribution to growth was considerably smaller than in the US. Focusing on the European slowdown in the mid nineties, Timmer, Ypma and van Ark (2003) emphasize that slower ICT capital deepening and TFP growth in ICT-Producing industries were only one part of the story. Declining rates of Non-ICT capital deepening and flat TFP growth in most other industries were equally important in explaining the diverging productivity trends between the U.S and Europe. Several studies use industry-level data to suggest that most of the difference in ALP growth between the US and Europe, Canada, Japan, and Germany can be traced back to a few ICT-intensive service industries, especially trade and finance.[4] These industries are also thought to be largely responsible for the higher rates of ICT capital deepening and TFP growth outside ICT production in the US (see, Inklaar, O'Mahony and Timmer, 2005).

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[2] Jorgenson and Stiroh (2000), Oliner and Sichel (2000), Stiroh (2002), Jorgenson, Ho and Stiroh (2005a).
[3] See Stiroh and Botsch (2006), Jorgenson, Ho and Stiroh (2006), van Ark and Inklaar (2005) and Jorgenson, Ho, Samuels and Stiroh (2006).
[4] See van Ark, Inklaar and McGuckin (2003a, b) and van Ark, and Inklaar (2003).

Our data shows that only six German industries, with 12 percent of total value added, saw labor productivity increases post 1995 and post 2000. The largest rise occurred in Wholesale Trade and Construction. More than twice as many industries (13 industries), with almost twice the share in total value added (21 percent), experienced successive declines, however, featuring prominently Machinery and the Chemicals manufacturing. Most remarkable, however, is our finding that the number of industries that contribute negatively to German labor productivity has been increasing over time. Between 1991 and 1995, fourteen industries contributed negatively; after 2000, however, over 40 percent of German industries (21 of the 52 industries) constituted a drag on the nation's aggregate labor productivity.

2. Data

To base our analysis on consistent data, we focus exclusively on Unified Germany (post 1990). For our industry-level analysis, we collect data on value added, investment, capital stocks and services, and quality adjusted labor hours for 52 German industries and 12 different assets from 1991 to 2003. For a detailed description of the data we refer the interested reader to Tables A1 and A2 in Roehn et al. (2006). The 52 industries span the entire German economy (with the exception of household services which constituted only a 0.3 percent value added share in 2004). The German Statistical Office (DeStatis) provides value added, labor hours, and labor compensation by industry.[5] Estimates of labor quality growth are taken from the Groningen Growth Accounting Database (Inklaar, O'Mahony and Timmer, 2005).[6]

The *ifo productivity database* is our source for capital data. It provides industry-level time series on 13 different investments, capital stocks and capital services for West Germany for the period 1970-1990 in the older WZ79 classification of DeStatis. From 1991 to 2003 the *ifo productivity database* provides 12 different investments, capital stocks and capital services for Unified Germany at the two digit industry-level NACE classification using the ownership concept. The *ifo productivity 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

[5] DeStatis provides labor hours for 14 broad industries only; to obtain estimates for our set of industries, we multiplied the DeStatis hours/worker ratios by workers in each sub-sector.
[6] Inklaar et al. (2005) provide labor quality until 2000. We use 1980-2000 data to extrapolate labor quality to 2003 using an AR process with optimal lag length (using the AIC, Final Prediction Error, Hannan-Quinn and Schwarz criterion) for each industry to match the post 2000 aggregate labor quality growth provided by Schwerdt and Turunen (2006).

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.

To deflate ICT assets into constant-quality units, the *ifo productivity database* employs the deflators for computer and office equipment, communication equipment and software developed by Timmer, Ypma and van Ark (2003) and Schreyer (2002). These deflators are based on US hedonic price indices and are adjusted for differences in general inflation levels between Germany and the US. For other assets the DeStatis deflators are applied. We obtain measures for ICT and Non-ICT capital services by using Tornqvist aggregation with user costs of capital as flexible weights.

The *ifo productivity 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.[7] 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.

Subsequent papers that examine the effects of ICT-Intensive industries in the EU or other countries customarily adopt US definitions (e.g. van Ark, Inklaar, McGuckin, 2003a, b, O'Mahony and van Ark, 2003). That is, if an industry is ICT-Using by US standards, it is also assumed to be ICT-Using in the comparison country. This does not take into account that the same industries in other countries may have very different ICT intensities. In addition, exact correspondences between US and other nations' industry classifications may not exist. The *ifo productivity database* contains unique ICT investment and capital stock data that allows us to develop an ICT industry classification scheme which uses the definitions introduced by the previous literature, but employs German data to draw distinctions. Therefore, we provide the first German industry-based categorization of industries into ICT-Intensive and Non-ICT-Intensive. We use Stiroh's (2002, 2006) definition for ICT-Intensive industries (those whose ICT shares exceed the median). To separate ICT-Producing industries from ICT-Intensive industries, we adopt the DeStatis (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).[8]

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[7] See, for example, Stiroh (2002, 2006), Jorgenson, Ho, Stiroh (2005b), Bailey and Lawrence (2001), and Triplett and Bosworth (2004).
[8] 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 productivity database* and the *Groningen Industry Growth Accounting Database* are fourfold. First, Groningen reports 26 industries, while the *ifo productivity database* contains 52 industries. Second, ICT assets are said to include computers and peripherals, software and communication equipment. The *ifo productivity database* includes 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 DeStatis.

Finally, and perhaps most importantly, since German software investments are not reported by DeStatis, 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 productivity database* obtains data on software investment shares in total intangible assets, and industry-level software investment from on studies and surveys conducted by the *ifo investment survey* as detailed in Herrmann and Mueller (1997).[9]

3. Deriving Industry Contributions to Labor Productivity Growth

3.1 Methodology

As outlined in the introduction, the German productivity demise exists not only in absolute terms as labor productivity has been declining secularly over the past decade, but also in relative terms as productivity has been falling even further behind the industry-leading US. In order to uncover the sources of Germany's aggregate productivity demise, we seek to trace the aggregate origins to differences in US-German industry-level labor productivity. In this section we outline a methodology that "preserves the underlying industry detail yet maintains conclusions consistent with the aggregate results without arbitrary and inappropriate aggregation assumptions" (Jorgenson, Ho, Samuels and Stiroh, 2006: p.1).

To quantify the industry contributions to aggregate productivity, we apply the *aggregation over industries* method developed by Jorgenson, Gallop and Fraumeni (1987).[10] Industry-level gross output growth can be decomposed into input and TFP contributions according to

[9] For specific differences in asset types and asset classes, see Roehn et al. (2006).

[10] 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).

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

where Y_i, K_i^{IT}, K_i^{NON}, L_i and X_i are gross output, ICT capital services, Non-ICT capital services, and intermediate inputs in industry *i*, respectively. The $\bar{v}$'s are the two period-average nominal input shares. To relate industry gross output to value added we rewrite equation (1)

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

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 the 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 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 sum of industry hours. 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.[11] 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

[11] 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.

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

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 begin our analysis with the standard decomposition of APL growth into five main contributions from 1) ICT capital deepening, 2) Non-ICT deepening, 3) labor quality growth, 4) TFP growth, and 5) the reallocation of hours. This decomposition follows the "bottom-up" approach outlined in the previous section (equation 6). Table 1 displays the results for the three sample periods (1991-1995, 1995-2000, 2000-2003) as well as the differences in contributions between the two break points (1995, 2000).[12]

The first three rows decompose labor productivity growth into value added growth and labor hour growth. The decomposition highlights the strong, negative drag on German growth from the secular decline in hours worked. The main culprits are German unification, systemic high unemployment, reductions in work weeks, and earnings inequality (see Bell and Freeman, 2001). Annual output growth rates for the total economy could have been about one percent higher, had working hours not dropped so dramatically. The phenomenon is well known and documented as a key factor that has been driving a wedge between US and German output growth (see, for example, Blanchard 2004).

The following rows of Table 1 dissect labor productivity into the contributions from capital deepening, TFP growth, labor quality, and hours reallocation. Capital deepening contributes by far the greatest share to German average labor productivity in all periods, highlighting the crucial role of investment for labor productivity. The decomposition of capital deepening into ICT and Non-ICT capital deepening provides further information. The gap between the ICT and Non-ICT capital contributions narrowed substantially in 1995-2000. ICT capital deepening contributed about 20 percent to total economy capital deepening in each period, except between 1995 and 2000 when its contribution doubled to almost 40 percent. It is interesting to see that ICT-Using industries were the driving force behind the capital dynamics between 1991-1995 and 1995-2000, when ICT-capital deepening surged and Non-ICT capital deepening declined. Jorgenson, Ho and Stiroh (2005a) point out that the substitution from Non-ICT capital to ICT capital was simply reacted to a sharp declines in ICT prices during that

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

period. In Germany, however, the surge in ICT investment could not offset the sharp decline in Non-ICT capital investment leading to an overall decline in capital deepening.

Nevertheless, one might easily conclude that the increases in ICT capital deepening represent evidence of healthy ICT investment levels in Germany that facilitated the structural transformation towards the information economy. Comparisons with US ICT investment reveal, however, a remarkable German deficit. Jorgenson, Ho, Samuels and Stiroh (2006, Table3) report only slightly higher labor productivity growth in the US as compared to Germany during 1995-2000 (2.13 percent compared to Germany's 2.04 percent) and even lower Non-ICT capital deepening contributions (0.41 percent vs. 0.55 in Germany). However, US ICT capital deepening significantly outpaced ICT capital deepening in Germany, being *three times* higher in the US than in Germany.

The increase in German ICT capital deepening was accompanied by a surge in ICT-Intensive industries' TFP growth. Almost one third of all German labor productivity growth from 1995 to 2000 is attributable to efficiency improvements in ICT-Intensive industries. In particular, the contribution from ICT-Producing industries' TFP to labor productivity quadrupled after 1995. This observation is especially striking given the small size of this sector (about 5 percent of aggregate value added) and suggests extraordinary efficiency gains from ICT production in Germany. At the same time, however, TFP contributions from Non-ICT industries collapsed post 1995, resulting in a negative contribution from this set of industries.

Nevertheless, the positive impact of ICT capital deepening and ICT-Intensive industries' TFP contributions prevented a steeper decline in German labor productivity growth than the observed -0.27 percent reduction from 1991-1995 to 1995-2000. At the same time, however, productivity increased in the US. Not only was German ICT capital deepening significantly lower than in the US, but the decline in Non-ICT capital deepening and the collapse in Non-ICT industries' productivity were also accompanied by reductions in the contributions of labor quality and reallocations of hours.

The second labor productivity slowdown post 2000 was driven by different, if not opposing, factors. Table 1 shows that German ICT capital deepening and ICT-Producing industries' TFP growth declined by about 25 percent. Most important was, however, the change in productivity growth of Non-ICT-Producing industries. TFP contributions from ICT-Using industries weakened significantly, and the contributions of Non-ICT industries to APL continued to decline even further to -0.31. For the economy as a whole, this lead to a dramatic collapse in TFP contributions from 0.47 percent in 1995-2000 to -0.01 percent in 2000-2003.

In the US, the 1995-2000 surge in ICT investment was followed by a surge in the contribution of Non-ICT production TFP to productivity. Van Ark and Inklaar (2005), for example, report contributions of Non-ICT-Production TFP of 1.4 percent (a sharp 1 percentage point acceleration compared to the 1995-2000 level). One possible explanation may be that this represented the diffusion of ICT investment to the rest of the US economy. In sharp contrast, German Non-ICT-Producing industry TFP growth declined so dramatically that it registered a negative contribution to labor productivity post 2000. It was a broad resurgence of Non-ICT capital deepening that mitigated the second German productivity reduction. This resurgence was largely carried by increased contributions from ICT-Using and especially Non-ICT industries.

In summary, a key source of the first productivity decline was insufficient ICT capital deepening relative to the US levels. German ICT capital deepening was insufficient to offset the decline in Non-ICT capital deepening which was associated with a sharp drop in Non-ICT industries' TFP growth. The origin of the second reduction in German labor productivity was the insufficient diffusion of ICT investment to Non-ICT-Producing industries. The dramatic decline in German TFP growth raises serious questions about a departure from the technology frontier. In the next section we take a closer look at the productivity contributions of each of the 52 industries and present head to head industry comparisons with the US.

4. The Evolution of ICT Industries in Germany and the US

4.1 German Labor Productivity Contributions by Industry

In this section we identify the exact 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.[13] Industries with positive slopes contribute to labor productivity and those along the negatively sloped part of the curve generated a drag on productivity growth. How important a given industry's contribution (or drag) is depends on the horizontal distance between points.

Figures 2a-c highlight the heterogeneity of labor productivity contributions across industries and time. Surprising is the large and increasing numbers of industries that contributed negatively to German labor productivity. For example, from 1991-1995, fourteen industries contributed negatively, but by 2000-2003 over 40 percent of German industries (21 of the 52) reduced the nations overall labor productivity. Even more striking is the large share of total value added comprised by firms that had negative labor productivity growth. Industries that constituted

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

between 40 percent (1991-1995) and 25 percent (1995-2000) to German value added output contributed negatively to productivity growth. Only half (26 of the 52) industries contributed consistently positively to German labor productivity from 1991 to 2003.

Top contributors to total industry labor productivity growth in all periods are the Communications and Wholesale Trade industries, whereas Other Business Services exerted a strong drag on German labor productivity growth throughout. Notable are also the performances of the Office Machinery & Computers industry as well as Financial Intermediation, which made strong contributions in the second period, but declined post 2000. In contrast, Real Estate and Motor Vehicles were among the weakest performers during 1995-2000 but posted strong productivity gains after 2000. In particular, the Real Estate sector made by far the largest contribution during the last period, adding 0.51 percent to APL growth.

Instead of examining the *within* period contributions of industries, we are, of course, especially interested in uncovering the drivers of the two-stage German productivity demise. Therefore, 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 three industries with value added shares greater than one percent saw consecutive increases in their contributions to labor productivity (Construction, Vehicle Sales and Repair, and Wholesale Trade). In contrast, the number of industries with secularly declining contributions to labor productivity is large: thirteen industries with a cumulative share of German value added of over 20 percent are lead by Public Administration, Machinery, and Chemicals.

Just about half of the industries (24 out of 52) contributed negatively to labor productivity during the first slowdown. Even more worrisome, the second slowdown was driven by an even larger number of 35 declining industries. Table 2 tallies the performance across periods and shows that the majority of industries, however, (33 out of 52, constituting 67 percent of value added) experienced a reversal of their productivity fortunes between 1991 and 2003. Real Estate, Other Business Services and Motor Vehicles drove much of the slowdown post 1995, but all three industries reversed their performances and contributed strongly to productivity post 2000. Note however, 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. In contrast, Financial Intermediation and Retail Trade were among the largest positive contributors post 1995, who then had strongly negative contributions to labor productivity post 2000. Real Estate and Other Business Services are classified as Non-ICT-Using industries, whereas Financial Intermediation and Retail Trade are ICT-Using. This helps us pinpoint the industries that are largely responsible for the underlying dynamics of the first and second productivity declines.

We can now utilize the data in Stiroh (2006) to highlight the source of the diverging labor productivity experience with head to head US/German industry comparisons.[14] Figures 3a,b display industry contributions to the two labor productivity slowdowns (surges) in Germany (US). It is immediately apparent from Figure 3a that most of the US/German differences between the first two periods can be traced to a few ICT-Intensive industries. Computer & Electronics Equipment, Wholesale Trade, and Retail Trade made positive contributions in both countries, but the gains were two to three times greater in the US. Further, Finance & Insurance contributed substantially to the first productivity surge in the US while its contribution in Germany was close to zero. Most striking is the divergence in the Other Business Services, which was a major contributor of the productivity surge in the US while it exerted the largest drag on German productivity growth. It is surprising that key industries which have traditionally been beacons of German productivity – Machinery and Motor Vehicles – also contributed significantly to the productivity slowdown while they added to the productivity surge in the US.

Turning to the industry origins of the diverging productivity trends post 2000 in Figure 3b, we make two important observations. First, a completely different set of industries explains the widening productivity gap. For example, we find the largest differences in US German productivity arise in Computer Services, Telecommunication, Utilities, and Food & Tobacco. Note that all of these industries had actually mitigated the productivity divergence in US and German productivity post 1995. Second, a larger number of German industries is responsible for the prolonged divergence in US versus German productivity. During the first productivity divergence post 1995, 22 industries contributed to the divergence while this number increased to 27 industries post 2000. This constitutes a worrisome implication: the post 2000 productivity (decline) surge in the US (Germany) is driven by larger group of industries than the first divergence in the late 1990s.

Our US-German 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, an not only from Germany. Novel are our results that the origins of this divergence changed dramatically post 2000.

[14] US and German industry classifications differ, requiring us to merge 51 German and 60 US industries into 37 industries that represent a consistent harmonization. The German Public Administration, Defense and Social

4.2 German TFP Contributions by Industry

Figures 2d-f plots the modified Harberger (1998) diagram for the individual industry TFP growth contributions for the three periods 1991-1995, 1995-2000 and 2000-2003. 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 heterogeneity of TFP growth contributions among industries is striking. The curves are surprisingly steep indicating a bifurcated economy with either strong productivity gains or sharp productivity losses. Most importantly, the share of industries that contribute negatively over time is increasing dramatically. This is especially apparent if we compare the 1995-2000 and 2000-2003 periods in Figures 2e,f. In 1995-2000, 17 industries experienced negative TFP growth rates, featuring large contractions in Other Business Services, Motor Vehicles and the Insurance industry. In 2000-2003, in contrast, 28 industries accounting for almost 50 percent of aggregate value added showed negative TFP growth.

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 between the two periods. The same is true for Office Machinery & Computers and Communications (both ICT-Producing). Of these industries only Wholesale Trade managed to increase its TFP growth contribution further post 2000 when TFP growth in Communication and Office Machinery & Computer slowed, and Financial Intermediation TFP turned negative. Contributions from the Insurance, Machinery and the Government sector steadily declined over the three periods, pointing to severe problems within these industries. These industries started with positive TFP growth but showed negative TFP growth post 2000.[15]

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.

Security sector is excluded since US data focuses on the private sector. The periods under consideration differ slightly: Stiroh's first period begins 1988 and his last period ends 2004.

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

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

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.[16]

The interpretation of the coefficients in equation (7) is that β 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 γ, and δ 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 0.4 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 2 percent deceleration of their labor productivity growth, while ICT-Intensive industries experienced a statistically significant 3.1 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 (1.9 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 (2.3 percent). However, ICT-Intensive industries did

[16] 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 0.3 percent of German value added. It reports labor productivity swings of over 100 percent.

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 (0.5 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 has experienced two surges in the United States, one around 1995 and the other post 2000. In contrast, Germany experienced two successive productivity reductions in the same time periods. This paper employs industry-level data from the *ifo productivity database* to analyze the sources of Germany's productivity demise. We compare our results to the US performance to identify the drivers of Germany's departure from the technology frontier.

The disaggregation to the 52 industry-level allows us to identify clear but distinct sources of the two German productivity declines. The post 1995 slowdown was characterized by a surge in productivity gains in the ICT-Intensive industries, especially in the ICT-Producing industries. The origin of this productivity surge was the substitution of investment from Non-ICT-capital to ICT-capital. Compared to the US, however, German productivity gains in these ICT-Intensive industries were small (particularly Trade, Finance and ICT-manufacturing). Our estimates identify that the source of the weak productivity gains rests in the lackluster performance of German ICT-Using industries. Ultimately the productivity gains in ICT-Intensive industries were too small to offset large productivity reductions in Non-ICT industries.

The sources of the second productivity slowdown were different. The positive impact of ICT-Intensive industries vanished after 2000, as these industries' ICT capital deepening and TFP growth decelerated significantly. Non-ICT productivity never recovered, however. We can only surmise that ICT diffusion was significantly smaller in Germany than in the US. The resurgence of Non-ICT capital deepening was too small to prevent a second aggregate productivity decline.

Comparing the sources of the second productivity decline in Germany post 2000 to the first post 1995, we make two especially worrisome observations. First, the number of industries experiencing negative TFP growth increased dramatically after 2000. 28 out of 52 industries accounting for almost 50 percent of aggregate value added showed negative total factor productivity growth. Second, a larger number of German industries was responsible for the prolonged divergence in US versus German productivity. During the first productivity divergence post 1995, 22 industries contributed to the divergence while this number increased to 27 industries post 2000.

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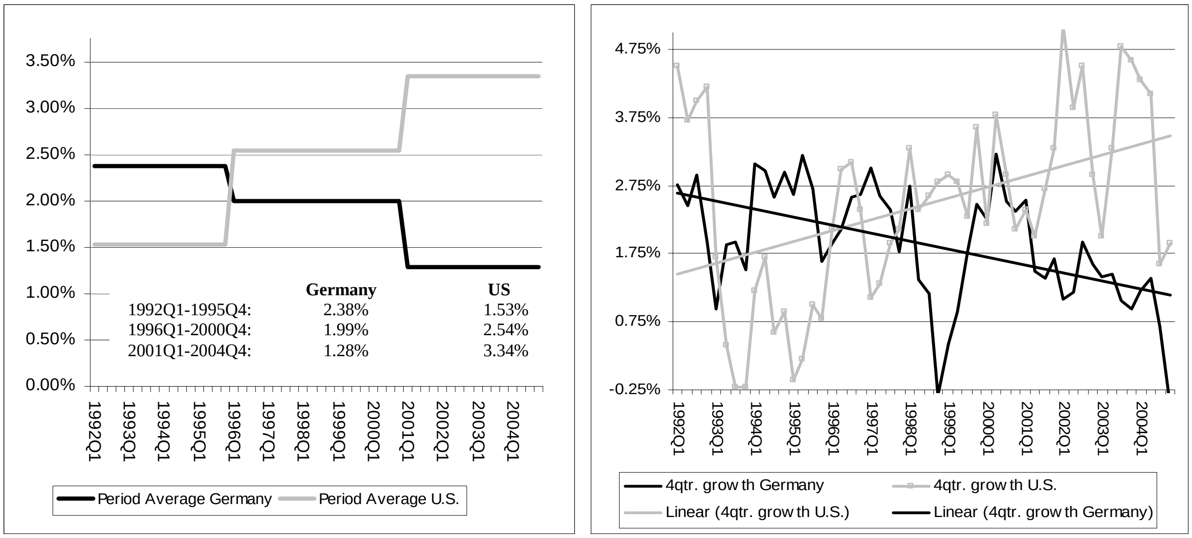
Figure 1: Labor Productivity Growth: U.S vs. Germany

a) Period average labor productivity growth **b) 4-quarter labor productivity growth**



Sources: US is Nonfarm Business Sector (US Bureau of Labor Statistics), Germany: Total Economy (DeStatis).

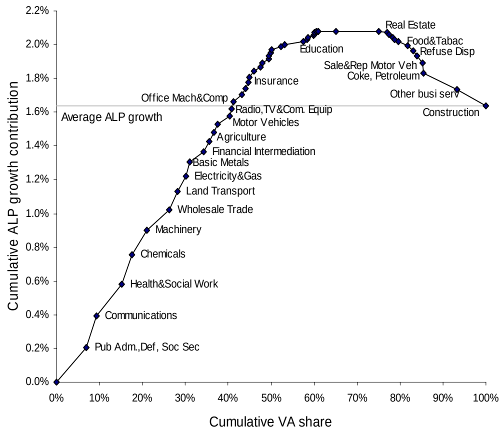
Table 1: Sources of German Labor Productivity Growth, Germany 1991-2003

	1991-1995	1995-2000	2000-2003	1995-2000 Less 1991-1995	2000-2003 Less 1995-2000
Total Economy Labor Productivity Growth	**2.31**	**2.04**	**1.57**	**-0.27**	**-0.47**
Aggregate Value Added Growth	1.38	2.01	0.43	0.63	-1.58
Aggregate Hours Growth	-0.93	-0.03	-1.14	0.90	-1.11
Contributions **to Total Economy Labor Productivity:**					
1) Capital Deepening (Total)	**1.02**	**0.88**	**1.14**	**-0.14**	**0.26**
1.1) *of which* ICT capital deepening	*0.23*	*0.33*	*0.29*	*0.10*	*-0.04*
1.1.1)*Generated in ICT-Producing industries*	0.07	0.05	0.06	-0.02	0.01
1.1.2) *Generated in ICT-Using industries*	0.12	0.21	0.13	0.09	-0.08
1.1.3) *Generated in Non-ICT industries*	0.04	0.07	0.10	0.03	0.03
1.2) *of which* Non-ICT capital deepening	*0.79*	*0.55*	*0.85*	*-0.24*	*0.30*
1.2.1) *Generated in ICT-Producing industries*	0.10	0.04	0.03	-0.06	-0.01
1.2.1) *Generated in ICT-Using industries*	0.39	0.20	0.27	-0.19	0.07
1.2.3) *Generated in Non-ICT industries*	0.30	0.31	0.55	0.01	0.24
2) Total Factor Productivity Growth (Total)	**0.35**	**0.47**	**-0.01**	**0.12**	**-0.48**
2.1) *Generated in ICT-Production industries*	0.07	0.27	0.17	0.20	-0.10
2.2) *Generated in ICT-Using industries*	-0.03	0.37	0.13	0.40	-0.24
2.3) *Generated in Non-ICT industries*	0.31	-0.17	-0.31	-0.48	-0.14
3) Labor Quality Growth	**0.27**	**0.13**	**0.23**	**-0.14**	**0.10**
4) Hours Reallocation	**0.67**	**0.56**	**0.21**	**-0.11**	**-0.35**

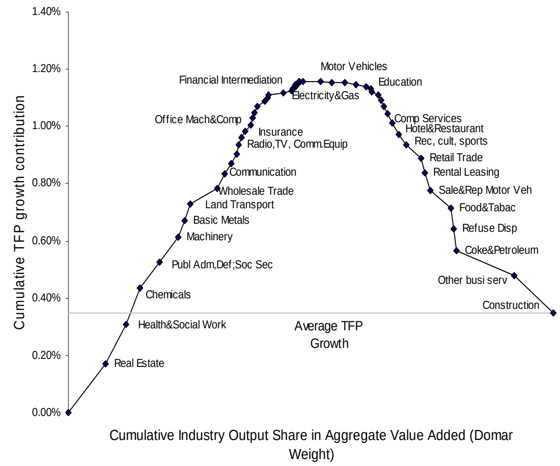
Notes: All figures are average annual percentages. The contributions of inputs are growth rates multiplied by average input shares. TFP refers to Domar-weighted TFP. ICT-Producing industries defined according to DeStatis (2006). ICT-Using industries are Non-ICT Producing industries whose ICT capital share exceeded the median in 1995. Data source: *ifo productivity database*, Roehn et al. (2006), and authors' calculations.

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

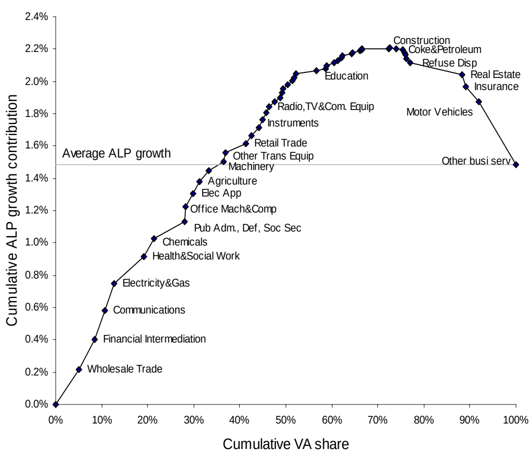
a) ALP, 1991-1995



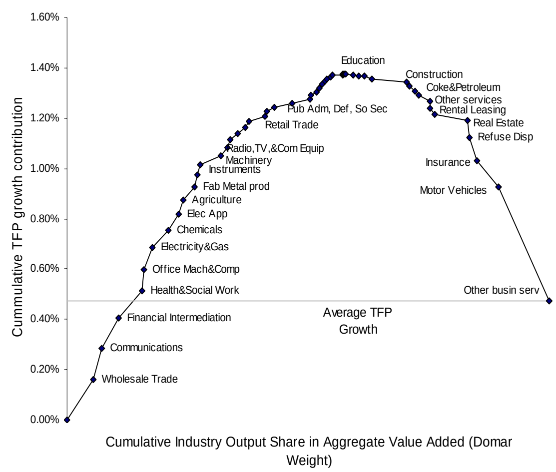
d) TFP, 1991-1995



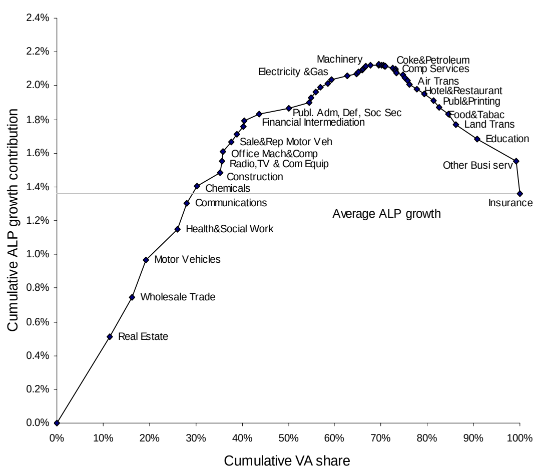
b) ALP, 1995-2000



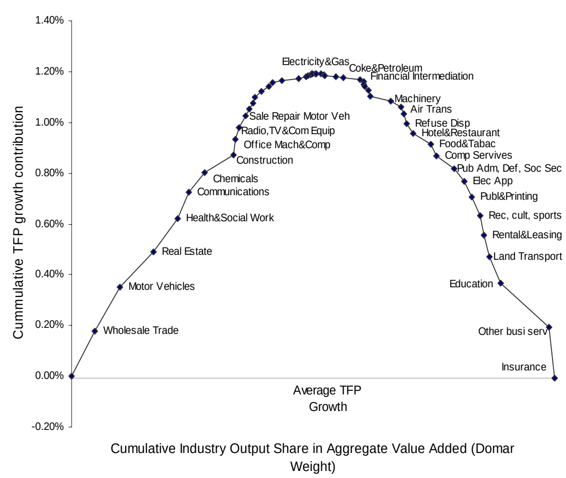
e) TFP, 1995-2000



c) ALP, 2000-2003



f) TFP, 2000-2003



Data source: DeStatis, *ifo productivity database*, Roehn et al. (2006), and authors' calculations.

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	11.87	-0.07	0.58	Wholesale Trade	4.83	0.10	0.01
Other Business Services	8.73	-0.29	0.26	Construction	4.46	0.10	0.08
Health&Social Work	7.19	-0.02	0.01	Sale/Repair vehicles	1.85	0.05	0.05
Motor Vehicles	3.21	-0.14	0.32	SewageRefuse Disp.	0.64	0.01	0.01
Auxiliaries Transport	1.51	-0.02	0.01	Coke, Petroleum,	0.28	0.04	0.01
Plastic&Rubber	1.08	-0.01	0.01	Water Transport	0.23	0.01	0.01
Aux. Fin/Insur. Interm	0.53	0.00	0.01				
Radio, TV, Comm Equip.	0.52	-0.01	0.03				
Textiles	0.26	-0.01	0.00				
Energy Mining & Quarring	0.09	-0.06	0.01				
Leather	0.06	-0.01	0.00				
Count	**11**			**Count**	**6**		
Sum	**35.03**	**-0.63**	**1.25**	**Sum**	**12.28**	**0.31**	**0.16**
	VA (%)	**1st Change < 0**	**2nd Change < 0**		**VA (%)**	**1st Change > 0**	**2nd Change < 0**
Pub. Adm., Def, Social Sec	6.21	-0.10	-0.07	Education	4.58	0.00	-0.10
Machinery	3.33	-0.09	-0.04	Retail Trade	4.22	0.05	-0.02
Chemicals	2.27	-0.07	-0.01	Fin, Intermediation	3.34	0.12	-0.15
Communications	2.09	-0.01	-0.02	Fab. Metal Products	1.99	0.05	-0.05
Land Transport	1.54	-0.09	-0.08	Food & Tabacco	1.96	0.03	-0.05
Other services	1.41	-0.03	-0.00	Rec., cultural, sports	1.93	0.02	-0.06
Basic Metals	0.89	-0.04	-0.02	Rental & Leas. Serv.	1.82	0.02	-0.05
Organizations, nec	0.86	0.00	-0.01	Electricity, Gas	1.63	0.08	-0.14
Insurance	0.73	-0.11	-0.11	Hotels & Restaurants	1.59	0.02	-0.03
Non-Metallic Min. Prod.	0.72	-0.03	0.00	Computer services.	1.58	0.04	-0.04
Wood products	0.36	-0.01	-0.01	Electr. Apparatus nec	1.56	0.04	-0.11
Air Transport	0.28	-0.02	-0.04	Ag, Forestry, Fish	1.12	0.02	-0.03
Mining/Quarring, ex. Energy	0.12	-0.01	-0.02	Publishing, Printing	1.08	0.04	-0.09
				Instruments	0.90	0.03	-0.04
				Furn./misc. manuf.	0.55	0.03	-0.02
				Paper, Pulp	0.53	0.02	-0.03
				Oth Transp. Equip.	0.49	0.07	-0.02
				R&D	0.38	0.01	-0.04
				Water supply	0.29	0.01	0.00
				Office Mach&Comp.	0.18	0.05	-0.03
				Apparel	0.14	0.00	0.00
				Recycling	0.05	0.00	0.00
Count	**13**			**Count**	**22**		
Sum	**20.79**	**-0.62**	**-0.43**	**Sum**	**31.89**	**0.79**	**-1.10**

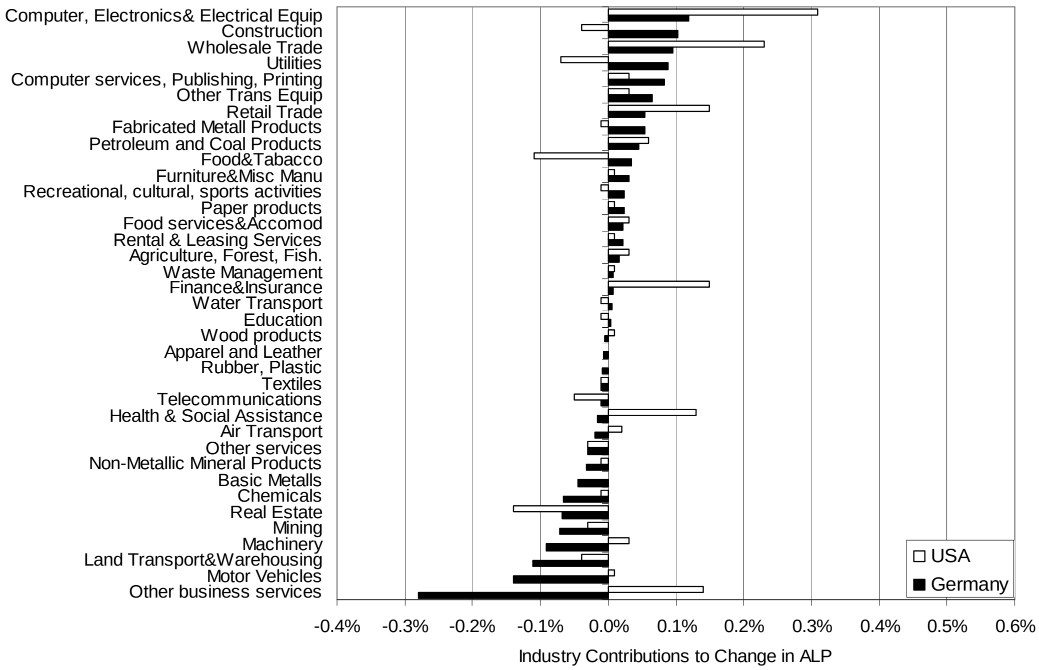
Notes : VA is the value added share of an industry in 2003. 1st Change is the difference of an industry ALP contribution between 1991-1995 and 1995-2000. 2nd Change is the 1995-2000 and 2000-2003 difference. Source: DeStatis, *ifo productivity database*, Roehn et al. (2006).

Table 3: Labor Productivity Accelerations 1991-2003

	Dependent variable: Average Labor Productivity Growth (value added)					
Dummy_Post1995	-0.39 (0.84)	-1.97** (0.89)	-1.97** (0.89)			
Dummy_ICT1995		-0.83 (1.15)	-1.60 (1.10)			
Post1995*ICT1995		3.09* (1.62)	1.89 (1.52)			
Dummy_Post2000				-1.99*** (0.74)	-2.26** (0.94)	-2.26** (0.94)
Dummy_ICT2000					0.79 (1.36)	-0.63 (1.02)
Post2000*ICT2000					0.53 (1.47)	-0.22 (1.59)
Drop ICT-Producing Industries			yes			yes
No. Obs	612	612	552	612	612	552
No. Industries	51	51	46	51	51	46
R2	0.00	0.01	0.01	0.01	0.01	0.01

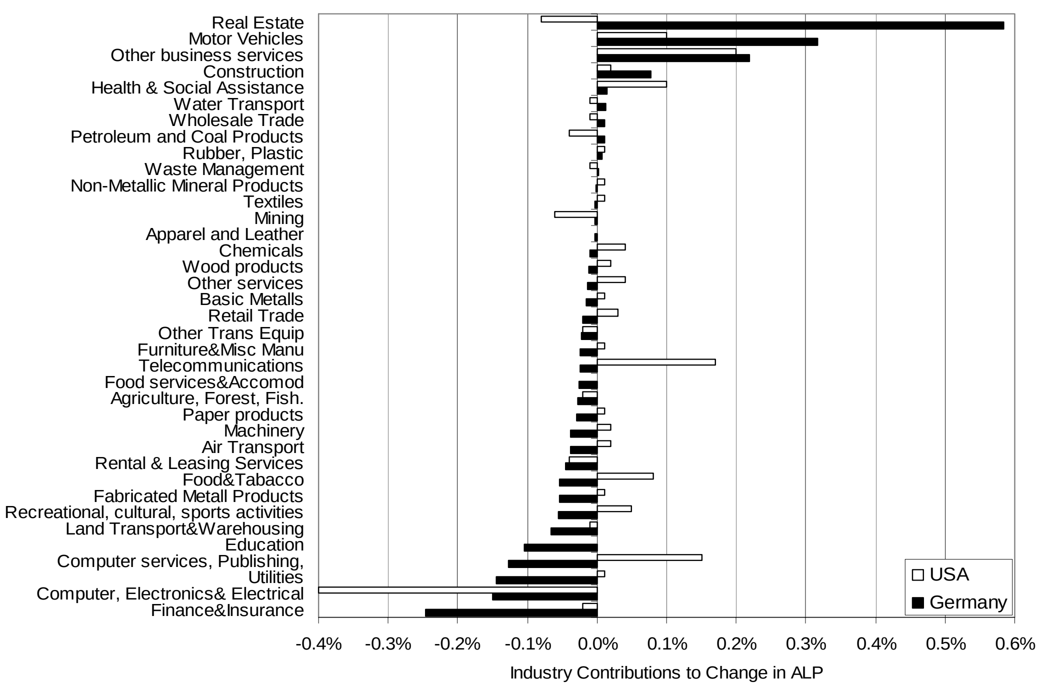
Notes: Robust standard errors allow for correlation within industries over time in parentheses. ***, **, * indicate 1 percent, 5 percent, 10 percent significance levels. Source: *ifo productivity database*, Roehn et al. (2006). Authors' calculations

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



Source: Stiroh (2006), DeStatis, *ifo productivity database*, Roehn et al. (2006), and authors' calculations.

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



Source: Stiroh (2006), DeStatis, *ifo productivity database*, Roehn et al. (2006), and authors' calculations.

Appendix

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

Industry	VA share 2003	ALP Contributions			TFP Contributions		
		1991-1995	1995-2000	2000-2003	1991-1995	1995-2000	2000-2003
Communications[a)]	2.1	0.19	0.18	0.15	0.05	0.13	0.11
Computer & Related Services[a)]	1.6	-0.01	0.03	-0.01	-0.03	0.00	-0.05
Instruments[a)]	0.9	0.01	0.05	0.01	0.00	0.04	0.00
Radio, TV & Comm. Equipment[a)]	0.5	0.05	0.04	0.07	0.03	0.03	0.05
Office Machinery & Computers[a)]	0.2	0.04	0.09	0.06	0.02	0.09	0.06
Health, Social Work[b)]	7.2	0.18	0.17	0.18	0.14	0.11	0.13
Wholesale Trade[b)]	4.8	0.12	0.22	0.23	0.05	0.16	0.18
Construction[b)]	4.3	-0.10	0.00	0.08	-0.13	-0.01	0.07
Retail Trade[b)]	4.2	0.00	0.05	0.03	-0.05	0.02	0.01
Financial Intermediation[b)]	3.5	0.06	0.18	0.04	0.01	0.12	-0.01
Machinery[b)]	3.3	0.15	0.06	0.02	0.08	0.04	-0.02
Motor Vehicles[d)]	3.3	0.05	-0.09	0.23	0.00	-0.10	0.18
Sale, Repair Motor vehicles[b)]	1.8	-0.04	0.01	0.06	-0.06	0.00	0.05
Rental. Leasing Services[b)]	1.9	0.03	0.05	0.00	-0.05	-0.03	-0.08
Rec., Cultural, & Sports Activities[b)]	1.9	-0.01	0.02	-0.04	-0.04	0.00	-0.07
Electrical Apparatus n.e.c. [b)]	1.6	0.04	0.08	-0.03	0.00	0.06	-0.05
Other Services[b)]	1.4	0.02	-0.01	-0.01	0.00	-0.02	-0.02
Rubber, Plastic[b)]	1.1	0.03	0.02	0.03	0.02	0.02	0.02
Publishing, Printing[b)]	1.0	0.01	0.05	-0.04	-0.01	0.03	-0.06
Organizations, n.e.c[b)]	0.9	0.01	0.01	0.01	0.01	0.01	0.00
Insurance[b)]	0.8	0.04	-0.08	-0.19	0.02	-0.09	-0.20
Other Transport Equipment[b)]	0.5	-0.01	0.05	0.03	-0.02	0.05	0.02
Aux. Fin. & Ins. Intermediation[b)]	0.5	-0.01	-0.02	0.00	-0.02	-0.02	0.00
Research & Development[b)]	0.4	0.01	0.02	-0.02	0.01	0.02	-0.02
Water Transport[b)]	0.2	0.02	0.03	0.04	0.01	0.02	0.02
Recycling[b)]	0.0	0.00	0.00	0.00	0.00	0.00	0.00
Real Estate[c)]	11.7	0.00	-0.07	0.51	0.17	-0.03	0.14
Other Business Services[e)]	8.8	-0.10	-0.39	-0.13	-0.09	-0.45	-0.17
Pub. Admin., Defense, Soc. Secur.[c)]	6.2	0.20	0.11	0.03	0.09	0.02	-0.05
Education[c)]	4.6	0.01	0.02	-0.09	-0.01	0.00	-0.11
Chemicals[c)]	2.3	0.18	0.11	0.10	0.13	0.07	0.08
Fabricated Metal Products[c)]	2.0	0.02	0.07	0.01	-0.01	0.05	0.00
Food, Tobacco[c)]	2.0	-0.02	0.01	-0.04	-0.06	0.02	-0.04
Electricity, Gas [c)]	1.7	0.09	0.17	0.03	0.01	0.09	0.01
Hotels, Restaurants[c)]	1.6	-0.03	-0.01	-0.03	-0.04	-0.01	-0.04
Land Transport[c)]	1.5	0.11	0.02	-0.06	0.06	-0.02	-0.08
Auxiliary Transport Activities[c)]	1.5	0.05	0.03	0.04	0.03	0.02	0.01
Agriculture, Forestry, Fishing[c)]	1.1	0.06	0.07	0.05	0.02	0.05	0.03
Basic Metals[c)]	0.9	0.09	0.04	0.03	0.06	0.04	0.02
Non-Metallic Mineral Products[c)]	0.7	0.06	0.02	0.02	0.04	0.01	0.01
Sewage & Refuse Disposal[c)]	0.6	-0.03	-0.03	-0.02	-0.07	-0.07	-0.04
Furniture & Misc. Manufacturing[c)]	0.5	-0.01	0.02	-0.01	-0.03	0.01	-0.02
Paper, Pulp[c)]	0.5	0.00	0.03	0.00	-0.01	0.02	-0.01
Wood Products[c)]	0.4	0.02	0.02	0.01	0.02	0.01	0.00
Textiles[c)]	0.3	0.02	0.01	0.01	0.01	0.01	0.00
Coke, Petroleum, Nuclear Fuels[c)]	0.3	-0.06	-0.02	-0.01	-0.07	-0.02	0.00
Water Supply[c)]	0.3	0.01	0.01	0.01	-0.01	0.00	0.00
Air Transport[c)]	0.3	0.04	0.02	-0.02	0.03	0.01	-0.03
Energy Mining & Quarrying[c)]	0.1	0.04	-0.02	-0.01	0.02	-0.02	-0.01
Mining & Quarrying, exc. Energy[c)]	0.1	0.02	0.00	-0.01	0.01	0.00	-0.01
Apparel[c)]	0.1	0.01	0.01	0.01	0.01	0.01	0.01
Leather[c)]	0.0	0.01	0.00	0.00	0.00	0.00	0.00

a) ICT-Producing Industry, b) ICT-Using Industry 1995 and 2000, c) Non-ICT-Intensive Industry d) ICT-Using Industry in 1995, e) ICT-Using Industry in 2000. 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 DeStatis (2006). Data source: *ifo productivity database*, Roehn et al. (2006) and authors calculations.