Labor Productivity Developments in Austria in an International Perspective

Martin Schneider[1]

After World War II, Austria, like other European countries, had for decades been improving its labor productivity, continuously catching up relative to the United States. Only when U.S. labor productivity grew at an accelerated pace from the mid-1990s to the mid-2000s on the back of new technologies implemented in distribution as well as finance and business services, did Austria – and in particular its service sector – fall behind. Unlike the U.S.A., Austria did not benefit from a technology-driven boom. By contrast, the productivity performance of Austrian manufacturing, without the production of information and communications technologies, is comparable to that in the U.S.A. and in Germany. Hence, to boost labor productivity in Austria, a high priority should be given to policies stimulating the diffusion of new technologies in the service sector.

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Productivity is key in determining the growth performance of a country. Since labor and capital cannot be expanded ad infinitum, long-run growth can only be based on a more efficient use of resources. After World War II, Austria – like European economies in general – had for decades been catching up toward the U.S. productivity level. However, since the mid-1990s, European countries have been falling behind the U.S.A. in terms of productivity growth. This phenomenon triggered a wave of empirical research, which showed that the accelerated productivity growth in the U.S.A. was broadly based and covered both manufacturing and market services. Within manufacturing, the production of information and communications technologies (ICTs) recorded the strongest productivity growth. Productivity growth in market services was mainly concentrated in sectors, such as retail trade or financial services, that had expansively integrated ICTs into their production process (Bosworth and Triplett, 2007). Uppenberg (2011) found that market services accounted for two-thirds of the U.S.-EU productivity growth gap in the 2000s, and manufacturing for the remaining third.

Various studies (O'Mahony and van Ark, 2003; Denis et al., 2004; Gomez-Salvador et al., 2006; van Ark et al., 2008) tried to shed light on the question why European countries had not been able to keep up with the U.S.A. since the mid-1990s. The key finding of this literature is that the slower emergence of the knowledge economy in Europe is the main contributor. Within the EU, substantial differences across individual Member States and industries were observed. Most papers did not focus on Austria, it being only a small EU Member State. Kegels et al. (2008) analyzed productivity performance in Austria, Belgium and the Netherlands, using data until 2004. The authors attributed the lower productivity growth to the "disappearance of the catch up bonus diminishing the possibility to learn from the US." Biatour and Kegels (2007) analyzed labor productivity growth in market services in Austria, Belgium and the Netherlands. They found that Austria and Belgium recorded a decrease in productivity growth between 1995 and 2004, while the Netherlands showed

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[1] *Oesterreichische Nationalbank, Economic Analysis Division, martin.schneider@oenb.at. The author thanks Stefan Girstmair for his help in setting up the database.*

a pattern similar to the U.S.A. and posted an increase in its growth rate. Later, the financial and economic crisis was followed by a solid upswing in the U.S.A., whereas the recovery in Europe was much more muted, which left its mark on productivity.

The aim of this paper is to examine labor productivity developments in Austria in an international perspective. Therefore Austria is compared with the U.S.A. and Germany, with a special focus on sectoral productivity developments. The EU KLEMS database, which provides output, input and productivity measures at the industry level, allows for a comprehensive analysis of productivity developments.

The paper is organized as follows. Section 1 explains how labor productivity is measured. Section 2 discusses Austrian labor productivity developments in an international perspective and is followed by a decomposition of labor productivity growth in Austria, Germany and the U.S.A. Section 3 analyzes developments in different industries in more detail. Section 4 provides a breakdown of labor productivity growth within the classical growth accounting framework into contributions from labor composition, capital deepening and total factor productivity. Section 5 concludes.

1 Measuring Labor Productivity

The EU KLEMS database provides output, input and productivity measures at the industry level (O'Mahony and Timmer, 2009). The analysis presented here draws on data from the ISIC Rev. 4 industry classification, which are available for 12 countries (Austria, Belgium, Finland, France, Germany, Spain, Italy, the Netherlands, Sweden, the United Kingdom, the U.S.A. and Japan) and 34 industries (see table A1 in annex 2). For most countries, the data series start in 1970 and extend to 2010. The data are organized according to the growth accounting methodology, which allows for assessing the relative importance of labor, capital and intermediate input for output growth. In addition, a measure for multifactor productivity growth can be derived. Labor input is divided into hours worked and a labor composition index, which takes the heterogeneity of the labor force into account. Labor input is cross-classified by education, gender and age, which produces 18 labor categories. Based on the assumption that marginal costs reflect marginal productivity, wage differentials result in different productivities per category. Capital is split into ICT capital and non-ICT capital (Timmer et al., 2007). The EU KLEMS database suffers from a considerable time lag. Therefore, to include also more recent years in the analysis, we use productivity data from the Conference Board Total Economy Database, which are available at the national level until 2013. We define labor productivity as real value added Y_t per hour worked H_t

$$LP_t \equiv \frac{Y_t}{H_t}.$$ [2]

Since the growth accounting methodology is based on a loglinearization of the production function, and to ensure consistency within the paper, we define labor productivity growth as the log-differences of value added minus the log-difference of hours worked

$$\left(\Delta \ln(LP_t) \equiv \Delta \ln(Y_t) - \Delta \ln(H_t)\right).$$

[2] *This is not the only way to define labor productivity. Besides value added, gross output can be used as an output measure. Labor input can also be measured in heads instead of hours. The OECD (2001) gives an overview of different productivity measures.*

2 International Labor Productivity over Time

In the post-World War II period, labor productivity in Europe was characterized by a fast catching-up process relative to the United States, with the first oil crisis in 1973 marking a break. From 1952 to 1973, labor productivity growth in Austria amounted to around 5% p.a., almost tripling from EUR 5.7 to EUR 16.1 per hour worked (at 2005 purchasing power parities).[3] Relative to the U.S.A., productivity increased from 38% of the U.S. level to 68%. This fast catching-up was attributable to a well-educated labor force and institutional arrangements that basically ensured limited wage demands and enabled productivity-enhancing investment (van Ark et al., 2008). After the first oil crisis, however, productivity growth slowed down considerably in most world regions.

Despite this slowdown, European countries kept catching up relative to the U.S.A. until the mid-1990s. In 1995, labor productivity in Austria reached 78% of the U.S. level, Germany attained 88%, and Belgium drew level with the U.S.A. After 1995, the pattern of productivity growth reversed. In the subsequent decade, labor productivity growth rates trended downward in Europe, whereas productivity growth in the United States doubled. Between 2005 and 2008, output and productivity in Europe grew somewhat more strongly than in the U.S.A. With the onset of the financial and economic crisis and the following recovery, the patterns reversed once again. While the United States has experienced a solid recovery, the European economies started to suffer from a variety of problems that have been exerting a drag on growth and productivity.

Chart 2 shows labor productivity growth for all 12 countries in the EU KLEMS database for four different time periods (1986–1995, 1996–2005,

Table 1

Average Growth of Output, Hours Worked and Labor Productivity 1952–2013[1]

	1952–1973	1974–1985	1986–1995	1996–2004	2005–2008	2009–2013
	Average annual growth rate in %					
Real value added						
Austria	5.2	2.3	2.7	2.4	2.9	0.4
Germany	5.6	1.9	2.5	1.4	2.3	0.6
U.S.A.	3.7	2.7	2.5	3.1	1.6	1.1
Hours worked						
Austria	–0.5	–0.9	0.2	0.8	0.7	–0.2
Germany	0.1	–0.9	0.1	–0.3	0.6	0.2
U.S.A.	1.2	1.6	1.4	0.8	0.8	–0.3
Labor productivity						
Austria	5.7	3.2	2.5	1.6	2.1	0.6
Germany	5.6	2.7	2.4	1.8	1.8	0.3
U.S.A.	2.5	1.1	1.1	2.3	0.8	1.4

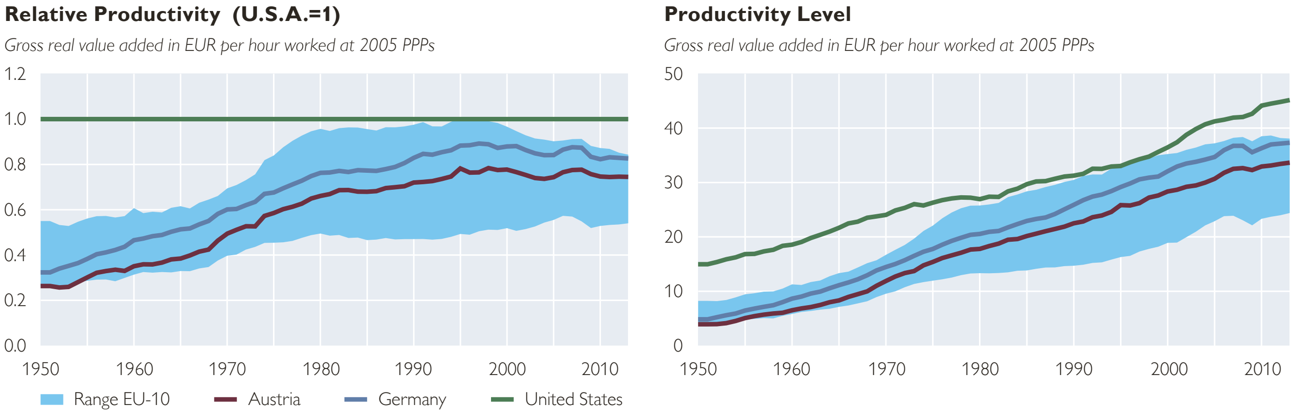
Source: EU KLEMS database (1980–2010), the Conference Board Total Economy Database (1952–1969, 2011–2013), Eurostat.

[1] Values between 1980 and 2010 are taken from the EU KLEMS database. Values before 1970 and after 2010 have been chained with the growth rate (measured by the log-difference) of the respective variable from the Conference Board Total Economy Database. Real value added was chained with the growth rate of real GDP.

[3] It is difficult to compare productivity levels between countries given the issues of currency conversion and purchasing power (van Ark and Timmer, 2001; Dey-Chowdhury, 2007). Absolute values at purchasing power parities consequently depend on the choice of the base year and are hence not unique.

Chart 1

Labor Productivity Developments of EU Member States Relative to the United States, 1950–2013

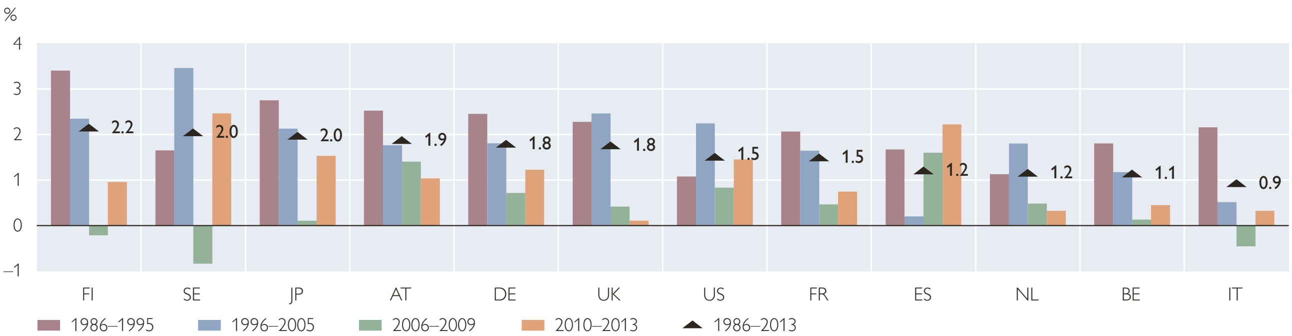


Source: New Cronos, EU KLEMS database (1970–2010), the Conference Board Total Economy Database (1950–1969, 2011–2013).

Note: The EU-10 consist of Belgium, Germany, Spain, France, Italy, the Netherlands, Austria, Finland, Sweden and the United Kingdom. Data before 1970 and after 2010 are chained by using data from the Conference Board Total Economy Database (growth rates of real GDP and hours worked, respectively).

Chart 2

Average Annual Labor Productivity Growth



Source: EU KLEMS database (1986–2010), the Conference Board Total Economy Database (2011–2013 and 1986–1995 for Sweden).

2006–2009 and 2010–2013). The countries are sorted in descending order according to labor productivity growth over the whole horizon (1986–2013). Austria ranks fourth after Finland, Sweden and Japan, outperforming most European countries. Italy shows the worst performance, which reflects the country's failure to undertake structural change. The United Kingdom's weak performance from 2006 onward is likewise noteworthy. Belgium's modest labor productivity growth should not be a matter of concern; after all, Belgium exhibits the highest level of labor productivity of the EU-10.

3 Productivity Developments by Industry

Analyzing labor productivity developments at the industry level provided us with many interesting insights. We calculated labor productivity in 2005 purchasing power parities (PPPs) to allow for a comparison between countries. Total labor productivity in Austria amounted to EUR 33 per hour worked in 2010 (see table 2 as well as table A2 in annex 2 for a detailed breakdown).

Table 2

Labor Productivity Levels in Austria, Germany and the United States by Industry

	Austria			Germany			U.S.A.		
	1990	2000	2010	1990	2000	2010	1990	2000	2010
	EUR per hour worked at 2005 PPPs								
Total	22	28	33	26	32	36	31	36	44
Agriculture and mining (NACE A–B)	4	6	8	11	11	18	49	56	61
Manufacturing (NACE C)	22	33	41	25	35	44	20	31	54
Utilities (NACE D–E)	54	71	78	52	73	84	60	80	78
Construction (NACE F)	26	29	28	20	20	20	37	35	30
Distribution services (NACE G–I)	20	24	27	18	21	26	25	35	44
Finance and business services (NACE J–N)	44	47	56	52	60	58	44	46	60
Personal services (NACE O–U)	24	25	26	24	27	28	31	30	30

Source: EU KLEMS database, Eurostat, author's calculations.

Labor productivity levels differ markedly between industries. Agriculture and mining post the lowest level by far, reaching a mere 24% of total labor productivity. In manufacturing, labor productivity exceeds the country-wide productivity average by 24%. Utilities, in turn, stand out with a very high level of productivity (239% of the average). This industry consists mainly of sectors supplying natural resources like gas, water and electricity, which have low employment intensity. The service sector is very heterogeneous with high productivity differentials. Finance and business services exhibit a very high level of productivity, while distribution and personal services are clearly below average. In Germany, labor productivity is slightly higher (EUR 36 per hour worked), whereas it is considerably higher in the U.S.A. (EUR 44 per hour worked). The marked productivity dispersion also holds for Germany and the U.S.A. (with the exception of the relatively high level of labor productivity of agriculture and mining in the U.S.A.).

Chart 3 shows the contributions of seven industries to total trend labor productivity growth for Austria, Germany and the United States as from 1980. We calculated the industry contributions according to equation (1) as described in box 1 with EU KLEMS data running to 2010. For the period from 2011 to 2013, we took labor productivity growth from the Conference Board Total Economy Database, which includes more recent data than EU KLEMS, but does not provide an industry breakdown. Since the annual contributions are very volatile, we calculated trend labor productivity by using the HP filter to obtain a clearer picture.

Labor productivity in *Austria* – like in all European countries – is characterized by a downward trend, which started in the mid-1970s. Two episodes of increasing labor productivity interrupted this downward trend. In the mid-1990s, structural change and Austria's EU accession temporarily increased labor productivity growth, driven by a shrinking agricultural sector combined with the remaining sector's increasing productivity and a short-lived surge in service productivity. In the mid-2000s, agriculture and the manufacturing sector – having recovered from a dip in productivity growth after the 2001 recession – contributed to higher productivity growth. The financial and economic crisis then again exerted a

Box 1

Decomposing Labor Productivity Growth by Industry

Labor productivity growth for the total economy can be the result of two phenomena. First, labor productivity can increase within an industry ("within-industry effect") for numerous reasons (capital deepening, labor composition change, total factor productivity). Second, resources can be shifted from less productive industries to sectors with higher productivity and/or higher productivity growth ("reallocation effect"). The appropriate framework for disentangling these two effects is a shift-share analysis. In equation (1), growth of total labor productivity LP_t *(measured as the log-difference of labor productivity) is decomposed into the sum of contributions of industries* i

$$\Delta\log\left(LP_t\right) \approx \underbrace{\sum_{i=1}^{I} \overline{w}_{i,t}^{V} \Delta\log\left(LP_{i,t}\right)}_{\text{within-industry effect}} + \underbrace{\sum_{i=1}^{I} \left(\overline{w}_{i,t}^{V} - \overline{w}_{i,t}^{H}\right) * \left(\ln\left(w_{i,t}^{H}\right) - \ln\left(w_{i,t-1}^{H}\right)\right)}_{\text{reallocation effect}}, \qquad (1)$$

where $\Delta\log\left(LP_{i,t}\right)$ *denotes labor productivity growth of industry* i*. Weights* $w_{i,t}^{H} = H_{i,t} / H_t$ *denote the share of industry* i *in total hours worked in year* t*.*

$\overline{w}_{i,t}^{H} = \left(w_{i,t-1}^{H} + w_{i,t}^{H}\right)/2$ *and* $\overline{w}_{i,t}^{V} = \left(w_{i,t-1}^{V} + w_{i,t}^{V}\right)/2$

are defined as the average weights of the current and the previous year of hours worked and value added $V_{i,t}$ *of industry* i *in total hours worked and value added, respectively.*[1]

Within-industry effects of industry i *are calculated by multiplying its labor productivity growth rate* $lp_{i,t}$ *with its share in total hours worked (*$w_{i,t}^{V}$*). If there is no reallocation of labor input over time, the within-industry effects will add up to total labor productivity. Since there is continuous structural change in the economy, the reallocation effect has to be taken into account. An increase of labor input*

$$(\ln\left(w_{i,t}^{H}\right) - \ln\left(w_{i,t-1}^{H}\right) > 0)$$

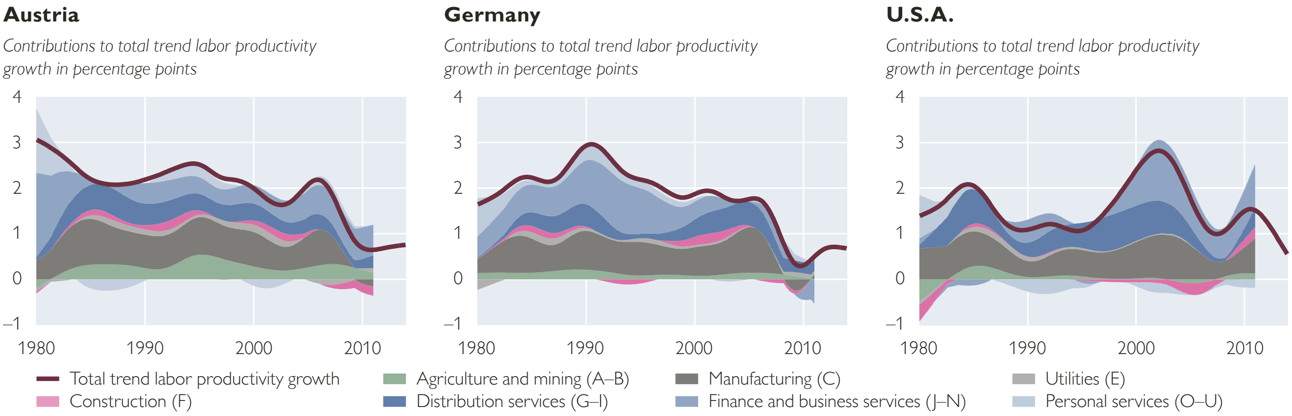
into an industry with above-average productivity $(\overline{w}_{i,t}^{V} - \overline{w}_{i,t}^{H} > 0)$ *leads to an increase in overall labor productivity.*

This equation can be used in two ways to analyze productivity developments. First, we may look at the contributions for industry i*. Industry contributions approximately add up to labor productivity growth (measured as log-difference). Discrepancies between the sum of industries and total labor productivity growth mainly arise from the fact that real value added of industries does not add up to total value added because of the chainlinking and, to a lesser extent, because of the approximate character of the formula. Second, we may calculate aggregated within-industry and reallocation effects. In that way, we can disentangle "pure" labor productivity gains that occur within one sector from shifts in the industry composition of total output.*

[1] *See Reinsdorf and Yuskavage (2010) for a discussion of different formula to decompose labor productivity into industry contributions.*

Chart 3

Contributions to Total Trend Labor Productivity Growth in Austria, Germany and the United States by Industry



Source: EU KLEMS database (1980–2010), the Conference Board Total Economy Database (2011–2013), author's calculations.

drag on productivity growth. As a case in point, manufacturing and the construction sector exhibited a decline in productivity, mainly driven by firms' labor hoarding and by government measures that helped mitigate the employment impact of the crisis (Hofer et al., 2014).[4] The contributions of the Austrian service sector do not show strong time variation (with the exception of the sharp decrease in the first half of the 1980s, which is exaggerated by end-point problems of the HP filter).

The time profile of labor productivity growth in *Germany* differs from that in Austria mainly due to German reunification. While there is no comparable structural change in agriculture, the development of manufacturing is broadly similar to that in Austria (with the exception of the mid-2000s, when labor productivity growth was much stronger in Germany). The main difference to Austria arises from the service sector, which contributed considerably to Germany's overall labor productivity growth in the early 1990s.

In the *United States,* labor productivity growth differed markedly from that in European countries. Prior to the first oil crisis, it was clearly below Austria (1952–1973: +5.2% p.a.; U.S.A.: +2.5% p.a.). From 1974 to 1995, it slowed down further to 1.1% p.a. (Austria: 2.5% p.a.). After 1995, the picture changed for one decade. While labor productivity further declined in Europe, it doubled in the U.S.A. (1995–2004: +2.3% p.a.). This development was to a large extent driven by the service sector. In addition, the computer industry also contributed heavily to this development.[5] In the following subsections, we will dig more deeply into developments by industry to identify the main contributors to overall labor productivity growth in Austria.

[4] *The decline of employment in Austria during the crisis was small given the severity of the recession. Firms adapted mainly by reducing the number of hours worked (Stiglbauer, 2010).*

[5] *The spike in the sum of the contributions for the U.S.A. is caused by end-point problems of the HP filter and should not be overinterpreted.*

3.1 Agriculture and Mining: Decline of Agriculture Drives Economy-Wide Labor Productivity Growth

Developments in *agriculture and mining have* played an important role for overall labor productivity in Austria over the last decade. Besides productivity increases within the sector, *reallocation effects* (a shift of employment away from agriculture to other sectors) have proved to be significant. Chart 3 (left panel) shows that the contribution from agriculture and mining to economywide trend labor productivity growth is dominated by this reallocation effect. Between 1990 and 2010, the hours worked in agriculture and mining dropped by 43%. Since labor productivity in agriculture and mining is clearly below the economy-wide productivity level (see table 2 and table A2 in annex 2), this drop in hours resulted in an increase of overall productivity.

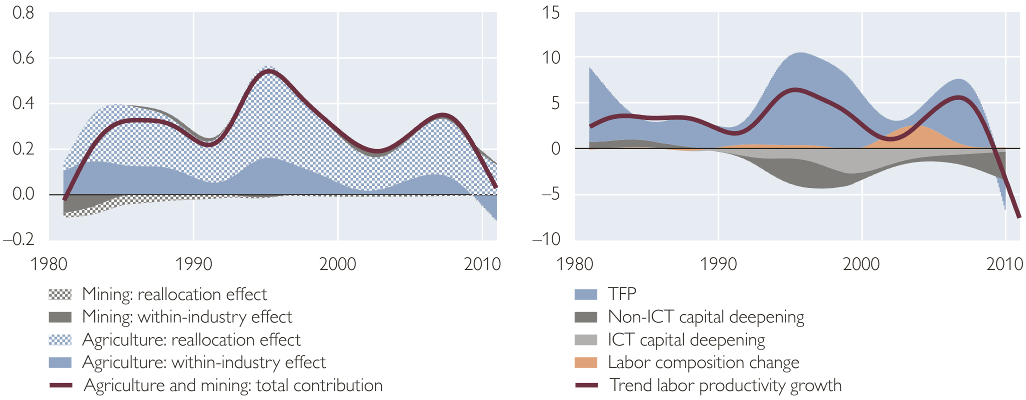
Productivity in *agriculture* has traditionally been low for numerous reasons, including the nature of Austria as an alpine country with often difficult conditions, the small average farm size and the fact that many farms are operated on a part-time basis (see Schneider, 2003, for a more detailed discussion). Over the last decades, an immense structural change took place, driven by technological progress, EU accession, changes of the subsidies schemes and the emergence of organic farms. Between 1995 and 2010, the number of farms fell by 32%; employment decreased by 39%. In the same period, the average farm size increased by 24% according to Eurostat. The growth decomposition (right panel of chart 4[6]) shows that productivity developments within agriculture (i.e. without reallocation effects) are driven by large positive contributions of total factor productivity (TFP), whereas contributions from capital deepening are negative over the entire horizon. This implies that investment declined even more strongly than labor input. Developments in *mining* do not have any significant effect on overall developments.

Chart 4

Agriculture and Mining

Contributions of Agriculture and Mining to Total Trend Labor Productivity Growth | **Contributions to Trend Labor Productivity Growth in Agrigulture**

Contributions in percentage points | *Contributions in percentage points*



Source: EU KLEMS database (1980–2010), author's calculations.

[6] *Note that while the left panel of chart 4 shows contributions to economy-wide trend labor productivity growth, the right panel of this chart presents a decomposition of trend labor productivity growth in agriculture.*

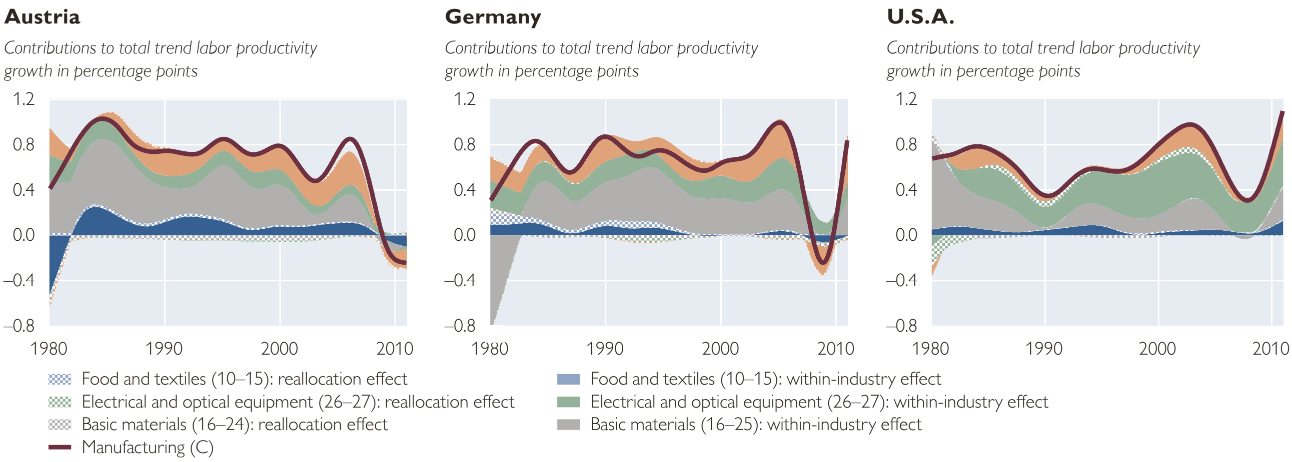
3.2 Manufacturing: Productivity Growth in Austria Driven by Traditional Industries

Labor productivity in Austrian manufacturing industries developed well during the last decades, being either above (1986–1995) or at (1996–2005) the EU-10 average. In a long-term perspective, the contributions of the manufacturing sector to overall labor productivity developed in a similar way in Austria and Germany.

The main drivers of manufacturing were traditional industries (*basic materials,* NACE 16–25). *Electrical and optical equipment* (NACE 26–27) did not play a significant role, especially in Austria. The 2001 recession caused labor productivity growth to decline. Reallocation effects were slightly negative for *basic materials* and *electrical and optical equipment* and positive for *food and textiles.* This finding implies a fall in the relative size of all three industries, since labor productivity of the former two industries is above, while labor productivity of the latter was below the economy-wide average.

Chart 5

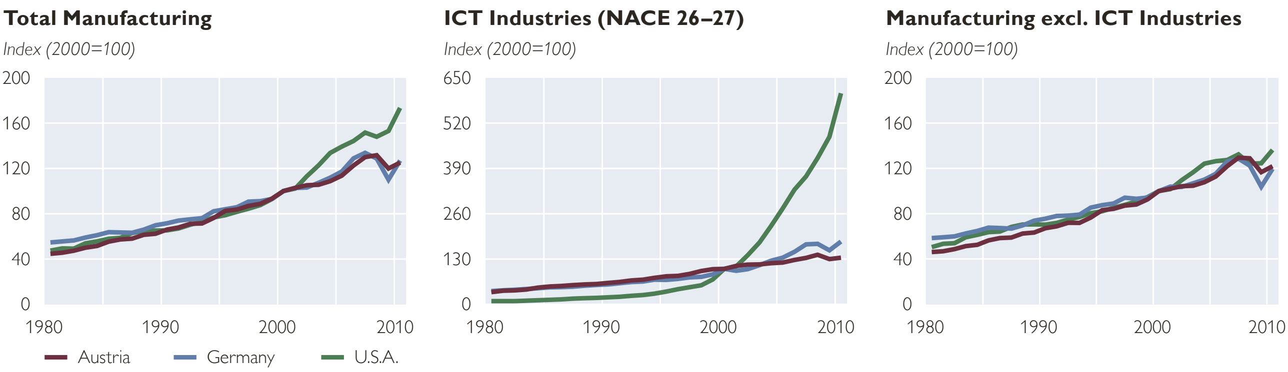
Contributions to Total Trend Labor Productivity Growth in Austria, Germany and the United States: Manufacturing



Source: EU KLEMS database (1980–2010), author's calculations.

Chart 6

Labor Productivity in Manufacturing in Austria, Germany and the United States



Source: EU KLEMS database.

Between 1980 and 2000, developments of labor productivity in manufacturing were very similar in all three countries (chart 6). Beginning in 2002, labor productivity in U.S. manufacturing outpaced developments in Austria and Germany, accounting for one-third of U.S. productivity growth. This growth was solely driven by the ICT industry *(electrical and optical equipment),* where labor productivity exploded. However, productivity growth in the U.S. ICT industry might be overestimated due to flawed input price measurement (see box 2). Between 2000 and 2008, the manufacturing sectors – without ICT industries – of the three countries under review showed a relatively similar development, with increases of 20% (Austria), 22% (Germany) and 24% (United States). The financial and economic crisis exerted a stronger drag on labor productivity in manufacturing in Austria and Germany compared with the U.S.A.

3.3 Services: U.S.A. Has Been Outperforming Austria and Germany since the End-1990s

The service sector, which is by far the largest sector in industrialized economies, accounts for the lion's share of value added and employment. Its share in total value added in Austria increased from 64% in 1990 to 70% in 2010. In the United States, the share is even higher (80% in 2010). Although the share of services in total exports amounts to less than 30% in Austria, their role is greater for overall productivity and competitiveness, since many services are important inputs into the production of goods. Woerz (2008) finds that labor productivity is one of the key determinants of export competitiveness of the Austrian service sector.

The structure of the service sector differs markedly between the three countries reviewed here (table 3). In Austria, *distribution* services play a much greater role than in Germany and the U.S.A., while the importance of *finance and business services* is much lower. The relative size of *personal services* is similar across the three countries.

Productivity developments in services explain a large part of the difference in labor productivity growth of Austria vis-à-vis Germany and the U.S.A. In the periods from 1986 to 1995 and from 2006 to 2009, services in Austria contributed 1 percentage point to overall annual labor productivity growth. Between 1996 and 2005, the contribution slowed down to 0.6 percentage points. Chart 7 shows a decomposition of the contribution of the service sector into the within-industry and the reallocation effect for the three service categories distribution services, finance and business services and personal services.

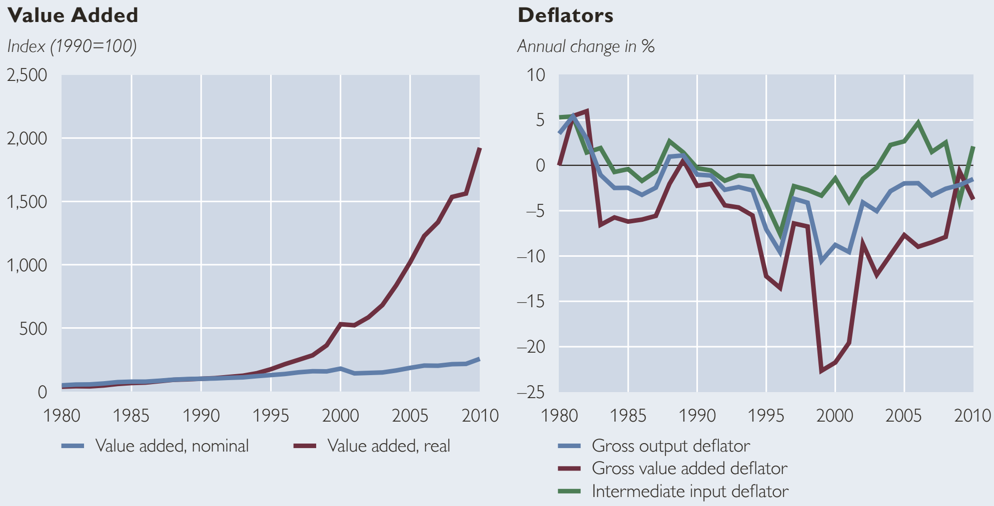
The contribution of *distribution services* in Austria slowed down from 0.5 percentage points between 1986 and 1995 to 0.3 percentage points between 1996 and 2005. In Germany, the contribution remained more or less constant (1986–1995: 0.3 percentage points; 1996–2005: 0.4 percentage points). The U.S. distribution sector experienced a boost of labor productivity growth between the mid-1990s and the mid-2000s (1986–1995: 0.4 percentage points; 1996–2005: 0.7 percentage points). This boost was attributable primarily to productivity gains in the U.S. retail sector based on various factors. The implementation of information and communications technologies like barcode scanners, communication equipment and inventory tracking devices as well as transaction processing software proved to be one important source of productivity growth (van Ark et al., 2008). These technologies enabled process innovations

Box 2

To Which Extent Is Labor Productivity Growth in U.S. Manufacturing Overestimated by Flawed Input Price Measurement?

There is an ongoing debate about whether and to which extent real growth in U.S. manufacturing is overestimated by an "input price bias." Value added of an industry is defined as gross output minus inputs used in the production process. Real value added is thus influenced by nominal values as well as by the prices of gross output and inputs. The hypothesis is that the value added deflator exhibits a downward bias – and hence real value added an upward bias – for two reasons. The first is a change in the statistical methodology to construct price indices. In 1997, the output price index in U.S. manufacturing was changed to a hedonic-based index. Quality improvements – which are especially large for the computer industry – subsequently lead to lower output prices and higher real gross output. However, no corresponding shift was made for the measurement of input prices. As a consequence, input prices exhibit an upward and real inputs a downward bias. (Baily and Bosworth, 2014).

Value Added in the U.S. Electrical and Optical Equipment Industry



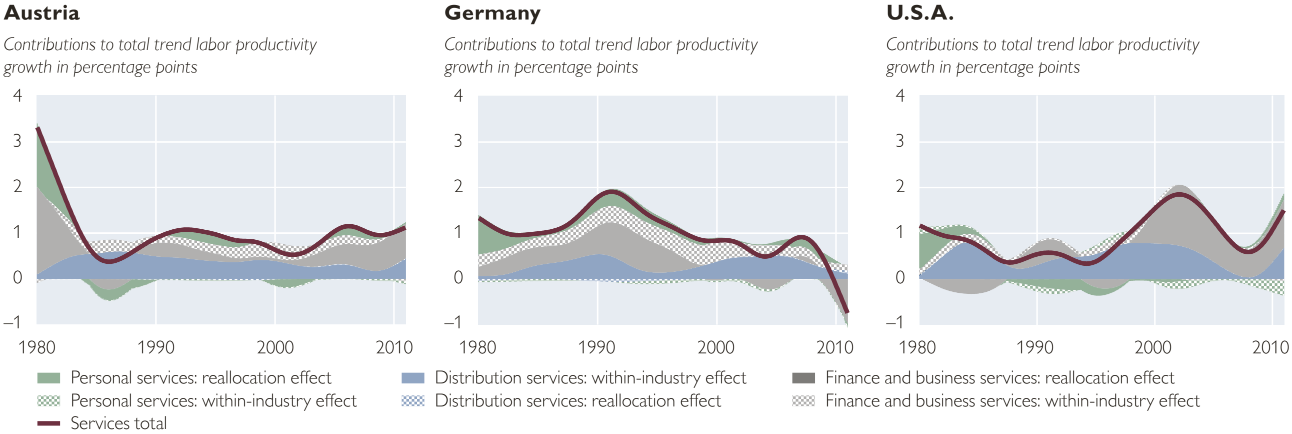
Source: EU KLEMS database.

The second argument is that offshoring activities cause an upward bias of input prices. Since the mid-1990s, massive outsourcing has taken place in the U.S. manufacturing industries. The import share of material inputs by U.S. manufacturers increased from 17% to 25% between 1997 and 2007. Houseman et al. (2011) argue that the price declines associated with the shift to low-cost foreign suppliers (i.e. offshoring) are not captured in existing price indices. They estimated that real value added growth in manufacturing, which amounted to 3.0% p.a. between 1997 and 2007, was overstated by 0.2 to 0.5 percentage points (i.e. by about 7% to 18% of growth).

in the areas of store and supply chain management and allowed for optimized marketing campaigns. In addition, large-scale retail formats (as exemplified by Walmart) were an important driver of U.S. productivity growth (McKinsey Global Institute, 2002). Austria and Germany are clearly lagging behind the U.S.A. in the implementation of such productivity-enhancing innovations. In transport and storage activities (NACE 49–52), labor productivity in Austria

Chart 7

Contributions to Total Trend Labor Productivity Growth in Austria, Germany and the United States: Services



Source: EU KLEMS database (1980–2010), author's calculations.

Table 3

Composition of the Service Sector in Austria, Germany and the United States in 2010

	Austria	Germany	U.S.A.
	Share of value added in %		
Service sector (G–U)	100.0	100.0	100.0
Distribution services (G–I)	32.9	22.8	21.5
Trade (G)	19.3	14.6	14.5
Transportation and storage (H)	6.7	5.6	3.5
Accommodation and food services (I)	7.0	2.6	3.6
Finance and business services (J–N)	37.8	44.5	46.3
Information and communication (J)	4.4	5.8	7.0
Financial and insurance activities (K)	7.0	6.5	10.7
Real estate activities (L)	13.5	16.9	15.2
Business services (M–N)	12.8	15.2	13.4
Personal services (O–U)	29.3	32.7	32.2
Share of service sector in total value added	70.3	69.5	79.9

Source: EU KLEMS database, author's calculations.

declined slightly between 1996 and 2005, while Germany and the United States saw strong productivity increases. Similar to the retail sector, new technologies, such as network optimization and dispatching, barcode scanning, data exchange with customers, intelligent vehicle systems, positioning and remote tracking, might explain the differences in productivity performance. By contrast, labor productivity growth in postal and courier activities (NACE 53) in Austria outpaced that in Germany and the United States, reflecting the massive structural changes in the wake of liberalization during this period (see table A3 in annex 2).

An important source of labor productivity growth in all three economies, *finance and business services* account for most of the difference between Austria, Germany and the United States. Two results are noteworthy. First, reallocation effects resulting from the growing role of these services played an important role in Austria and Germany. For the U.S.A., reallocation effects are almost negligible. Second, U.S. finance and business services experienced a boost in labor productivity (within-industry effect) from the mid-1990s onward, which is well documented in the literature (see e.g. Bosworth and Triplett, 2007). This boost was ascribable to ICT capital deepening and an acceleration of TFP growth on the back of stepped-up use of ICTs. However, precrisis growth patterns were distorted by the existence of financial bubbles and debt-fueled demand growth (Uppenberg, 2011).

Since 2006, labor productivity growth of finance and business services in Austria has been accelerating, while it turned negative in Germany. The U.S.A. shows strong cyclical behavior, with a deceleration during the crisis and a strong acceleration afterward.

3.4 Structural Change Contributes Positively to Labor Productivity Growth in Austria

This subsection provides a summary of our findings on the impact structural change had on labor productivity growth in Austria. As mentioned earlier, structural change – i.e. the shift of resources between industries – contributed positively to labor productivity growth in Austria and Germany, whereas its effect was negative in the United States.

In Austria, this is mainly attributable to the declining share of agriculture and the increasing share of finance and business services. This effect was especially strong between 1986 and 1995, accounting for 11% of labor productivity growth. Over the entire horizon, the effect amounted to 0.2 percentage points or 9% of labor productivity growth. In Germany, the effect was even stronger (0.3 percentage points or 15% of labor productivity growth), driven by a declining share of food and textiles and the growth of finance and business services. The U.S.A. recorded a negative reallocation effect of –0.1 percentage points or –7% of labor productivity growth, which stems primarily from the deindustrialization that took place during the last decades.

4 Contribution of Production Factors to Trend Labor Productivity Growth

The EU KLEMS database enables us to calculate the contributions made by production factors to labor productivity growth at both the national and industry level. We decompose labor productivity growth into its contributions from labor composition, ICT capital deepening[7], non-ICT capital deepening and total factor productivity. In annex 1 we explain how we calculated these contributions based on the production factor framework.

Chart 9 shows the results of this decomposition for Austria, Germany and the United States. Since annual labor productivity and its contributions are very volatile, we calculated trend labor productivity by using the HP

Chart 8

The Role of Structural Change for Total Labor Productivity Growth

Source: EU KLEMS database, author's calculations.

[7] *Capital deepening is defined as capital services per hour worked.*

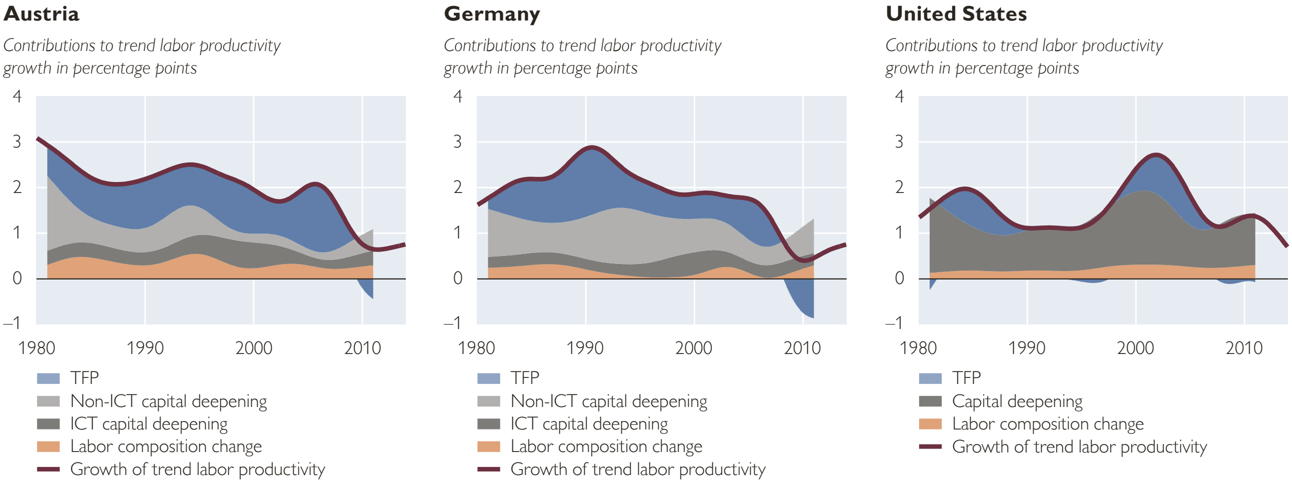
filter[8]. Overall trend labor productivity growth in Austria and Germany are of a similar magnitude, but they are driven by different factors. In Austria, the most important contribution came from TFP. By contrast, non-ICT capital deepening played the dominant role in Germany. For the U.S.A., capital deepening explains the bulk of labor productivity growth.[9]

Turning to the time profile of labor productivity growth in *Austria,* we see that the slowdown during the late 1980s was to a large extent driven by a slowdown in non-ICT capital deepening. The Austrian economy experienced a boom phase between 1988 and 1992 resulting in strong growth of employment and hours worked. The acceleration in labor productivity during the first half of the 1990s coincided with Austria's EU accession in 1995 and was mainly driven by falling labor input. The productivity surge in the mid-2000s and the drop during the financial and economic crisis cannot be explained by inputs into the production process and are thus attributed to TFP. Investment was especially weak in this period. Labor composition change also made positive contributions, which were on average higher than in Germany and the United States.

Having peaked in the early 1990s, labor productivity growth in *Germany* decelerated considerably to levels observed in the 1980s, mainly driven by weaker contributions from TFP. According to Eicher and Roehn (2007), this TFP decline was attributable to productivity decreases in non-ICT industries, whereas ICT-producing ones recorded a surge in productivity. However, this surge was not strong enough to offset the decline in non-ICT industries. The financial and economic crisis was the main reason for the slowdown observed in Germany in the late 2000s.

Chart 9

Contributions of Production Factors to Trend Labor Productivity Growth in Austria, Germany and the United States



Source: EU-KLEMS database (1985-2010), Conference Board Total Economy Database (2011-2013), author's calculations.

[8] *Since the HP filter suffers from end-point problems, developments at the beginning and end of the sample should not be overinterpreted.*

[9] *For the U.S.A., data are available for overall capital contributions only. No breakdown into ICT and non-ICT capital is available.*

The surge in labor productivity growth in the *United States* in the 2000s is attributable both to capital deepening (mainly ICTs, although the EU KLEMS database provides no breakdown for the United States) and to stronger TFP growth.

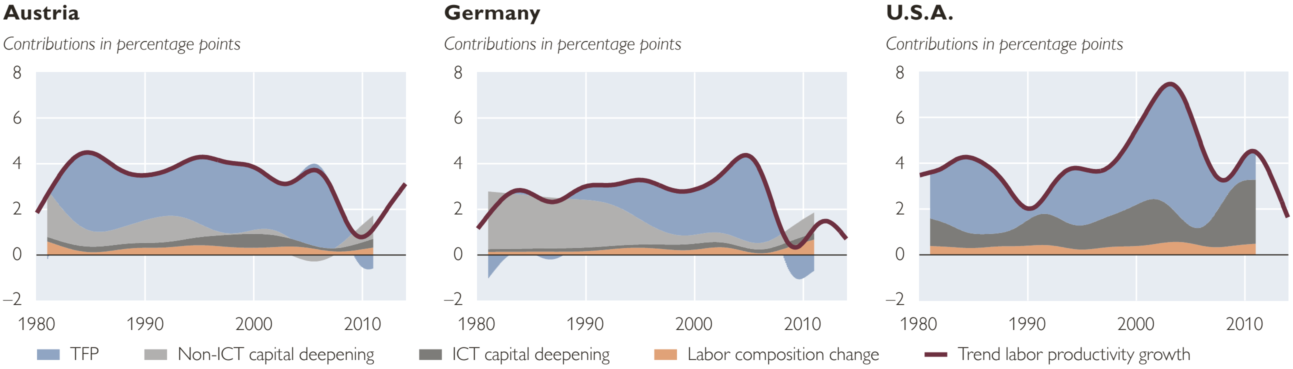
4.1 Manufacturing

In the *United States,* periods with high contributions from capital deepening (1980s, 2000s) were closely followed by periods with strong TFP growth, which indicates massive spillovers from investment (especially in ICTs). The importance of ICT investment for TFP growth is well documented in the literature (Fukao and Miyagawa, 2007; Jorgenson et al., 2008; Biagi, 2013). Investment in ICTs fosters productivity enhancements, but for such technologies to be used efficiently, the workforce must be sufficiently capable and proper organizational structures must be in place as well. According to the above literature, the U.S. economy fared best in creating an environment promoting the adaptation of new technologies. Most European countries, including Austria and Germany, failed to achieve that. The dominant role ICT investment plays in explaining the different productivity developments in the United States and in Europe is well established in the empirical literature. Biagi (2013) finds this difference to be traceable to the smaller size of the ICT-producing industry in Europe, lower investment in ICT capital and a lower TFP in the ICT-using industries, especially in wholesale trade and financial services. This implies that EU firms in these industries lack in capability to integrate new technologies and to use them in an efficient way. This may be due to market segmentation and the smaller firm size in Europe, which makes it more difficult for firms to cope with the high costs of implementing ICTs. Differences in access to funding might be another explanation.

Chart 10 shows the contributions of production factors to trend labor productivity growth in manufacturing. It shows similarities as well as striking differences between the three countries. The common factor is that labor productivity growth in manufacturing is to a large extent driven by TFP, i.e. it cannot be explained by capital deepening and labor composition change. This can be seen as evidence for the various *new*

Chart 10

Contributions of Production Factors to Trend Labor Productivity Growth in Manufacturing (NACE C) in Austria, Germany and the United States



Source: EU KLEMS database (1980–2010) , Eurostat, U.S. Bureau of Labor Statistics (2011–2013), author's calculations.

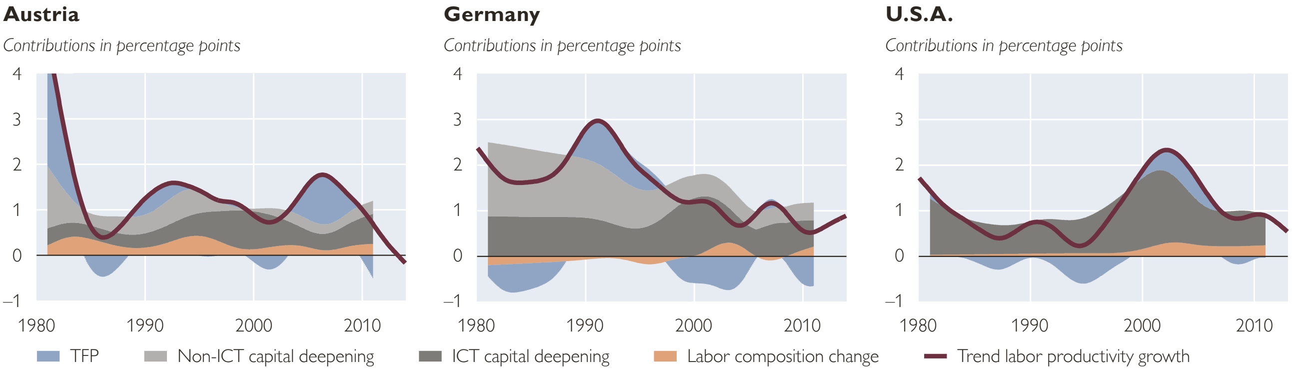
technologies that have already impacted on productivity in manufacturing over the last years and will have an increasing impact over the next years. Some examples are given below. Industrial robots and automation are no new phenomena, but the rapidly falling prices and increasing abilities of industrial robots create numerous new areas of application. Technologies such as 3D printing ("additive manufacturing") are still only at an early stage, but create an enormous potential for the future. Progress in computing allows for building digital prototypes when developing new products, thus enabling cost savings and reduced time to market (advanced design). The use of low-cost sensors leads to an "Internet of Things," which refers to the direct interconnectedness of machines over the Internet and brings about improved monitoring of the production process. While these new technologies play an important role for the acceleration of TFP growth in the United States (Baily and Bosworth, 2014), the slowdown of TFP growth in Austria and Germany points to an enormous untapped potential in both countries. Capital deepening has played a subordinate role in Austria – especially during the last decade, which ties in with the weak investment development.

4.2 Services

The decomposition of trend labor productivity growth in the service sector (chart 11) attests to a striking difference regarding manufacturing. While total factor productivity plays a significant role in manufacturing in all three countries, capital deepening is the main driver of labor productivity in services, with the contribution of TFP being only of minor importance. The relative size of the contributions is similar in all three countries. Measuring the output and productivity of service industries is a challenging task. This holds especially for non-market services and the real estate industry. In addition, the high heterogeneity of the service sector (see the results of Bosworth and Triplett, 2007, for the United States) poses severe aggregation problems. Hence, the aggregated small role of TFP for the service sector masks different developments at the industry level. One additional caveat has to be considered. TFP measures the efficiency with which input factors are used in the production

Chart 11

Contributions of Production Factors to Trend Labor Productivity Growth in Services (NACE G–U) in Austria, Germany and the United States



Source: EU KLEMS database (1980–2010) , Eurostat (2011–2013, for Austria and Germany), U.S. Bureau of Economic Analysis (2011–2012, for the U.S.A.), author's calculations.

process. As a residual measure, it also includes measurement errors.

A summary of the main drivers of labor productivity growth – TFP and capital deepening – and their respective significance is presented in table 4. For economy-wide labor productivity growth, the role of production factors varies from country to country and over time. The most obvious result for Austria and Germany is the declining role of capital deepening over time. For the United States, in contrast, the contribution of capital deepening remained stable over time. At the sectoral level, the picture becomes clearer. In manufacturing, TFP dominated labor productivity growth in all three countries. Exceptions are Germany during the 1980s and the United States at the end of the 2000s. During these episodes, capital deepening was the main driver. In the service sector, the reverse held true, with labor productivity growth almost solely driven by capital deepening.

Table 4

Main Drivers of Labor Productivity Growth in Austria, Germany and the United States

	Austria	Germany	U.S.A.
Total economy	TFP Capital deepening (steady decline)	Capital deepening TFP (after the reunification)	Capital deepening TFP (in the 2000s)
Manufacturing	TFP	TFP	TFP (especially in the 2000s)
Services	Capital deepening	Capital deepening	Capital deepening

Source: Author's compilation.

5 Summary and Discussion of the Results

This paper sheds light on the question "How did labor productivity develop in Austria relative to Germany and the U.S.A.?", drawing on data from the EU KLEMS database. Labor productivity growth in Austria and Germany had outpaced U.S. growth for decades after World War II, which implied a narrowing of the productivity gap. From the mid-1990s to the mid-2000s, accelerated U.S. labor productivity growth reversed this picture, however. The U.S. boom was to a large extent driven by the development and application of information and communications technologies. Austria and Germany did not experience such a boom, given the negligible size of ICT-producing industries and deficits in implementing such new technologies.

A look at the industry level reveals that structural change (especially the shrinking size of the agricultural sector and growth of finance and business services) has supported overall labor productivity growth in Austria. Labor productivity growth in manufacturing in Austria has been keeping up with that in Germany. Relative to the U.S.A., Austrian manufacturing industries have posted higher productivity growth, except in the early 2000s and ever since the financial and economic crisis. However, U.S. productivity growth might be overstated due to measurement issues. Labor productivity growth of the Austrian service sector fell behind the U.S.A. particularly markedly, as new technologies in distribution services as well as finance and business services were not adopted as rapidly and sweepingly in Austria as in the U.S.A. Since the onset of the crisis, the Austrian service sector has developed more favorably vis-à-vis Germany thanks to the solid productivity performance of finance and business services, which contrasts with a productivity drop in Germany.

Which policy conclusions can be drawn from these findings? Although the decompositions based on the growth accounting framework are much too simplistic to provide a definitive answer, they can give guidance on how to deal with future challenges. Austria's falling behind the United States from the mid-1990s onward was clearly driven by Austria's lack in producing and implementing new technologies. By contrast, the Austrian growth model in manufacturing, which promotes the exploitation of niches in traditional industries, has proven successful. Building up significant ICT-producing industries in Austria seems to be unrealistic, but the adoption of ICTs should be fostered, especially in the service sector. Hence, a high priority should be given to policies stimulating innovation and the diffusion of information and communications technologies. Also, the approach should be broadly based, since the empirical literature suggests that fostering innovation requires more than just putting one or two key elements into place.

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Annex 1: Calculating Contributions to Labor Productivity Growth

To calculate labor productivity growth, we use the Cobb-Douglas production function (1) with constant returns to scale.

$$Y_t = A_t K^{\alpha}_{ICT,t} K^{\beta}_{Non-ICT,t} (H_t L_t)^{\gamma} \qquad (1)$$

In formula (1) A represents total factor productivity. Capital services are separated into ICT capital (K_{ICT}) and non-ICT capital $(K_{NON-ICT})$. H represents the labor input in total hours worked and L is a composite index of labor composition including gender, age and educational levels (see O'Mahony and Timmer, 2009). α, β and γ represent the share of ICT capital, non-ICT capital and labor compensation in total income $(\alpha + \beta + \gamma = 1)$. By taking logarithms and differentiating (1), we derive equation (2), which gives us a decomposition of output growth into its contributions.

$$\begin{aligned} \Delta\ln(Y_t) &= \Delta\ln(A_t) + \alpha\Delta\ln(K_{ICT,t}) + \\ &+ \beta\Delta\ln(K_{Non-ICT,t}) + \gamma\Delta\ln(H_t L_t) \end{aligned} \qquad (2)$$

We define labor productivity as output by hours worked. Subtracting $\Delta\ln(H_t)$ from both sides of the log-linear version (2) gives us a decomposition of labor productivity growth (3).

$$\begin{aligned} \Delta\ln(Y_t) - \Delta\ln(H_t) &= \Delta\ln(A_t) + \\ &+ \alpha\left(\Delta\ln(K_{ICT,t}) - \Delta\ln(H_t)\right) + \\ &+ \beta\left(\Delta\ln(K_{Non-ICT,t}) - \right. \\ &\left. - \Delta\ln(H_t)\right) + \gamma\Delta\ln(L_t) \end{aligned} \qquad (3)$$

Labor productivity growth $\left(\Delta\ln(Y_t) - \Delta\ln(H_t)\right)$ is decomposed into a contribution from total factor productivity $\left(\Delta\ln(A_t)\right)$, from ICT capital deepening $\left(\alpha\left(\Delta\ln(K_{ICT,t}) - \Delta\ln(H_t)\right)\right)$, from non-ICT capital deepening $\left(\alpha\left(\Delta\ln(K_{Non-ICT,t}) - \Delta\ln(H_t)\right)\right)$ and from labor composition change $\left(\gamma\Delta\ln(L_t)\right)$.

Annex 2: Tables

Table A1

Industry Structure of Austria, Germany and the United States

	Austria			Germany			U.S.A.		
	1990	2000	2010	1990	2000	2010	1990	2000	2010
	%								
TOTAL ECONOMY	100	100	100	100	100	100	100	100	100
Agriculture and mining (A–B)	4.2	2.3	1.9	2.1	1.4	1.0	3.1	2.1	2.7
Agriculture, forestry and fishing (A)	3.6	1.9	1.5	1.3	1.1	0.8	1.6	1.0	1.1
Mining and quarrying (B)	0.6	0.4	0.5	0.8	0.3	0.2	1.5	1.1	1.6
Total manufacturing (C)	21.5	20.1	17.5	27.1	22.3	21.5	15.7	14.2	11.7
Food and textiles (10–15)	4.1	3.0	2.2	3.5	2.5	2.0	2.6	2.2	1.6
Food products, beverages and tobacco (10–12)	2.6	2.1	1.8	2.4	2.0	1.7	1.8	1.7	1.4
Textiles, wearing apparel, leather and related prodcuts (13–15)	1.5	0.8	0.4	1.0	0.5	0.3	0.8	0.5	0.2
Basic materials (16–25)	10.1	9.7	8.3	10.7	9.0	8.3	6.9	6.0	5.3
Wood and paper products; printing and reproduction of recorded media (16–18)	2.7	2.6	1.9	1.8	1.6	1.1	1.5	1.3	0.8
Coke and refined petroleum products (19)	0.3	0.6	0.1	0.2	0.3	0.2	0.7	0.4	1.2
Chemicals and chemical products (20–21)	1.4	1.3	1.5	2.7	2.2	2.5	1.7	1.5	1.6
Rubber and plastics products, and other non-metallic mineral products (22–23)	2.3	2.1	1.5	2.3	2.0	1.7	1.0	1.1	0.7
Basic metals and fabricated metal products, except machinery and equipment (24–25)	3.5	3.1	3.3	3.7	3.0	2.8	1.9	1.7	1.1
Electrical and optical equipment (26–27)	2.5	2.5	2.1	4.0	3.2	2.8	2.0	2.2	2.1
Manufacturing, transport equipment and other manufacturing (28–33)	4.8	5.0	5.0	8.9	7.5	8.4	4.2	3.9	2.6
Machinery and equipment n.e.c. (28)	2.2	2.0	2.1	3.9	3.2	3.3	1.4	1.1	1.0
Transport equipment (29–30)	1.0	1.4	1.4	3.3	2.9	3.6	1.9	1.8	0.9
Other manufacturing; repair and installation of machinery and equipment (31–33)	1.7	1.6	1.5	1.7	1.4	1.5	0.9	0.9	0.8
Utilities (Electricity, gas and water supply) (D–E)	3.6	3.3	3.4	3.0	2.7	3.5	2.5	2.0	2.1
Construction (F)	7.2	7.7	6.8	6.2	5.3	4.5	4.3	4.7	3.5
Services (G–U)	63.5	66.7	70.3	61.7	68.4	69.5	74.4	77.0	79.9
Distribution services (G–I)	23.6	22.9	23.2	15.8	16.1	15.9	18.8	19.0	17.2
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)	14.3	13.2	13.6	9.6	10.2	10.1	13.3	13.1	11.6
Wholesale and retail trade and repair of motor vehicles and motorcycles (45)	2.0	1.7	1.5	1.4	1.5	1.4	×	×	×
Wholesale trade, except of motor vehicles and motorcycles (46)	7.0	6.7	7.3	4.2	4.2	5.0	×	6.2	5.5
Retail trade, except of motor vehicles and motorcycles (47)	5.4	4.8	4.8	4.1	4.6	3.7	×	6.9	6.1
Transportation and storage (H)	5.5	5.6	4.7	4.8	4.2	3.9	2.9	3.0	2.8
Transport and storage (49–52)	4.9	4.8	4.2	3.9	3.5	3.5	2.9	3.0	2.8
Postal and courier activities (53)	0.6	0.7	0.5	0.9	0.7	0.4	×	×	×
Accommodation and food service activities (I)	3.8	4.1	4.9	1.4	1.7	1.8	2.7	2.8	2.9
Finance and business services (J–N)	20.4	24.0	26.5	25.7	30.4	30.9	31.1	35.2	37.0
Information and communication (J)	3.1	3.3	3.1	3.5	4.2	4.0	4.7	5.3	5.6
Publishing, audiovisual and broadcasting activities (58–60)	0.6	0.8	0.7	1.1	1.3	1.3	1.3	1.4	1.4
Telecommunications (61)	1.9	1.3	1.1	1.6	1.5	1.1	2.6	2.6	2.4
IT and other information services (62–63)	0.5	1.2	1.4	0.9	1.3	1.6	0.8	1.4	1.8
Financial and insurance activities (K)	5.9	5.6	4.9	4.7	4.4	4.5	5.7	7.7	8.5
Real estate activities (L)	6.8	8.3	9.5	9.1	10.9	11.8	12.1	12.4	12.2
Professional, scientific, technical, administrative and support service activities (M–N)	4.7	6.8	9.0	8.3	10.9	10.6	8.5	9.8	10.7
Community, social and personal services (O–U)	19.4	19.8	20.6	20.2	21.9	22.7	24.5	22.8	25.7
Public administration and defence; compulsory social security (O)	6.1	6.2	5.9	6.8	6.5	6.3	14.4	12.2	13.6
Education (P)	5.6	5.4	5.6	4.2	4.5	4.5	0.8	0.9	1.1
Health and social work (Q)	5.2	5.4	6.3	5.0	6.4	7.3	5.9	6.0	7.6
Arts, entertainment, recreation and other service activities (R–S)	2.5	2.7	2.8	4.0	4.1	4.2	3.4	3.8	3.4
Arts, entertainment and recreation (R)	0.9	1.1	1.2	1.2	1.4	1.4	0.7	1.0	1.0
Other service activities (S)	1.6	1.6	1.6	2.7	2.7	2.8	2.7	2.8	2.5
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (T)	0.1	0.0	0.0	0.3	0.3	0.3	×	×	×
Activities of extraterritorial organizations and bodies (U)	×	×	×	×	×	×	×	×	×

Source: EU KLEMS database (ISIC Rev. 4).

Table A2

Labor Productivity Levels in Austria, Germany and the United States

	Austria			Germany			U.S.A.		
	1990	2000	2010	1990	2000	2010	1990	2000	2010
	EUR per hour worked at 2005 PPPs								
TOTAL ECONOMY	22	28	33	26	32	36	31	36	44
Agriculture and mining (A–B)	4	6	8	11	11	18	49	56	61
Agriculture, forestry and fishing (A)	3	5	6	8	9	16	16	24	36
Mining and quarrying (B)	49	54	98	23	28	34	113	133	105
Total manufacturing (C)	22	33	41	25	35	44	20	31	54
Food and textiles (10–15)	18	25	30	23	28	26	32	41	56
Food products, beverages and tobacco (10–12)	20	27	31	30	30	26	44	49	57
Textiles, wearing apparel, leather and related prodcuts (13–15)	14	22	28	14	21	29	17	24	56
Basic materials (16–25)	28	41	43	24	36	46	31	39	54
Wood and paper products; printing and reproduction of recorded media (16–18)	25	33	41	20	28	38	30	29	38
Coke and refined petroleum products (19)	157	503	167	86	149	145	48	130	267
Chemicals and chemical products (20–21)	26	48	71	25	47	78	36	47	61
Rubber and plastics products, and other non-metallic mineral products (22–23)	26	36	33	22	31	39	25	34	40
Basic metals and fabricated metal products, except machinery and equipment (24–25)	27	38	41	24	34	36	28	35	38
Electrical and optical equipment (26–27)	21	36	47	19	34	61	2	13	82
Manufacturing, transport equipment and other manufacturing (28–33)	21	29	38	31	37	44	24	28	40
Machinery and equipment n.e.c. (28)	24	32	38	33	43	41	28	29	47
Transport equipment (29–30)	28	37	55	34	36	54	22	27	31
Other manufacturing; repair and installation of machinery and equipment (31–33)	16	22	29	22	29	34	22	29	50
Utilities (Electricity, gas and water supply) (D–E)	54	71	78	52	73	84	60	80	78
Construction (F)	26	29	28	20	20	20	37	35	30
Services (G–U)	26	30	34	28	33	36	34	37	43
Distribution services (G–I)	20	24	27	18	21	26	25	35	44
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)	20	25	29	17	21	28	24	36	46
Wholesale and retail trade and repair of motor vehicles and motorcycles (45)	30	25	22	21	23	30	×	×	×
Wholesale trade, except of motor vehicles and motorcycles (46)	24	36	45	19	26	47	×	36	47
Retail trade, except of motor vehicles and motorcycles (47)	15	18	21	16	17	18	×	36	46
Transportation and storage (H)	20	25	27	19	25	31	23	30	38
Transport and storage (49–52)	23	27	26	19	27	35	23	30	38
Postal and courier activities (53)	8	16	30	17	20	16	×	×	×
Accommodation and food service activities (I)	19	20	22	17	15	15	34	37	40
Finance and business services (J–N)	44	47	56	52	60	58	44	46	60
Information and communication (J)	31	34	44	26	43	57	28	29	57
Publishing, audiovisual and broadcasting activities (58–60)	30	36	37	31	41	47	32	29	54
Telecommunications (61)	39	45	93	24	73	153	35	44	104
IT and other information services (62–63)	23	27	31	27	30	40	17	18	36
Financial and insurance activities (K)	32	49	76	51	59	59	27	36	50
Real estate activities (L)	210	216	222	347	354	428	249	291	346
Professional, scientific, technical, administrative and support service activities (M–N)	22	25	29	36	37	30	31	28	33
Community, social and personal services (O–U)	24	25	26	24	27	28	31	30	30
Public administration and defence; compulsory social security (O)	24	27	29	23	28	33	30	29	30
Education (P)	29	32	32	29	31	28	31	30	26
Health and social work (Q)	22	22	23	20	24	26	32	28	30
Arts, entertainment, recreation and other service activities (R–S)	20	20	22	29	29	29	32	34	31
Arts, entertainment and recreation (R)	27	26	28	31	36	30	28	32	35
Other service activities (S)	17	17	18	28	26	28	34	35	30
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (T)	14	7	7	12	12	13	×	×	×
Activities of extraterritorial organizations and bodies (U)	×	×	×	×	×	×	×	×	×

Source: EU KLEMS database (ISIC Rev. 4), Eurostat, author's calculations.

Table A3

Labor Productivity Growth in Austria, Germany and the United States

	Austria			Germany			U.S.A.		
	86–95	96–05	06–10	86–95	96–05	06–10	86–95	96–05	06–10
	*Annual change (log-difference*100)*								
TOTAL ECONOMY	2.5	1.7	1.3	2.4	1.7	0.6	1.1	2.2	0.8
Agriculture and mining (A–B)	2.5	3.3	3.8	1.6	3.0	9.3	3.2	–0.7	4.3
Agriculture, forestry and fishing (A)	4.1	2.7	2.8	0.9	6.3	10.0	0.4	6.7	3.2
Mining and quarrying (B)	–0.9	6.7	4.2	3.8	–2.8	8.5	6.1	–4.2	3.3
Total manufacturing (C)	4.0	3.2	1.0	2.7	3.2	–1.6	3.1	5.7	2.4
Food and textiles (10–15)	3.8	2.1	1.0	2.2	0.7	–2.5	2.9	2.0	1.1
Food products, beverages and tobacco (10–12)	3.9	1.5	0.7	0.1	–0.4	–3.0	2.0	–0.2	0.2
Textiles, wearing apparel, leather and related prodcuts (13–15)	2.5	3.0	1.0	4.4	3.5	–0.0	3.8	5.1	2.3
Basic materials (16–25)	3.9	1.8	–0.1	2.5	3.4	–0.3	1.7	3.8	0.6
Wood and paper products; printing and reproduction of recorded media (16–18)	4.1	1.8	1.7	2.1	3.1	3.0	–0.5	2.0	3.0
Coke and refined petroleum products (19)	8.8	–2.4	–12.9	–3.4	0.9	0.9	–0.4	13.0	–5.5
Chemicals and chemical products (20–21)	6.5	6.5	1.9	4.9	5.6	1.0	3.1	3.2	2.5
Rubber and plastics products, and other non-metallic mineral products (22–23)	2.3	2.1	–1.7	3.6	2.8	–0.5	3.1	3.0	–1.0
Basic metals and fabricated metal products, except machinery and equipment (24–25)	3.4	1.6	–0.8	3.1	2.5	–3.2	2.7	1.7	–1.2
Electrical and optical equipment (26–27)	4.7	4.1	2.0	3.8	6.6	3.7	11.5	20.8	14.1
Manufacturing, transport equipment and other manufacturing (28–33)	3.7	4.1	0.1	1.8	2.5	–4.6	1.3	3.7	–1.7
Machinery and equipment n.e.c. (28)	4.5	3.1	0.2	1.9	2.1	–6.3	1.7	2.9	0.7
Transport equipment (29–30)	1.5	3.6	1.1	1.7	1.8	–3.9	1.0	4.1	–6.9
Other manufacturing; repair and installation of machinery and equipment (31–33)	4.3	4.1	0.5	1.8	4.3	–2.1	1.5	4.1	3.0
Utilities (Electricity, gas and water supply) (D–E)	2.0	4.5	–2.5	2.7	3.3	1.9	3.9	1.8	–2.0
Construction (F)	1.5	1.0	–2.0	0.2	0.5	–2.5	–0.2	–1.6	–1.8
Services (G–U)	1.5	0.9	1.5	2.3	1.0	1.4	0.4	1.8	0.6
Distribution services (G–I)	2.4	1.3	0.8	2.3	2.3	2.1	1.9	3.7	–0.2
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)	3.0	1.9	0.4	2.5	2.8	2.6	2.2	4.3	0.2
Wholesale and retail trade and repair of motor vehicles and motorcycles (45)	–1.4	–0.6	–2.3	4.7	3.5	0.5	×	×	×
Wholesale trade, except of motor vehicles and motorcycles (46)	5.0	2.8	1.7	2.1	5.6	4.8	×	×	–0.6
Retail trade, except of motor vehicles and motorcycles (47)	1.9	1.8	0.2	2.4	–0.1	1.0	×	×	0.8
Transportation and storage (H)	2.4	0.8	1.8	3.2	2.6	1.2	2.5	3.0	0.4
Transport and storage (49–52)	1.7	–0.2	1.3	3.4	3.0	1.7	2.5	3.0	0.4
Postal and courier activities (53)	7.3	7.5	5.0	2.0	0.0	–1.7	×	×	×
Accommodation and food service activities (I)	1.0	0.1	0.7	–0.5	–1.0	1.7	–0.0	1.7	–2.0
Finance and business services (J–N)	1.1	0.4	2.5	2.3	–0.1	0.7	0.4	2.1	1.6
Information and communication (J)	3.8	1.4	1.3	3.6	2.4	7.3	2.4	4.4	2.8
Publishing, audiovisual and broadcasting activities (58–60)	2.2	2.5	0.1	2.7	0.3	6.1	0.9	4.3	0.6
Telecommunications (61)	6.5	3.7	5.5	6.6	7.7	11.8	3.1	6.0	6.4
IT and other information services (62–63)	1.1	2.2	0.1	1.1	1.6	7.1	3.8	4.3	2.6
Financial and insurance activities (K)	1.5	5.6	7.0	2.6	–1.6	5.0	1.7	3.9	1.3
Real estate activities (L)	0.4	–0.2	2.2	–0.0	1.6	1.3	1.1	0.8	4.1
Professional, scientific, technical, administrative and support service activities (M–N)	2.5	0.1	1.9	2.3	–1.0	–3.2	–0.4	1.4	0.1
Community, social and personal services (O-U)	0.5	–0.2	0.8	1.3	0.4	1.1	–0.6	–0.1	0.2
Public administration and defence; compulsory social security (O)	1.3	0.2	1.4	2.7	1.0	2.2	–0.0	0.2	0.3
Education (P)	1.6	–0.7	0.2	1.0	–0.5	–0.8	–0.4	–1.0	–0.9
Health and social work (Q)	–0.8	–0.2	1.1	0.4	1.1	1.8	–1.9	–0.3	0.7
Arts, entertainment, recreation and other service activities (R–S)	0.2	–0.0	–0.0	0.8	–0.5	0.8	–0.2	–0.3	–1.0
Arts, entertainment and recreation (R)	2.2	–1.0	1.0	2.2	–1.1	–1.8	0.1	0.7	1.3
Other service activities (S)	–0.8	0.3	–0.7	0.3	–0.3	2.0	–0.4	–0.6	–1.8
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (T)	–4.4	–2.6	3.3	–0.1	0.3	0.5	×	×	×
Activities of extraterritorial organizations and bodies (U)	×	×	×	×	×	×	×	×	×

Source: EU KLEMS database (ISIC Rev. 4), author's calculations.