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Productivity growth and global value chain participation in the digital age

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Productivity growth and global value chain participation in the digital age

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This paper provides a comprehensive overview of the current productivity trends and their potential drivers in the Euro area and in the US taking into account the ongoing digital transformation. We then investigate whether the reorganization of the production activity and the adoption of new business models as captured by the extent of Global Value Chain (GVC) participation contribute to gain fresh insights about the drivers of the productivity slowdown in the advanced economies. The analysis covers 13 European countries (AT, BE, DE, DK, ES, FI, FR, GR, IT, NL, PR, SE, UK) plus the US and 30 industries (ISIC Rev. 4) over the years 2000-2014. We empirically test the linkages between productivity growth and GVC participation in an augmented production function framework and we find: a) positive and statistically significant impact of forward and backward participation on productivity growth; b) a stronger productivity growth effect across the digital sectors of forward compared to backward linkages; c) the productivity returns of forward participation are relatively bigger in the medium intensive digital sectors. [4]

Keywords: Productivity growth, Global value chains, Digital economy.
JEL reference: O30, F23

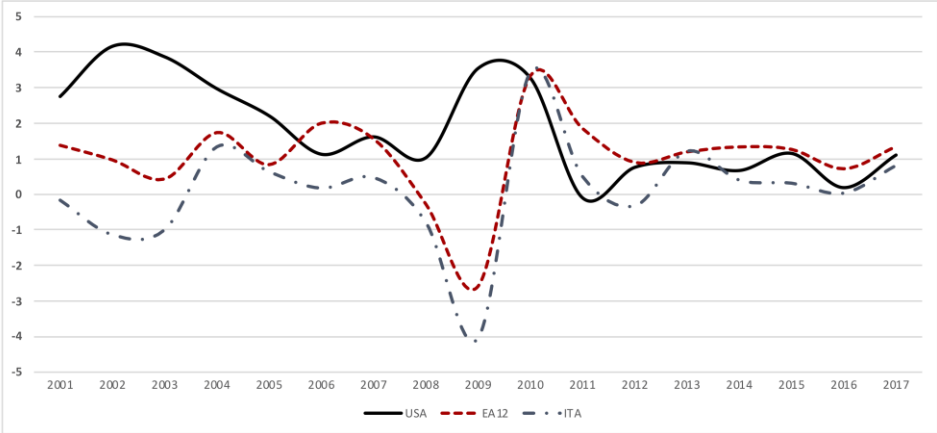
Introduction

Labor productivity growth has been declining across advanced economies since the beginning of the seventies (Bergeaud et al. 2016) experiencing a pronounced deceleration after the Great Recession (Figure 1). Many different explanations have been proposed so far about the underlying causes of this

[4] This research has been conducted within the Luiss School of European Political Economy - Istat project on “Productivity trends in the Euro Area”. We are grateful to Sergio De Nardis, Paolo Giordani, Marcello Messori, Roberto Monducci and Gianni Toniolo for useful discussions and insights to develop this research. We also thank the participants to the workshop on “Global Value Chains: Current developments and implications for Europe" NIESR, London 6th June 2019, for useful comments and suggestions. All errors are our own.

so-called secular stagnation but there is no consensus among them. Explanations vary from the view that the slowdown reflects cyclical factors related to the financial crisis to the belief that the decline is driven by longer-standing structural factors: measurement errors, misallocation of production inputs, changes in sectoral composition of the economy, reduction in the rate of technical progress and diffusion, the increasing necessity to adopt new business models to compete in the global market (ECB 2017; Jona-Lasinio et al. 2019).

Figure 1: Labor productivity growth in the Euro Area, the US and Italy (2000-2017) (%changes)



Note: The figure shows annual growth in gross value added per hour worked in Italy and EA-12 (Market Economy aggregate), and in the US (Business Sector). Source: authors' calculations based on Eurostat and BEA data.

The empirical evidence suggests that after the financial crisis, the labor productivity slowdown in the United States and Europe has been driven primarily by Total Factor Productivity (TFP) associated with a marked reduction of capital per worker (capital deepening). The analysis of the factors affecting the decline of the growth rate of capital accumulation reveals that it has been mainly determined by an accelerator response of investment to the prolonged demand weakness that contributed to reduce capital deepening (Ollivaud et al. 2018). Then the decline of capital deepening negatively influenced TFP growth via spillover effects further contributing to subdued labor productivity growth (Jona-Lasinio et al. 2019).

Such a slowdown is puzzling for several reasons and it is very difficult to identify a sole driver to account for the productivity decline in the European economies and in the US. There are relevant heterogeneities across countries that have to be taken into account when exploring the forces driving

the slowdown. Some countries may require more emphasis on demand side as opposite to supply-side factors. Additionally, the slowdown is puzzling also because the same countries are increasingly involved in the digital transformation that is expected to boost productivity-enhancing investment in innovation and to reduce the costs of a range of business processes (Pilat and Criscuolo 2018). Further, the same economies are also actively participating to the globalization of the production activity assumed to generate productivity gains, especially for digital intensive countries (Criscuolo and Timmis 2017).

The aim of this paper is to provide new empirical evidence on the factor driving the slowdown by exploring the linkages between productivity growth and GVC participation. First we offer a comprehensive overview of the current productivity trends and their potential drivers in the Euro area and in the US taking into account the ongoing digital transformation. Second to investigate whether the reorganization of the production activity and the adoption of new business models as captured by the extent of Global Value Chain (GVC) participation contributes to gain fresh insights about the drivers of productivity growth in the advanced economies over the last 15 years.

The paper is organized as follows. Section 2 provides an overview of the literature while section 3 illustrates the data used in the analysis. Section 4 offers some descriptive evidence about the drivers of the slowdown and the extent of countries' participation in GVC and its correlation with productivity growth. Section 5 presents the empirical strategy and discusses the econometric results. Section 6 concludes.

Background Literature

The rising relevance of global value chains in modern economies promoted new research efforts investigating the linkages between firms', industries' and countries' participation in GVCs and productivity gains. At the same time, another body of literature explored the potential impact of the ongoing digital transformation in the modern economies on both productivity growth and GVC participation (Pilat and Criscuolo 2018).

The exploration of the linkages between productivity growth and GVC participation in the modern economies cannot be developed without taking into account the influence of digitalization both on

productivity and participation and on their relationship. This is crucial in the understanding of the factors driving the slowdown as the digital transformation is expected to boost productivity-enhancing investment in innovation and to reduce the costs of a range of business processes (Pilat and Criscuolo 2018) thus promoting productivity growth and facilitating GVC involvement. Let's first look at the potential impact of GVC participation on productivity, to then move to the linkages between digitalization and productivity growth and to finally explore the correlation between digitalization and GVC participation.

GVC participation and productivity growth

As outlined by Criscuolo and Timmis (2017) GVCs can foster productivity growth through several channels: first, there is the classical argument of gains from specialisation: in a value chain firms can specialise in the activities (the analogous to product specialisation in the classical literature on trade liberalization) in which they are relatively more efficient and outsource the others. Then GVCs participation can affect productivity by allowing firms to have access to a larger variety of cheaper and/or higher quality and/or higher technology imported inputs. Third, GVCs facilitates knowledge spillovers stimulating the interaction of domestic firms with multinationals. Finally, similarly to the case of international trade, GVCs can give firms access to larger markets and increase competition, thus favoring the development of the most productive firms and inducing the exit of the least productive.

A different perspective to explore the correlation between participation and productivity can be identified following the literature dating back to Coase (1937) focused on the identification of the forces driving the "make or buy" decision of a firm evaluating the pros and cons of both market transactions and vertical integration. In principle, GVC participation put the firm in the position of escaping from this dichotomy, as GVC involvement permits to choose between a wide array of market-based governance arrangements representing alternatives and intermediate stages to both simple anonymous repeated spot market transactions and vertical integration. The organization of the production process along a global value chain increases the extent of modularization, given the current level of technology, thus generating productivity gains. Hortacsu and Syverson (2007) find that value chain integration increases

firms' productivity, but the cause is not vertical integration per se. The productivity improvement is connected to the ability of operating in multiple ready-mix plants and to logistical advancements.

A more recent theoretical approach was proposed by Grossman and Rossi-Hansberg (2008) showing that offshoring and GVCs generate productivity gains because of the implied finer international division of labor acting as factor-augmenting technical change. Also, Li and Liu (2012) and Baldwin and Robert-Nicoud (2014) emphasize a positive productivity effect from GVC participation driven by increased competition, greater diversity in input varieties, learning externalities and technology spillovers. Early contributions focusing on the benefits of offshoring at the country level include Feenstra and Hanson (1996); Egger and Egger (2006); Amiti and Wei 2009); Winkler (2010)) while more up to date efforts analyze the impact of vertical specialization on countries participating in GVCs (Kummritz 2016, Constantinescu et al, 2017, Del Prete et al. 2018). In particular, Kummritz (2016) considering 54 countries, 20 industries and over 5 years finds that an increase in GVC participation leads to higher domestic value added and productivity for all countries independently of their income levels. Using an instrumental variable approach, he shows that a one percent increase in backward GVC participation leads to 0.11% higher domestic value added but there is no effect on labor productivity while a one percent increase in forward[5] GVC participation leads to 0.60% higher domestic value added and to 0.33% higher labor productivity. Constantinescu et al. (2017), using data on trade in value added from the World Input-Output Database, covering 13 sectors in 40 countries over 15 years find that participation in global value chains is a significant driver of labor productivity.

Productivity and digitalisation

The literature has identified multiple mechanisms through which the ongoing digitalisation may spur productivity growth. Starting from Ark (2016) who points to the shift from ICT investment to spending on ICT services, observed in several advanced economies since 2000, as a possible source of productivity gains from digitalization. Moving from owning assets to purchasing services determines an increase in

[5] Measures of GVC participation include forward and backward linkages indicators as illustrated in section 3.1 below.

firm's business flexibility and an improvement of resource allocation by enabling sizable savings on ICT-related costs such as energy, labor or the building and maintenance of IT infrastructure. Taking a cost-saving perspective, Brynjolfsson, Rock, and Syverson (2017) also stress the efficiency gains that would be attainable from the application of machine learning and artificial intelligence to the management of energy and materials usage. Mokyr (2014) suggests that digital technologies allow to raise the utilization rate of fixed assets, as is the case with enterprises such as Uber, Airbnb and others which have created rental markets for assets that were previously lying idle most of the time.

Such predictions are supported by some studies providing evidence of a positive relation between the adoption of digital technologies and productivity at the firm level. This link may operate by fostering the adoption of improved business processes (Brynjolfsson et al. 2007), by automating routine tasks and complementing skilled workers in the execution of non-routine tasks (Akerman et al. 2015), or by facilitating product customization and the set up of production lines for new products and prototypes (Bartel et al. 2007). However, the literature is not unanimous in this respect. Acemoglu et al. (2014), DeStefano, Kneller, and Timmis (2018), Bartelsman et al. (2016) find no evidence of a positive effect of digitalisation on firm productivity, although Bartelsman et al. (2016) finds a positive impact at the industry level, attributable to spillovers, reallocation effects or firm entry and exit.

A recent study by Gal et al. (2019) further investigates the influence of digitalisation on productivity by combining firm-level cross-country data on multifactor productivity with cross-country data on adoption of a range of digital technologies at the industry level to account for spillovers from early adopters to other firms. They find evidence of a positive association between digital adoption and firm-level productivity, the effect being stronger for manufacturing industries and more generally for industries that are intensive in routine tasks as well as for firms that are already highly productive. Thus, the heterogeneity of adoption rates across industries and their different effects at the firm level contribute to explain the disappointing productivity growth of the aggregate. They also suggest that the digitalisation itself contributes to the increasing dispersion in productivity outcomes since the adoption and the exploitation of digital technologies require also managerial ability, know-how or technical skills, that are less accessible to less productive firms.

GVC participation and digitalisation

So far, we have considered separately the potential mechanisms through which GVC participation and digitalization can affect productivity growth. However, the existence of strong linkages between these two factors can be posited, so that they may better be regarded as complementary.

Digital technology may increase GVC participation through two channels: reducing transportation and communication costs thus facilitating the coordination of geographically dispersed production activities along the chain; increasing the quality and availability of a wide range of intermediate services widely used as inputs in the GVC production (Miroudot and Cadestin 2017).

The endowment of adequate technology is shown to be a crucial element for GVC participation (Amador and Cabral 2016), necessary to coordinate the different stages of production ensuring sufficient logistic efficiency. Baldwin (2006) points out how the spatial unbundling of production stages previously clustered in factories and offices in the 1990s, is largely caused by the falls in communication and coordination costs originated by the ICT revolution. As coordination and communication costs associated with international fragmentation fell below the expected cost advantages through specialization and economies of scale, companies found it more attractive to organize their production processes on an international scale (Backer and Flaig 2017).

At the same time, digital technologies may also decrease GVC participation: rising (wage) costs in emerging economies and the development of sophisticated robots reducing the costs of domestic production may favor the reshoring of activities to developed economies.

Given the complexity of the aforementioned linkages, sectors are differently affected by the unfolding of the digital transformation, depending on their rate of adoption of the new technologies as well as on a variety of complementary factors such as organizational capital or managerial and technical skills[6]. In this paper we exploit such sectoral heterogeneity to investigate whether the relation between participation in global value chains and productivity growth varies with the extent of digital intensity.

[6] See (Gal et al. 2019) for a comprehensive exposition of the possible complementarities between digital technologies and other forms of capital.

Data

The database employed in this paper includes along with GVC indicators also data on tangible capital inputs, ICT capital as well as standard growth accounting variables such as output and labor input. The main source for output, labor, tangible and ICT capital is the EU KLEMS database (see O'Mahony and Timmer (2009), for details). The source for GVC measures of participation is the WIOD database while a set of control variables are gathered from the World Bank database. Data cover the period 2000-2014 for 13 European countries (AT, BE, DE, DK, ES, FI, FR, GR, IT, NL, PR, SE, UK) plus US and 30 industries. The time coverage of our analysis is determined by the availability of WIOD data that are up to 2014.

Measures of GVC participation

To derive our measures of GVC participation we use the World Input Output Database (WIOD) tracking the origin and the destination of value added embodied in gross exports, by country and sector. We build a set of indicators to measure the extent of GVC participation following Koopman et al. (2010; 2014). These indicators are built assuming that industry's production depends on its own value added and input from other industries either domestic and foreign. By means of this decomposition we generate two standard indicators of participation to GVC: DVAX, capturing the domestic value added in foreign exports, and FVAX, measuring the foreign value added in domestic exports. DVAX and FVAX capture two different modes of GVC participation: a) "Backward" measuring the extent to which domestic firms use foreign intermediate value added for exporting activities. This is the "Buyer" perspective or sourcing side in GVCs. b) "Forward" assessing the extent to which domestic exports are used by foreign firms as inputs to produce their own exports. This is the" seller-related" measure or supply side in GVCs.

FVAX is therefore likely to be higher if a sector is involved in downstream production as opposed to DVAX that is likely to be higher for sectors conduction mainly upstream productions. Therefore, the mechanisms trough which GVC participation may potentially affect productivity growth can differ depending on the position of the firm along the chain. In principle, backward activities favor the exploitation of complementarities between domestic and foreign capabilities and the access to more advanced foreign technology potentially beneficial for growth. Forward activities instead, increase

exposure to new ideas and incentives to upgrade the production process thus facilitating gains from specialization. In the empirical analysis below we divide our GVC indicators by country i sector k gross export.

Descriptive evidence

Sources of productivity growth

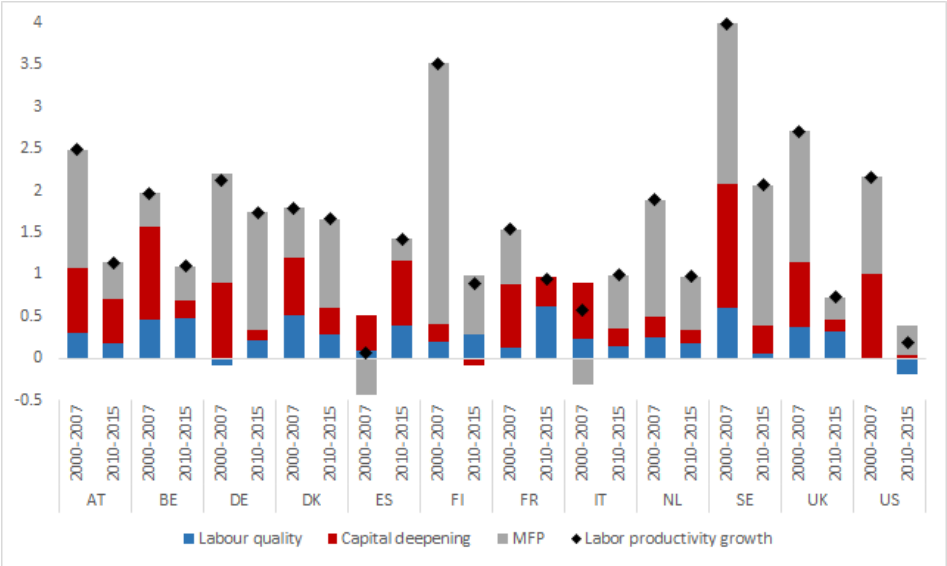
To provide evidence on the sources of the slowdown in the advanced economies first we adopt a standard growth accounting approach (GA), based on the seminal work of Tinbergen (1942) and Solow (1957), and further developed by Jorgenson and Griliches (1967) and Diewert (1976). We run a GA exercise on 12 economies (Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, UK and the US) over the years 2000-2015 distinguishing between three group of industries, "high" (HD), "medium" (MD) or "low" (LD) digital intensive, identified according to the digital taxonomy suggested by Calvino et al.(2018)[7]. On this basis we are now in the position of disentangling individual sectoral contribution to aggregate productivity growth and to assess to what extent the productivity growth differentials between countries varies with their sectoral digital intensity. Table 1 reports the average shares of value added for the three digital groups in 2000-2007 and 2010-2015. The data reveal that: High digital intensive sectors are expanding in the sample economies (mainly in DK, FI, UK and NLD) compared to pre-crisis years; Medium digital intensive sectors represent the largest share of value added except in UK and France; Low digital intensive sectors are instead rather heterogeneous across countries (down in DK and NLD, up in IT and FI).

[7] Sectors are ranked by their degree of digital intensity over the period 2001-2015 across five dimensions: tangible and intangible ICT investment, purchases of intermediate ICT goods and services, use of robots, proportion of ICT specialists, share of online sales.

Table 1: Total value added shares of sectors by digital intensity

Country	Share of total value added					
	HD		MD		LD	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Austria	0.26	0.27	0.43	0.42	0.32	0.31
Belgium	0.34	0.37	0.41	0.37	0.26	0.27
Germany	0.36	0.37	0.42	0.41	0.21	0.22
Denmark	0.27	0.32	0.43	0.43	0.29	0.25
Spain	0.26	0.29	0.38	0.37	0.40	0.39
Finland	0.22	0.27	0.52	0.44	0.26	0.29
France	0.36	0.38	0.37	0.33	0.27	0.29
Italy	0.31	0.32	0.43	0.39	0.27	0.29
Netherlands	0.37	0.41	0.39	0.36	0.24	0.23
Sweden	0.32	0.35	0.41	0.38	0.26	0.27
UK	0.37	0.42	0.36	0.32	0.27	0.26
USA	0.35	0.37	0.42	0.42	0.22	0.22

Figure 2: Contributions to labor productivity growth (%)



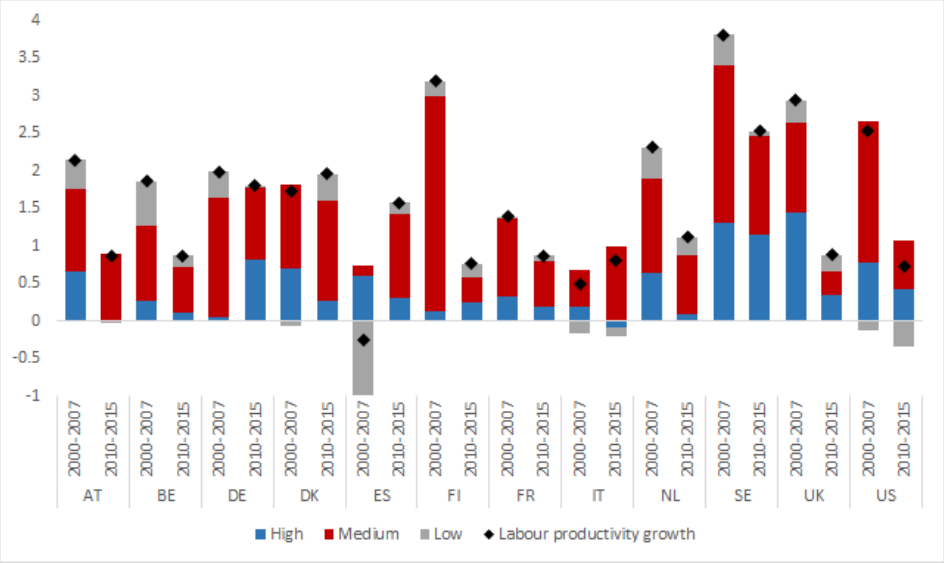
Note: The figure compares average factors contribution to annual growth in gross value added per hour worked in selected advanced economies over the periods 2000-2007 and 2010-2015. For the post-crisis years, data refer to 2010-2014 for Italy and Sweden. Source: authors' calculations based on EUKLEMS data.

Then, figure 2 presents the traditional decomposition of the sources growth in the sample countries before (2000-2007) and after (2010-2015) the financial crisis. The early 2000s were characterized by heterogeneous performances among advanced economies, with most of the countries in the sample experiencing robust labor productivity growth, and some European countries (UK, Finland, Sweden) even outpacing the performance of the US, while others (Spain, Italy, and to a lesser extent France) were lagging behind. Since 2007, however, productivity growth rates have recorded a widespread decline, resulting in a convergence towards historically low average growth rates. Some features of the slowdown are common to almost all countries, but striking differences emerge between countries, especially within Europe. In 2000 and 2007, capital deepening was the main driver of labor productivity growth in Belgium, France, Italy, Spain and Denmark (ranging from 0.4pp in Spain to 1.1pp in Belgium), whereas MFP accounted for a major share of labor productivity growth (from1.2pp in the US to 3.1pp in Finland) in the remaining economies.

In the post-crisis years the contribution of capital deepening was significantly reduced in most of the countries (-0.1pp in Finland, 0.5 pp in Austria but 0.8 pp in Spain). At the same time, the slowdown in MFP was even more widespread and dramatic, with the average growth rate being close to zero in the

US and negative in the European countries. However, if we exclude 2008 and 2009 from the calculations, we get a different, more varied picture. The contribution of MFP growth, increased after the crisis in Denmark, Germany, Italy and Spain, remained stable in Belgium, and decreasing in the remaining countries. On average, MFP has subtracted 0.02 pp per year between 2010 and 2015 to labor productivity growth in France, while providing positive contributions in all other countries, ranging from 0.26 pp in Spain to 1.41 pp in Germany. MFP is also the main driver of the growth differentials between the Mediterranean economies (Italy and Spain) and the other countries in the pre-crisis period, when it provided a negative contribution (on average by 0.32 pp and 0.45 pp respectively) to labor productivity growth. As the data show, the slowdown in capital deepening and MFP growth was partly counterbalanced by an increase in the contribution from labor quality in Finland, France, Germany and Spain.

Figure 3: Digital sectoral contributions to labor productivity growth (%)

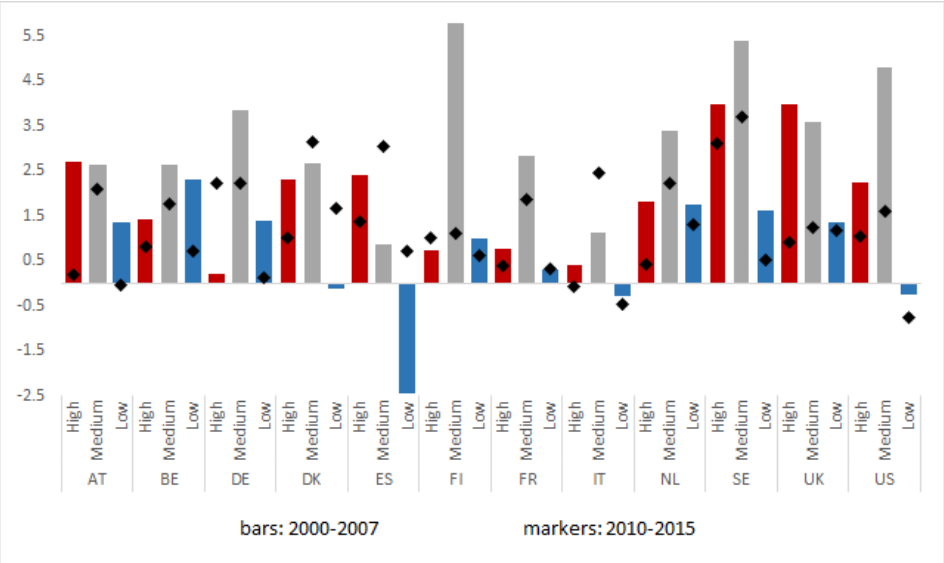


Note: The contribution of each sector to labor productivity growth of the HD, MD and LD aggregates is computed as the weighted difference between the growth rate of real gross value added and that of hours worked. For each sector, the weights are computed as the share in nominal gross value added and total hours worked respectively of total market economy aggregates. Sectors contributions are then summed up based on their digital-intensity classification. Source: authors' calculations based on EUKLEMS data.

The analysis of the growth contribution from digital sectors (figure 3) shows that medium digital-intensive sectors are the main productivity drivers across most of the sample economies (detailed results by industry are reported in the appendix) being the best performer (figure 4), compared to HD

and LD sectors. The evidence is the same after the crisis (Spain and Austria were exceptions in the years leading to the crisis, while in Germany HD sectors have been growing at the same pace as MD sectors since 2010).

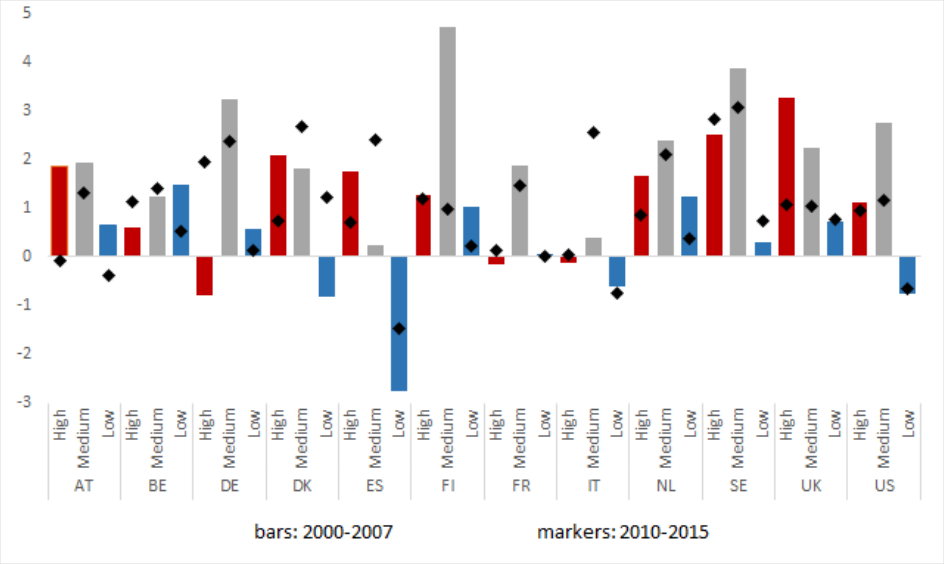
Figure 4: Labor productivity growth by sectoral digital intensity (%)



Note: Labor productivity for HD, MD and LD aggregates is calculated after constructing annual Tornqvist indices of constant price value added and of hours worked for each aggregate. Source: authors' calculations based on EUKLEMS data.

As to the HD sector, their average labor productivity growth has halved in the US after the crisis and in the European economies still lags behind, with the only exceptions of Germany, Spain and, above all, Sweden. In this respect, the performance of the Italian economy has been particularly striking, decreasing from an already small 0.4% average growth in the pre-crisis years to -0.1% between 2010 and 2015 (in both cases, the lowest values in the sample), driven by the dismal performance of MFP growth over the whole period (figure5). Countries experiencing a slowdown in MFP growth in 2010-2015 show a general widespread productivity decline across sectors, independently from the degree of digital intensity (HD sectors in France and Sweden, and LD sectors in UK and the US are the only exceptions). As to the countries where MFP growth increased, the improvement is accounted mainly to MD sectors in Denmark, Italy and Spain, and to the HD sector in Germany.

Figure 5: TFP productivity growth by sectoral digital intensity (%)



Note: MFP growth is computed by dividing the change in the volume index of gross value added by the change of a Tornqvist index of combined labor and capital inputs. Since hereby we are using hours worked as a measure of labor input, the index of combined inputs does not reflect the labor force composition eject, which is in contrast captured by the MFP.

Looking deeper into the sectoral productivity contribution reveals that Professional services have been the main drag on labor productivity growth in most countries, providing a positive contribution over the whole period only in Sweden, UK and the US. Then Wholesale and retail services is one of the main driver of aggregate productivity growth in all advanced economies, although its contribution declined in every country, with the exceptions of Italy (from an average of 0.11 pp to 0.45 pp in 2010-2015, up from 0.11pp) and Spain (from -0.19pp to 0.57pp).

In 2000-07, labor productivity growth was driven by Telecommunication services in France and Italy (where its contribution amounted on average to 0.28pp and 0.26pp, respectively), by Financial services in Spain (0.56pp), by Wholesale services in Germany (0.7pp) and in the US (0.6pp), and by the manufacturing of Electrical and optical equipment in Sweden (0.7pp). Such large contributions of Electrical and optical equipment and Telecommunications is related to the remarkably high industry growth rates recorded over this period. Between 2000 and 2007, Telecommunications experienced highly differentiated yearly rates of growth across countries recording 6% in Germany, 10% in Spain, 11% in Italy and Sweden, and 12% in France. At the same time, productivity growth was particularly high in Electrical and optical equipment increasing by 17% in the US, 15% in Sweden, 7% in France and

Germany, and around 4% in Spain and 2% in Italy. The very same sectors acting as the largest contributors to labor productivity growth before the crisis explain most of the slowdown observed at the aggregate level since 2010. Although the slowdown has been widespread across countries and sectors, a few exceptions emerge. Among them, Professional services in Spain (with average labor productivity growth increasing from -2.8% to 1.9%), IT services in Germany (from 3.2% to 5.6%), Transport equipment in France, Germany, Italy and Sweden (with increases between 0.5pp and 2.5pp), manufacturing sectors in Spain and Italy (from 2.5% to 3.4% and from 1.5% to 3.2%, respectively). These findings support the evidence that there are two different production models in Europe with the Continental and Northern EU economies adopting a tertiary based model and the Southern economies still characterized by an increasing manufacturing activity.

Global value chain participation, digitalization and productivity growth

Now let's put together the evidence on GVC participation and productivity taking into account the degree of digital intensity in the three sectoral groups. Figure 6 shows the average intensity of forward and backward participation (measured as DVAX and FVAX over gross exports) over the years 2000-2014 and distinguishing the extent of participation of high, medium and low digital intensive sectors. The scope of GVC participation varies significantly across countries and sectors. Small open economies such as Belgium and Denmark import a larger amount of input from abroad (backward participation) especially in the low digital sectors while bigger countries such as the US and UK are relatively more involved in the GVCs as suppliers of value added. Overall, the degree of forward participation is relatively homogeneous across countries, while backward participation appears significantly heterogeneous. On average, the sample countries are relatively more involved in forward linkages in high and low digital intensive sectors. On the other hand, backward linkages appear as a main mode of participation for the medium intensive digital industries that are predominantly in manufacturing. As for the Southern European economies, forward participation in Italy is close to the sample average but backward participation is lower particularly in the high digital sector. Alternatively, Spain has a very low involvement in forward linkages as opposed to a higher intensity in backward connections along the GVC.

Figure 6: GVC participation in the digital sectors: average values over the years 2000-2014

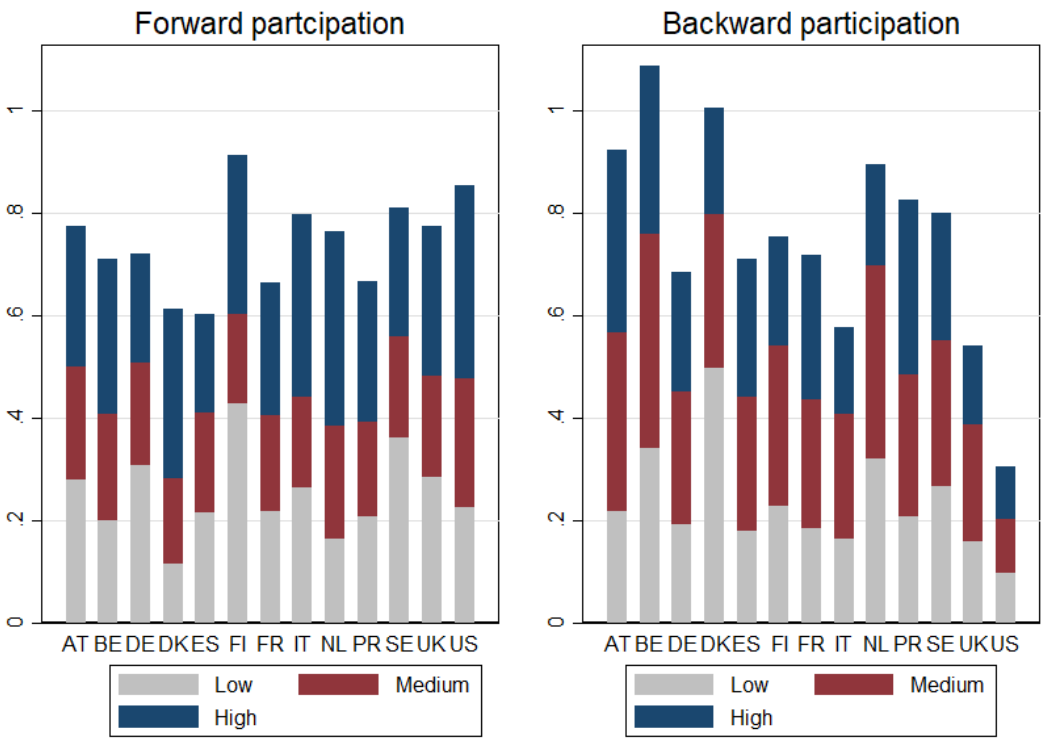


Figure 7 and 8 show the average rate of participation distinguishing the partner economies whether they are intra or extra euro area. Accounting for this dimension provides additional insights to check whether belonging to an integrated market makes a material difference between forward and backward linkages. Economic integration might favor GVC participation simply eliminating currency risk and tariffs. When production processes encompass multiple border crossings, as in GVC production, the trade costs are amplified, and can affect the competitiveness of the entire value chain. Moreover, euro area countries present a shared business climate which could boost participation lowering intra-firms monitoring costs. Our sample economies show stronger forward linkages intra euro area compared to the extra euro area especially in the high digital sector. Backward linkages are instead more differentiated. The EU countries have higher propensity to produce intermediate goods and services used into the assembling processes taking place in small euro area countries such as the various Central and Eastern European economies who joined the eurozone lately. Moreover, we find stronger

intra euro area forward linkages in the high digital sectors likely because high digital intensive productions are mainly characterized by lower relatively transaction and labour costs thus determining smaller incentives for high income countries to outsource this type of production.

Figure 7: Forward participation intra and extra EA

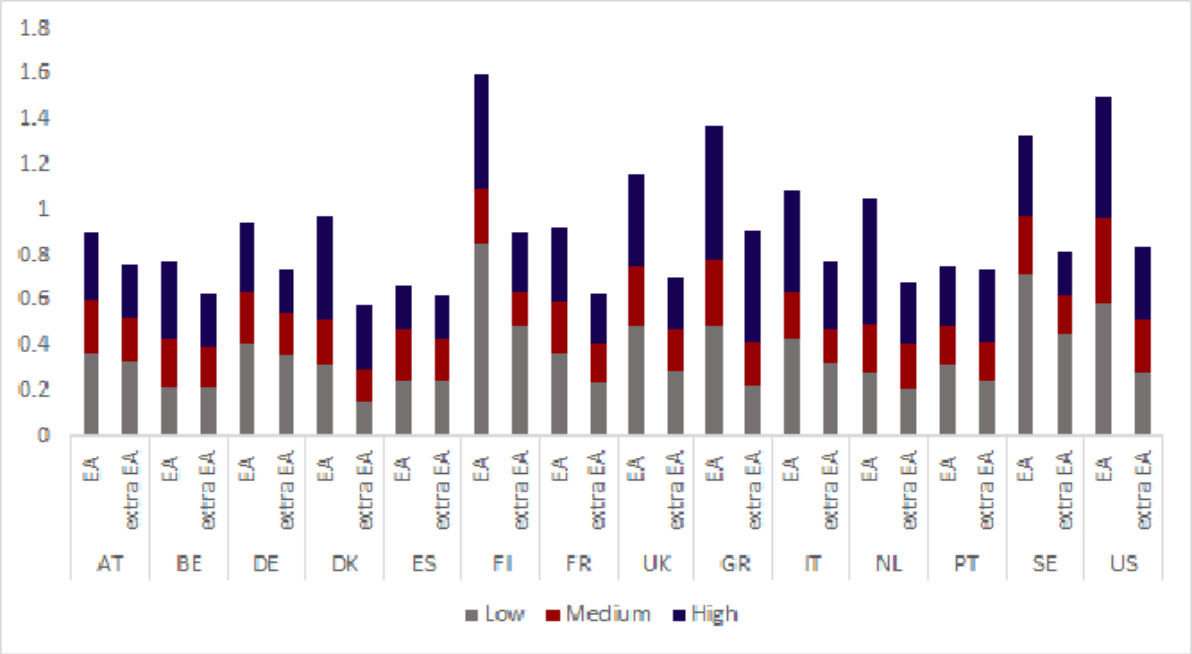
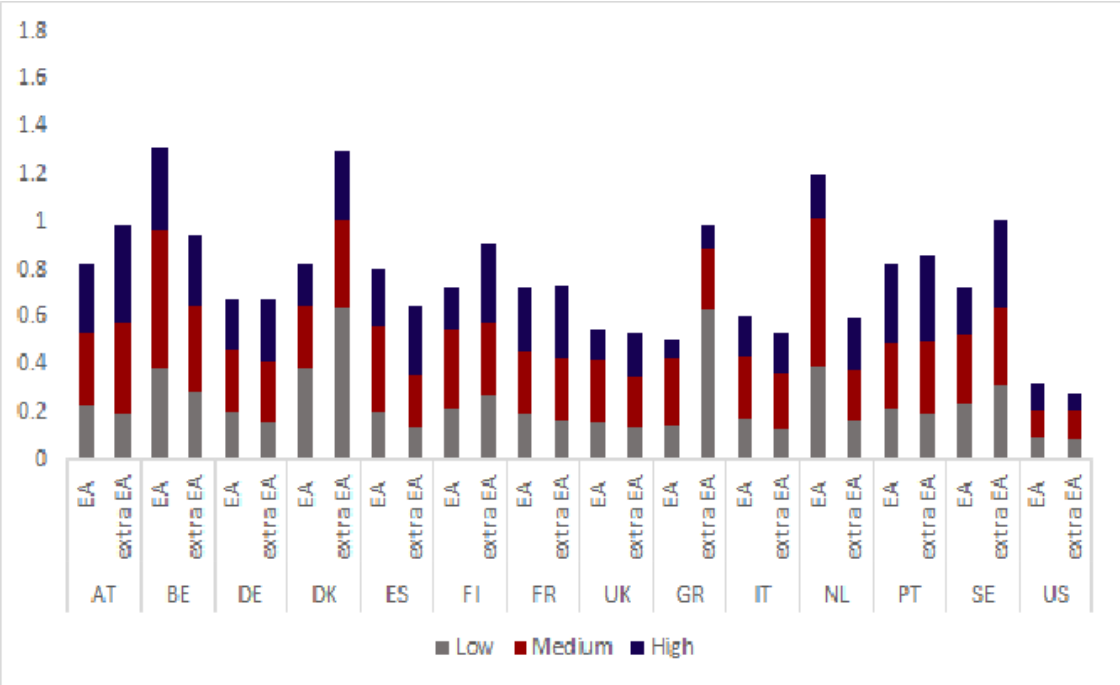
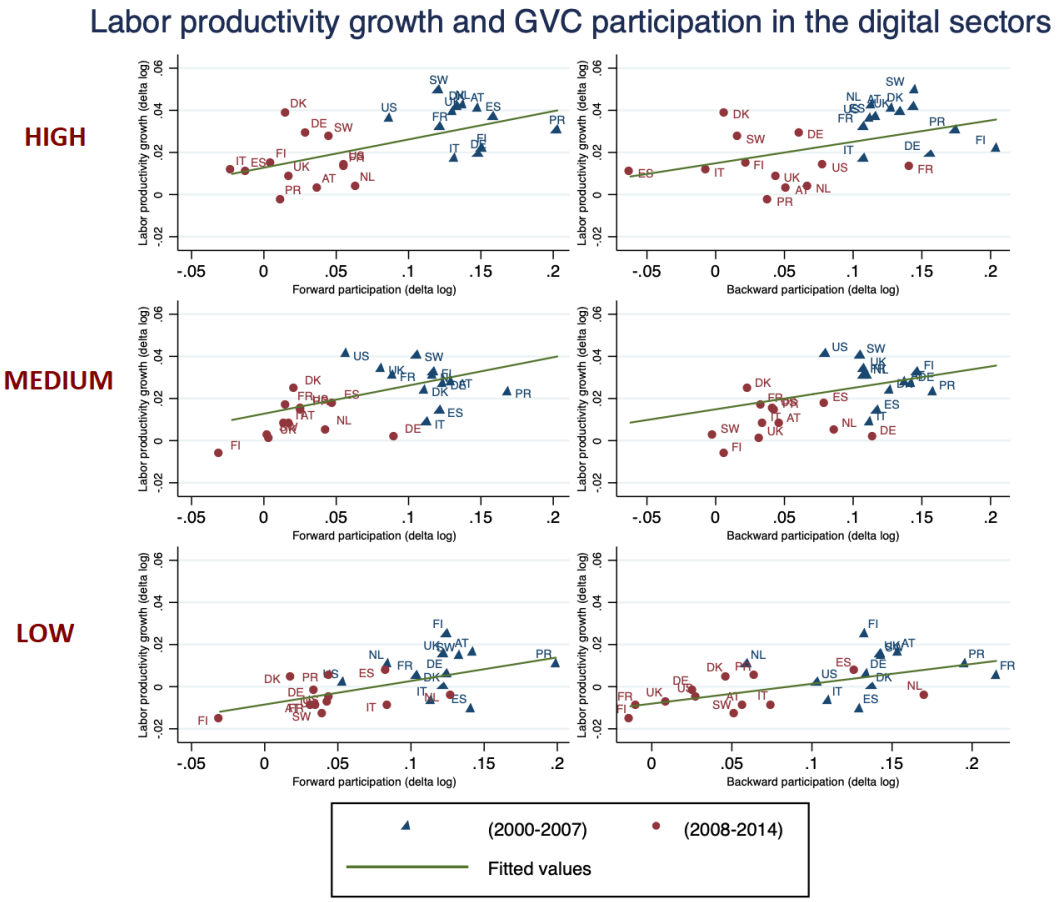


Figure 8: Backward participation intra and extra EA



As the main goal of our analysis is to investigate if and to what extent global value chain participation is related to labour productivity growth taking into account the scope of the digital transformation, figure 9 shows the relationship between the average rates of growth of labour productivity and GVC participation (both for forward and backward) in high and low digital intensive sectors across the sample economies. We split our time span showing the average values before (2000/2007) and after crisis (2008/2014). Productivity growth and GVC participation are positively and strongly related in high digital sectors with higher correlation for forward compared to backward participation.

Figure 9: Productivity and GVC participation growth by digital sectors



Forward and backward participation as well as productivity growth were relatively higher before the financial crisis across all sectors.

Empirical strategy

Econometric approach

We further explore the relationship between GVC participation and productivity growth estimating a standard production function augmented with measures of backward and forward participation. Our benchmark equation is as follows:

$$\Delta ln(Y/L)_{i,c,t} = \beta_0 + \beta_1 \Delta \ln(K^j/L)_{i,c,t} + \beta_2 \Delta \ln(GVC^z)_{i,c,t} + \delta_i + \gamma_t + \varepsilon_{i,c,t}$$

where c is country, i industry and t time; Y is total value added, L are hours worked, K^j is capital stock with j=total, tangible, R&D and software capital assets; GVC refers to the mode of global value chain

participation with z=dvax (forward) and fvax (backward), and δ_i and γ_t are country and time dummies. The estimation of a production function might be biased as it can violate the assumption of strict exogeneity of factor inputs, and might be affected by structural identification problems related to measurement errors and multicollinearity. Moreover, equation (3) may suffer from reverse causality because more productive sectors might be in the position of participating more intensively in GVCs reversing the direction of the relation we test. Thus, we also estimate the benchmark specification resorting to Instrumental Variables (IV) as suggested by Ackerberg et al (2015) and we follow Kummritz (2016) to identify the proper instrument for participation. We compute specific instruments a la Kummritz (2016) summing the predicted bilateral value added flows obtained combining a measure of trade and industry distance over countries and sectors.[8]

Econometric results

Table 2 shows estimation results for equation (1). All regressions contain industry and time fixed effects and are estimated by Generalized Least Squares (GLS) (odd cols) and IV (even cols). Columns 1 to 4 report results for the impact of forward participation on productivity growth while columns 5 to 8 for backward participation. Total capital stock has positive and statistically significant coefficient across all the specifications with bigger IV coefficients suggesting an underestimation bias affecting the GLS estimates. To check for a differential effect of capital assets types Cols 3,4 and 7,8 distinguish also between tangible, R&D and Software capital. Both GLS and IV estimated coefficients for the three asset types are statistically significant thus corroborating the evidence of a positive productivity impact from intangibles also in a framework accounting for GVC participation (Corrado er al, 2017). Both modes of GVC participation positively and significantly affect productivity growth with forward linkages exerting a stronger effect compared to backward participation. To judge the economic significance of our findings we look at the contribution of participation to labor productivity growth using columns 4 and 8 in Table 2. The contribution from forward participation accounts for 0.008 percentage points per year of a growth rate of productivity equal to 0.015 percent per year. That is a rather large contribution compared to backward participation providing a smaller contribution equal to 0.002 percentage points.

[8] The detailed description of the construction of the instruments for GVC participation is described in the appendix.

Productivity growth and GVC participation: benchmark specification

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			Forward Participation				Backward Participation	
VARIABLES	xtgls	IV	xtgls	IV	xtgls	IV	xtgls	IV
$\Delta\ln(K^{tot}/L)$	0.300***	0.503***			0.289***	0.802***		
	(0.017)	(0.106)			(0.017)	(0.217)		
$\Delta\ln(dvax)$	0.079***	0.144***	0.049***	0.114***				
	(0.006)	(0.022)	(0.005)	(0.018)				
$\Delta\ln(K^{tang}/L)$			0.086***	0.168**			0.088***	0.165**
			(0.014)	(0.077)			(0.014)	(0.077)
$\Delta\ln(K^{R\&D}/L)$			0.027***	0.035*			0.026***	0.031*
			(0.006)	(0.018)			(0.006)	(0.018)
$\Delta\ln(K^{Sw}/L)$			0.062***	0.089**			0.055***	0.096**
			(0.010)	(0.041)			(0.009)	(0.042)
$\Delta\ln(fvax)$					0.015***	0.042***	0.012***	0.027***
					(0.003)	(0.010)	(0.002)	(0.007)
Observations	3,486	2,699	2,839	2,431	3,494	2,795	2,844	2,433
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES	YES	YES	YES	YES

Table 3: Productivity growth and GVC participation accounting for digital intensities

VARIABLES	Low	Medium	High	Low	Medium	High

	Backward	Forward	Forward			Backward		
$\Delta\ln(K^{tang}/L)$	0.095***	0.0918***	0.222***	0.0881***	0.0673***	0.224***	0.0828***	0.0699***
	(0.0148)	(0.0149)	(0.0386)	(0.0233)	(0.0225)	(0.0391)	(0.0235)	(0.0224)
$\Delta\ln(K^{R\&D}/L)$	0.0279***	0.0273***	0.011	0.0346***	0.0349***	0.01	0.0391***	0.0335***
	(0.0067)	(0.0066)	(0.009)	(0.0117)	(0.013)	(0.0089)	(0.0117)	(0.0129)
$\Delta\ln(K^{Sw}/L)$	0.0563***	0.0517***	0.0458**	0.0552***	0.0902***	0.0385*	0.0503***	0.0938***
	(0.011)	(0.0104)	(0.0197)	(0.0161)	(0.0224)	(0.0197)	(0.0154)	(0.0215)
$\Delta\ln(dvax)$	0.0467***		0.0259***	0.0691***	0.0369***			
	(0.00498)		(0.007)	(0.00804)	(0.0139)			
$\Delta\ln(fvax)$		0.0123***				0.011***	0.0235***	-0.0007
		(0.00227)				(0.00378)	(0.00417)	(0.00769)
$\Delta\ln(pop)$	-0.107*	-0.119*	-0.184	-0.0319	-0.121	-0.23*	-0.0388	-0.153
	(0.0635)	(0.0611)	(0.135)	(0.0924)	(0.126)	(0.133)	(0.0873)	(0.122)
$\Delta\ln(tax)$	-0.0103	-0.00857	-0.014	-0.00217	-0.0319	-0.00916	0.0004	-0.0309
	(0.0156)	(0.0149)	(0.0326)	(0.0238)	(0.0271)	(0.0326)	(0.0227)	(0.026)
$\Delta\ln(reg)$	-0.0231**	-0.0149	0.0198	-0.0522**	-0.015	0.0274	-0.0415***	-0.0085
	(0.0113)	(0.0109)	(0.023)	(0.0165)	(0.0218)	(0.0229)	(0.016)	(0.0206)
Observations	2,435	2,439	503	1,296	636	507	1,296	636
year FE	YES	YES	YES	YES	YES	YES	YES	YES
sector FE	YES	YES	YES	YES	YES	YES	YES	YES

To check the robustness of our results, in Table 3 we test the benchmark specification including some controls for country size (population), the degree of market regulation (reg) and the fiscal pressure measured as corporate tax rate (tax). Market regulation has a small impact on productivity growth,

country size is barely significant while fiscal pressure has no effect. Then columns 3 to 8 show the benchmark estimates dividing the sample into three subsamples identified according to high, medium and low digital intensity. Interestingly, R&D capital stock is not significant in the low intensive sector but highly significant in both high and medium intensive digital sectors. Software appears as a key factor for productivity growth across all sectors.

Conclusions and next steps

We explored the linkages between GVC participation and productivity growth taking into account the extent of sectoral digitalization in a sample of 13 European economies and the US in 2000-2014. Our findings confirm the existence of a positive linkage between different modes of GVC participation and productivity growth that is stronger for forward linkages in the high and medium digital intensive sectors. The correlation between participation and productivity looks relatively weaker in the low digital intensive industries. The analysis developed so far support the idea that the increasing relevance of GVC participation and the consequent reorganization of the production process might significantly affect productivity growth and that a deeper investigation of the multiple mechanisms trough which GVC participation affects productivity in the modern economies is warranted.

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Appendix

Building the indicators of GVC participation

To compute our measures of GVC participation we follow the approach suggested by Koopman et al.(2014). Suppose to have a G-country, N-sector production and trade system where matrix **X** represents gross output. Gross output can be used either as intermediate or final good. From the harmonised input-output tables we can then derive **A** the matrix of input-output coefficients, describing the units of intermediate goods needed to produce one unit of gross output. Multiplying **AX** we obtain the matrix of goods for intermediate use. The relationship between gross output, intermediate goods, and final demand goods can then be expressed as:

$$X = AX + Y$$

With **Y** representing the matrix of goof for final use. We can rearrange the previous equation as X= BY with:

$$B = (I - A)^{-1}$$

B is the Leontief inverse matrix which elements consider the total output required both directly and indirectly to produce a unit of goods for final demand. To obtain the GVC indicators we need to calculate the value-added share matrix **V** and the matrix of gross export **E**. Finally, multiplying the **V** matrix with **B** and the matrix of gross exports **E**, we get the matrix **vae**. For the general G-country N-sector case, this is given below:

$$vae = \begin{bmatrix} v_1 & 0 & \cdots & 0 \\ 0 & v_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & v_{gn} \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1g} \\ b_{21} & b_{22} & \cdots & b_{2g} \\ \vdots & \vdots & \ddots & \vdots \\ b_{g1} & b_{g2} & \cdots & b_{gg} \end{bmatrix} \begin{bmatrix} e_1 & 0 & \cdots & 0 \\ 0 & e_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & e_{gn} \end{bmatrix}$$

In a simple example with two countries (i and j) and industries (k and l) we can zoom in to see the exact matrices' content:

$$\begin{bmatrix} v_{ik} & 0 & 0 & 0 \\ 0 & v_{il} & 0 & 0 \\ 0 & 0 & v_{jk} & 0 \\ 0 & 0 & 0 & v_{jl} \end{bmatrix} \begin{bmatrix} b_{ikik} & b_{ikil} & b_{ikjk} & b_{ikjl} \\ b_{ilik} & b_{ilil} & b_{iljk} & b_{il}l \\ b_{jkik} & b_{jkil} & b_{jkjk} & b_{jkjl} \\ b_{jlik} & b_{jlil} & b_{jljk} & b_{jljl} \end{bmatrix} \begin{bmatrix} e_{ik} & 0 & 0 & 0 \\ 0 & e_{il} & 0 & 0 \\ 0 & 0 & e_{jk} & 0 \\ 0 & 0 & 0 & e_{jl} \end{bmatrix}$$

$$= \begin{bmatrix} vae_{ikik} & vae_{ikil} & vae_{ikjk} & vae_{ikjl} \\ vae_{ilik} & vae_{ilil} & vae_{iljk} & vae_{il}l \\ vae_{jkik} & vae_{jkil} & vae_{jkjk} & vae_{jkjl} \\ vae_{jlik} & vae_{jlil} & vae_{jljk} & vae_{jljl} \end{bmatrix}$$

From the **vae** matrix we can derive a decomposition of gross exports into value added along four dimensions: source country, source industry, using country, and using industry. For instance, vae_{ikjl} is the the value added of industry k from country i in the exports of industry l from country j Defining ik as the domestic country i industry k and jl as the foregin country j industry l, DVAX of ik, the forward linkage indicator is obtained as:

$$DVAX_{ik} = \sum_{l} \sum_{j} vae_{ikjl}$$

With $i \neq l$. It represents the row sum of the elements of the vae matrix of country i sector k and is equal to the sum of value added from the domestic industry k of country i in the exports of all industries l in all foreign countries j.

FVAX of ik, the backward linkage indicator is obtained as:

$$FVAX_{ik} = \sum_{l} \sum_{j} vae_{jlik}$$

With $i \neq l$. It represents the column sum of the elements of the vae matrix of country i sector k and is equal to the sum of value added from all industries l of all foreign countries l in the exports of industry k in country i.

Instrumenting GVC participation

The estimation of our benchmark equation may violate the assumption of strict exogeneity therefore we choose to follow the (Kummritz 2016) approach instrumenting for GVC participation.

Both the GVCs indicators we use are calculated summing up for each country and sector combination, bilateral value added flows, therefore to build our IV we need at first to predict the bilateral value added flows then used as instruments in a 2SLS. To predict the vae_{ijkl} flows we need to take in account two dimensions: the distance between countries i and j and the distance between industries k and j. We could estimate country distance using the bilateral trade costs and the industrial distance as the number of intermediate stages between them: the interaction of these two components will be use in a "zero" stage to instrument the vae bilateral flows.

The gravity model augmented to consider GVCs (Noguera 2012) shows how the vae_{ij} flow depends not only on the bilateral trade costs τ_{ij} but also on the trade costs τ_{ic} of all the countries which sent indirectly value added to j through i mediation. If we exclude τ_{ij}, namely the trade cost between the two countries we are considering, we can use the normalised sum of the bilateral trade costs to predict the country distance component of the vae_{ij} flow. Given the exclusion of τ_{ij}, the indirect bilateral cost has the advantage to be exogenous respect to the vae_{ij} flow we try to instrument.

Thus, the first part of the instrument will be the average trade cost weighted by the trade partner export share:

$$\tau_{ijt} = \sum_{c} \tau_{ict} * \frac{e_{ict}}{\sum_c e_{ict}}$$

Where $c \neq i, j$

Considered the country level we need to address the industry one. To instrument GVC participation we need to take into account also industrial distance since, the value added between sectors could flow directly if the sectors are close or it can flow indirectly via other sectors if they are involved in different stages of production Thus, the larger the industrial distance, the larger the probability that third sector affects the trade relation.

The industrial distance is calculated using upstreamness and downstreamness developed by (Antràs and Chor 2013):

$$upstreamness_k = \sum_j \sum_l \frac{a_{ikjl} * y_{ik}}{y_{lj}} * upstreamness_l$$

$$downstreamness_k = \sum_j \sum_l a_{jlik} * downstreamness_l$$

Where y is total output and a the share of inputs in outputs obtained from the matrix of input-output coefficients. The indicator of industrial distance used is calculated as:

$$inddistance_{kl} = \frac{1}{upstreamness_k * downstreamness_l}$$

Where upstreamness represents how far is a sector as a seller of value added from the final demand and downstreamness represents how far is a sector as a buyer of value added from primary inputs.

Eventually, to implement the IV strategy, we need to combine these two elements to predict an instrument of the vae flows which can be used in a 2SLS strategy.

We predict the bilateral value added flows as:

$$\ln vae_{ikjlt} = \beta_0 + \beta_1 \ln(\tau_{ij} * indistance_{kl}) + \gamma_{ik} + \gamma_{ky} + \gamma_{iy}$$

And we obtain our instruments for fvax and dvax aggregating the vae flows as:

$$fvax_{ikt} = \sum_l \sum_j vae_{jlikt}$$

$$dvax_{ikt} = \sum_l \sum_j vae_{ikjlt}$$

We estimate 4 different instrumental variables as in (Kummritz 2016): the first is the same as the one in (Kummritz 2016) with bilateral gross export trade costs and industrial distance aggregated for all the years in the sample, the second is estimated using bilateral gross export trade costs and industrial distance computed for every year, the third is generated using bilateral value added trade costs and

industrial distance aggregated over time in our the sample and finally the fourth is obtained using bilateral value added trade costs and industrial distance calculated for every year.

Growth accounting analysis

Table 4: Sources of growth.

Country			Contribution of component					
	Labor productivity growth		Labor quality		Capital deepening		Mfp	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Austria	2.49	1.14	0.30	0.18	0.77	0.53	1.42	0.44
Belgium	1.97	1.09	0.46	0.48	1.11	0.20	0.39	0.41
Germany	2.12	1.74	-0.08	0.21	0.90	0.11	1.30	1.41
Denmark	1.79	1.66	0.51	0.27	0.68	0.32	0.60	1.07
Spain	0.07	1.42	0.10	0.40	0.42	0.77	-0.45	0.26
Finland	3.52	0.89	0.20	0.28	0.21	-0.10	3.11	0.71
France	1.54	0.95	0.12	0.62	0.77	0.35	0.65	-0.02
Italy	0.57	0.99	0.23	0.14	0.66	0.21	-0.32	0.64
Netherlands	1.89	0.97	0.25	0.18	0.24	0.15	1.39	0.64
Sweden	3.99	2.06	0.60	0.05	1.47	0.34	1.92	1.67
UK	2.71	0.73	0.37	0.32	0.77	0.14	1.57	0.27
USA	2.16	0.19	0.01	-0.19	1.01	0.04	1.15	0.35

The table compares average factors contribution to annual growth in gross value added per hour worked in selected advanced economies over the periods 2000-2007 and 2010-2015 for the market Economy aggregate. The contribution of labor and capital is measured as the growth rate of the volume indices of labor and capital services, multiplied by the share of each input compensation in total value added. For the post-crisis years, data refer to 2010-2014 for Italy and Sweden. Source: authors' calculations based on EUKLEMS data

Table 5: Productivity growth and contributions from the digital sectors.

Country	Labor productivity growth						Sectorial Contribution					
	HD		MD		LD		HD		MD		LD	
	00/07	10/15	00/07	10/15	00/07	10/15	00/07	10/15	00/07	10/15	00/07	10/15
Austria	2.69	0.2	2.62	2.1	1.35	-0.03	0.65	-0.01	1.11	0.90	0.39	-0.01
Belgium	1.41	0.82	2.65	1.76	2.31	0.73	0.26	0.12	1.00	0.60	0.60	0.16
Germany	0.21	2.21	3.83	2.22	1.37	0.14	0.04	0.81	1.60	0.97	0.35	0.02
Denmark	2.32	1.00	2.65	3.14	-0.13	1.66	0.70	0.26	1.11	1.33	-0.08	0.37
Spain	2.40	1.37	0.87	3.04	-2.46	0.71	0.60	0.30	0.13	1.12	-0.99	0.16
Finland	0.74	1.03	5.78	1.11	1.00	0.62	0.13	0.25	2.87	0.33	0.19	0.18
France	0.76	0.40	2.84	1.86	0.29	0.33	0.32	0.19	1.04	0.60	0.04	0.08
Italy	0.40	-0.08	1.14	2.46	-0.28	-0.46	0.18	-0.09	0.49	1.00	-0.17	-0.11
Netherlands	1.80	0.41	3.40	2.23	1.75	1.29	0.64	0.10	1.25	0.78	0.42	0.24
Sweden	3.99	3.11	5.39	3.70	1.63	0.50	1.30	1.15	2.10	1.32	0.42	0.06
UK	3.98	0.92	3.60	1.25	1.34	1.17	1.45	0.34	1.19	0.32	0.30	0.21
USA	2.23	1.04	4.79	1.62	-0.24	-0.76	0.78	0.42	1.87	0.66	-0.12	-0.35

The table shows labor productivity growth (LPG) for sectors classified according to the degree of digital intensity ((Calvino et al. 2018)), and their contributions to aggregate (Market Economy, excluding Agriculture, Mining, and Manufacturing of Coke and refined petroleum products) LPG. This is calculated as the difference in the growth rates of annual Tornqvist indices of constant price value added and of labor input (hours). The contribution of each sector to LPG of the HD, MD and LD aggregates is computed as the weighted difference between the growth rate of real gross value added and that of hours worked. For each sector, the weights are computed as the share in nominal gross value added and total hours worked respectively of total market economy aggregates. Sectors contributions are then summed up based on their digital-intensity classification. Source: authors' calculations based on EUKLEMS data

Productivity growth and industry contributions

Table 6: Austria

	Labor productivity growth		Contributions of components: Labor		Capital		MFP		Contribution to aggregate labor productivity growth	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Food, beverages, tob.	3.77	1.02	0.25	0.14	0.77	0.55	2.75	0.34	0.11	0.03
Textiles	4.51	2.46	0.44	0.17	1.85	0.48	2.23	1.81	0.06	0.02
Wood and paper	3.06	4.43	0.18	0.15	0.39	0.07	2.49	4.21	0.09	0.11
Chemicals	6.00	3.37	0.25	0.11	2.19	0.76	3.56	2.49	0.12	0.09
Rubber and plastics	1.85	3.73	0.21	0.14	0.84	1.00	0.79	2.58	0.05	0.09
Metals	1.82	3.44	0.26	0.15	0.58	0.41	0.99	2.87	0.09	0.16
Electrical and optical	3.68	2.92	0.17	0.12	1.70	2.77	1.80	0.04	0.13	0.10
Machinery, equip. n.e.c.	5.94	2.16	0.24	0.13	1.83	1.27	3.87	0.76	0.19	0.09
Transport equip	6.33	2.35	0.22	0.10	2.33	1.03	3.77	1.21	0.16	0.06
Other manufacturing	3.86	4.00	0.45	0.16	0.88	0.87	2.53	2.97	0.08	0.09
Electricity, gas, water	0.97	-0.67	0.20	-0.19	0.36	0.51	0.41	-0.99	0.04	-0.02
Construction	1.21	-1.78	0.32	-0.11	0.77	-0.18	0.12	-1.49	0.12	-0.17
Wholesale, retail trade	1.59	0.86	0.14	0.03	0.10	0.42	1.34	0.41	0.27	0.16
Transportation, storage	0.99	1.08	-0.20	-0.09	1.21	0.64	-0.02	0.53	0.08	0.08
Accomodation, food	1.25	0.95	-0.07	0.13	0.18	0.45	1.14	0.37	0.05	0.07
Publishing, audiovisual	2.53	-0.67	0.85	0.19	0.77	0.06	0.92	-0.93	0.03	0.00
Telecommunications	7.37	-3.65	0.09	0.13	2.70	-0.19	4.58	-3.58	0.11	-0.07
IT, other information	2.03	1.75	0.76	0.20	0.69	0.62	0.58	0.94	0.05	0.05
Finance and insurance	4.40	0.70	0.32	0.10	0.18	0.73	3.89	-0.13	0.32	0.02
Professional services	0.72	0.02	0.12	0.38	1.14	0.16	-0.53	-0.52	-0.01	-0.06
Arts and other services	0.77	0.02	0.73	-0.13	0.26	0.21	-0.22	-0.05		
Arts, entert., recreation	0.19	0.36	0.50	-0.35	-0.09	0.23	-0.22	0.47	0.00	0.01
Other services	0.94	-0.19	0.71	0.08	0.44	0.21	-0.21	-0.47	0.02	-0.01

Low Digital Intensity Medium Digital Intensity High Digital Intensity

Table 7: Belgium

	Labor productivity growth		Contributions of components: Labor		Capital		MFP		Contribution to aggregate labor productivity growth	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Food, beverages, tob.	3.73	3.36	0.14	0.25	0.45	0.22	3.14	2.89	0.12	0.10
Textiles	5.06	-0.24	0.47	0.38	0.07	-1.59	4.52	0.97	0.07	0.00
Wood and paper	4.59	0.22	0.19	0.21	0.81	-0.77	3.59	0.77	0.08	0.01
Chemicals	1.75	2.30	0.17	0.33	2.41	0.17	-0.83	1.81	0.10	0.14
Rubber and plastics	3.50	1.32	0.26	0.39	0.43	-0.61	2.81	1.53	0.08	0.02
Metals	2.45	10.62	0.23	0.36	0.17	-0.33	2.05	10.59	0.10	0.28
Electrical and optical	5.03	-2.02	0.48	0.61	0.15	-1.34	4.40	-1.30	0.08	-0.03
Machinery, equip. n.e.c.	3.82	0.89	0.20	0.35	0.45	0.12	3.17	0.42	0.06	0.01
Transport equip	4.05	3.80	0.31	0.40	0.74	-0.83	3.00	4.23	0.09	0.05
Other manufacturing	0.83	0.41	0.28	0.33	-0.03	-0.53	0.57	0.62	0.01	0.00
Electricity, gas, water	0.21	-1.26	-0.29	0.37	-0.53	-0.11	1.04	-1.51	0.02	-0.04
Construction	3.17	0.77	0.11	0.22	1.52	0.59	1.54	-0.04	0.22	0.06
Wholesale, retail trade	2.41	0.82	0.25	0.28	1.71	0.69	0.45	-0.15	0.45	0.15
Transportation, storage	1.54	1.20	0.38	0.34	0.86	0.00	0.30	0.85	0.14	0.10
Accomodation, food	3.09	-1.42	0.03	0.11	0.77	-0.47	2.29	-1.07	0.10	-0.06
Publishing, audiovisual	0.05	1.55	0.43	0.33	1.80	1.75	-2.17	-0.52	0.00	0.01
Telecommunications	7.80	1.61	0.44	0.27	0.69	1.45	6.66	-0.11	0.21	0.01
IT, other information	0.93	1.43	0.40	0.22	2.42	1.25	-1.90	-0.04	0.05	0.05
Finance and insurance	2.14	3.29	0.29	0.28	1.44	-0.52	0.41	3.53	0.14	0.25
Professional services	0.01	-0.17	0.16	0.29	0.83	-0.14	-0.99	-0.32	-0.26	-0.25
Arts and other services	0.53	0.56	0.41	0.59	0.71	0.18	-0.58	-0.21		
Arts, entert., recreation	-2.63	0.01	0.23	0.27	0.79	0.11	-3.65	-0.38	-0.03	-0.01
Other services	1.74	0.74	0.55	0.75	0.46	0.11	0.73	-0.12	0.03	0.01

Low Digital Intensity Medium Digital Intensity High Digital Intensity

Table 8: Germany

	Labor productivity growth		Contributions of components: Labor		Capital		MFP		Contribution to aggregate labor productivity growth	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Food, beverages, tob.	0.19	1.27	0.04	0.32	0.27	-0.20	-0.12	1.15	0.01	0.03
Textiles	4.44	2.49	0.15	0.32	0.80	0.30	3.49	1.88	0.04	0.01
Wood and paper	2.34	2.55	0.22	0.29	0.32	-0.35	1.80	2.62	0.04	0.04
Chemicals	5.00	1.13	-0.13	0.19	0.23	-1.79	4.89	2.74	0.16	0.08
Rubber and plastics	3.56	2.81	0.02	0.27	0.16	-0.58	3.38	3.12	0.09	0.07
Metals	2.26	3.79	0.06	0.30	0.43	-0.61	1.76	4.10	0.10	0.15
Electrical and optical	7.22	3.65	-0.08	0.25	1.01	-0.49	6.29	3.89	0.32	0.18
Machinery, equip. n.e.c.	3.01	2.14	0.13	0.28	0.94	-0.62	1.93	2.49	0.14	0.12
Transport equip	4.72	7.17	0.12	0.23	1.10	0.61	3.50	6.33	0.25	0.48
Other manufacturing	4.20	1.44	-0.03	0.33	0.28	-0.23	3.94	1.33	0.09	0.03
Electricity, gas, water	1.21	-0.68	-0.10	-0.15	1.15	-0.82	0.16	0.28	0.01	-0.01
Construction	-0.18	1.03	0.19	0.08	0.03	0.23	-0.40	0.72	0.11	0.05
Wholesale, retail trade	4.22	1.91	-0.15	0.31	0.45	0.43	3.92	1.16	0.66	0.28
Transportation, storage	3.39	-1.07	0.05	-0.13	1.37	0.15	1.98	-1.09	0.22	-0.07
Accomodation, food	0.07	1.05	0.11	0.17	0.02	0.03	-0.05	0.85	0.00	0.02
Publishing, audiovisual	-0.03	0.55	0.13	0.31	0.94	0.85	-1.10	-0.60	0.00	0.01
Telecommunications	6.43	6.64	-0.03	0.18	0.96	3.47	5.50	2.99	0.13	0.05
IT, other information	3.20	5.56	-0.34	0.45	-0.13	0.66	3.67	4.46	0.11	0.20
Finance and insurance	-3.19	2.02	0.23	0.00	0.09	0.44	-3.52	1.58	-0.25	0.12
Professional services	-1.52	-0.08	-0.45	0.05	1.63	-0.24	-2.70	0.12	-0.20	-0.05
Arts and other services	-0.38	0.27	-0.22	0.28	0.57	0.25	-0.72	-0.26		
Arts, entert., recreation	-1.31	0.61	-0.26	0.08	0.83	-0.14	-1.88	0.68	-0.03	0.01
Other services	0.01	-0.02	-0.23	0.35	0.39	0.37	-0.15	-0.75	-0.01	0.01

Low Digital Intensity Medium Digital Intensity High Digital Intensity

Table 9: Denmark

	Labor productivity growth		Contributions of components: Labor		Capital		MFP		Contribution to aggregate labor productivity growth	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Food, beverages, tob.	0.66	0.41	0.70	0.35	1.56	0.96	-1.60	-0.90	0.02	0.03
Textiles	2.26	2.27	0.98	0.39	0.82	0.30	0.47	1.59	0.02	0.01
Wood and paper	2.80	3.24	0.48	0.35	0.67	0.06	1.65	2.83	0.05	0.04
Chemicals	1.46	5.78	-0.09	0.14	2.01	1.25	-0.47	4.39	0.07	0.38
Rubber and plastics	3.29	0.89	-0.91	0.34	1.19	0.16	3.01	0.40	0.07	0.01
Metals	0.44	1.96	0.27	0.38	0.36	-0.27	-0.19	1.84	0.02	0.04
Electrical and optical	5.52	4.31	1.26	0.25	2.50	0.87	1.76	3.19	0.13	0.08
Machinery, equip. n.e.c.	4.50	5.27	-0.44	0.30	0.78	1.01	4.17	3.96	0.18	0.19
Transport equip	1.82	6.41	1.09	0.31	1.35	0.14	-0.62	5.96	0.02	0.03
Other manufacturing	3.51	6.47	-0.55	0.25	0.80	0.64	3.26	5.58	0.08	0.14
Electricity, gas, water	-0.04	1.34	-0.49	0.26	2.06	2.32	-1.62	-1.24	-0.03	0.01
Construction	-0.95	0.98	0.49	0.44	0.05	-0.01	-1.49	0.55	-0.14	0.08
Wholesale, retail trade	2.42	1.67	0.02	0.15	0.25	0.00	2.15	1.52	0.45	0.34
Transportation, storage	1.73	3.64	0.17	0.41	1.39	0.70	0.17	2.53	0.17	0.32
Accomodation, food	-2.89	-0.08	0.32	0.65	-0.46	-0.56	-2.75	-0.17	-0.10	-0.07
Publishing, audiovisual	4.44	3.97	-2.19	0.36	1.87	-0.45	4.76	4.06	0.09	0.09
Telecommunications	14.16	14.86	1.18	0.19	5.03	2.32	7.95	12.35	0.30	0.25
IT, other information	2.77	1.22	-0.28	0.45	-0.19	0.28	3.24	0.49	0.08	0.04
Finance and insurance	6.48	-0.14	0.43	0.55	-0.17	1.98	6.22	-2.67	0.57	-0.12
Professional services	-1.90	0.80	1.15	0.39	0.23	-0.10	-3.28	0.52	-0.27	0.04
Arts and other services	-0.89	0.47	0.59	0.34	0.35	-0.33	-1.82	0.46		
Arts, entert., recreation	-2.22	0.09	-0.53	0.05	-0.11	-0.94	-1.57	0.98	-0.05	0.00
Other services	-0.18	0.62	1.63	0.63	0.23	0.02	-2.04	-0.03	0.00	0.02

Low Digital Intensity Medium Digital Intensity High Digital Intensity

Table 10: Spain

	Labor productivity growth		Contributions of components: Labor		Capital		MFP		Contribution to aggregate labor productivity growth	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Food, beverages, tob.	2.79	-1.02	-0.52	0.44	0.33	1.29	2.98	-2.74	0.10	-0.05
Textiles	3.55	1.86	0.41	0.58	1.30	-0.77	1.84	2.05	0.10	0.03
Wood and paper	1.27	3.88	-0.06	0.60	1.21	0.94	0.12	2.34	0.02	0.06
Chemicals	2.42	2.39	-0.56	0.41	0.42	1.35	2.56	0.63	0.07	0.05
Rubber and plastics	0.81	3.45	0.33	0.60	0.83	0.32	-0.36	2.53	0.02	0.05
Metals	0.11	8.20	0.04	0.65	-0.03	0.53	0.10	7.02	0.01	0.23
Electrical and optical	4.27	2.93	-0.76	0.51	0.97	0.29	4.07	2.14	0.06	0.02
Machinery, equip. n.e.c.	2.74	2.66	-0.41	0.54	0.79	-0.34	2.35	2.46	0.04	0.04
Transport equip	5.48	5.10	0.25	0.54	2.30	-2.39	2.94	6.95	0.12	0.12
Other manufacturing	2.64	3.59	-0.87	0.60	-0.09	1.00	3.59	1.98	0.03	0.08
Electricity, gas, water	0.95	-1.37	-0.15	-0.11	-0.33	3.93	1.43	-5.19	0.11	-0.06
Construction	-3.92	1.60	-0.03	0.50	-0.16	3.24	-3.73	-2.14	-0.79	0.17
Wholesale, retail trade	0.56	2.60	-0.23	0.38	0.96	0.67	-0.17	1.54	-0.19	0.57
Transportation, storage	-1.21	3.04	0.81	0.50	1.41	0.99	-3.42	1.54	-0.08	0.21
Accomodation, food	-4.05	-1.00	0.03	0.18	0.53	-0.26	-4.61	-0.92	-0.34	-0.12
Publishing, audiovisual	-3.25	-0.97	-0.36	0.78	0.32	1.88	-3.22	-3.63	-0.03	-0.02
Telecommunications	10.19	7.29	-0.16	0.25	5.88	0.54	4.48	6.50	0.25	0.22
IT, other information	3.32	-0.36	0.01	0.75	-0.49	0.71	3.80	-1.82	0.07	0.01
Finance and insurance	7.20	-2.74	-0.25	0.38	0.25	2.18	7.20	-5.30	0.56	-0.26
Professional services	-2.83	1.86	0.92	0.50	0.82	0.61	-4.57	0.74	-0.40	0.21
Arts and other services	0.23	-0.49	1.08	0.70	1.05	-0.02	-1.89	-1.18		
Arts, entert., recreation	2.63	-2.55	1.49	0.62						
Other services	-2.09	1.60	0.97	0.74						

Low Digital Intensity Medium Digital Intensity High Digital Intensity

Table 11: Finland

	Labor productivity growth		Contributions of components: Labor		Capital		MFP		Contribution to aggregate labor productivity growth	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Food, beverages, tob.	6.81	-4.51	0.18	0.32	0.85	-0.69	5.79	-4.14	0.17	-0.11
Textiles	3.31	1.06	0.64	0.56	0.20	-0.77	2.47	1.26	0.04	0.02
Wood and paper	4.20	5.96	0.15	0.33	0.87	-0.49	3.19	6.11	0.25	0.22
Chemicals	3.09	3.32	0.09	0.18	1.00	0.13	1.99	3.01	0.07	0.09
Rubber and plastics	3.37	1.41	0.24	0.34	0.32	-0.08	2.81	1.15	0.08	0.02
Metals	4.38	3.22	0.09	0.38	0.01	-0.03	4.28	2.87	0.20	0.11
Electrical and optical	13.32	-1.09	0.63	0.25	4.93	1.33	7.76	-2.67	1.46	-0.25
Machinery, equip. n.e.c.	4.75	-0.07	0.11	0.30	-0.53	0.49	5.17	-0.86	0.18	0.00
Transport equip	0.60	3.45	0.10	0.41	-0.27	0.23	0.77	2.81	0.01	0.03
Other manufacturing	2.09	0.55	0.31	0.45	0.56	-0.89	1.22	0.98	0.05	0.02
Electricity, gas, water	2.50	1.51	-0.09	0.04	0.96	2.18	1.62	-0.71	0.09	0.07
Construction	-0.29	0.08	-0.27	0.10	0.36	0.00	-0.38	-0.03	-0.13	0.00
Wholesale, retail trade	3.96	1.21	0.26	0.23	-0.49	-0.02	4.19	0.99	0.53	0.19
Transportation, storage	0.39	3.44	0.12	-0.04	-0.36	0.31	0.64	3.17	0.03	0.31
Accomodation, food	2.75	-2.85	0.27	-0.09	0.02	0.00	2.46	-2.76	0.04	-0.09
Publishing, audiovisual	0.74	-1.53	0.44	0.46	-0.37	0.85	0.66	-2.84	0.02	-0.03
Telecommunications	10.71	6.90	0.22	0.23	2.10	-0.93	8.39	7.60	0.28	0.12
IT, other information	2.18	5.73	0.38	0.57	0.95	1.79	0.85	3.37	0.06	0.27
Finance and insurance	-0.79	0.63	-0.56	0.42	-1.89	-0.72	1.67	0.93	-0.01	0.02
Professional services	-0.64	-0.47	-0.65	0.56	-0.04	-0.18	0.06	-0.85	-0.18	-0.10
Arts and other services	-0.21	-2.00	0.24	0.05	-0.03	-0.20	-0.42	-1.86		
Arts, entert., recreation	-0.43	-1.77	0.03	0.04	0.07	-0.18	-0.53	-1.63	-0.02	-0.04
Other services	-0.02	-2.14	0.40	0.07	-0.09	-0.19	-0.33	-2.02	-0.03	-0.09

Low Digital Intensity Medium Digital Intensity High Digital Intensity

Table 12: France

	Labor productivity growth		Contributions of components: Labor		Capital		MFP		Contribution to aggregate labor productivity growth	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Food, beverages, tob.	1.81	1.21	0.42	0.49	0.61	-0.48	0.79	1.19	0.07	0.04
Textiles	6.35	3.42	0.58	0.65	1.42	0.06	4.35	2.71	0.09	0.02
Wood and paper	2.69	3.47	0.42	0.68	0.91	0.06	1.37	2.73	0.05	0.04
Chemicals	5.42	3.41	0.77	0.37	2.91	1.67	1.74	1.36	0.12	0.07
Rubber and plastics	4.49	1.47	-0.03	0.59	1.06	0.57	3.45	0.31	0.10	0.02
Metals	2.08	1.79	0.32	0.62	0.95	0.33	0.80	0.84	0.06	0.04
Electrical and optical	7.36	5.18	0.67	0.55	0.95	0.80	5.74	3.83	0.14	0.07
Machinery, equip. n.e.c.	5.25	3.54	0.40	0.57	1.11	0.67	3.74	2.31	0.07	0.04
Transport equip	0.85	2.02	-0.10	0.52	1.70	1.05	-0.76	0.45	0.01	0.03
Other manufacturing	3.05	1.63	-0.12	0.69	0.47	0.54	2.70	0.39	0.08	0.04
Electricity, gas, water	1.23	0.28	-0.10	-0.15	0.71	1.07	0.62	-0.64	0.06	0.04
Construction	-0.17	-1.50	-0.20	0.67	0.06	0.01	-0.03	-2.18	-0.08	-0.13
Wholesale, retail trade	1.27	1.49	0.07	0.60	0.64	0.13	0.56	0.77	0.19	0.25
Transportation, storage	0.82	1.77	0.11	0.52	0.76	0.53	-0.05	0.71	0.05	0.13
Accomodation, food	-0.67	0.50	-0.18	0.34	0.23	-0.01	-0.72	0.17	-0.06	0.00
Publishing, audiovisual	1.98	1.00	0.10	0.86	1.34	0.88	0.55	-0.74	0.05	0.02
Telecommunications	11.55	6.94	0.85	0.48	5.13	2.79	5.57	3.68	0.28	0.14
IT, other information	1.43	0.72	0.24	1.08	1.02	0.42	0.17	-0.78	0.08	0.05
Finance and insurance	1.76	0.70	-0.27	0.45	1.80	0.67	0.22	-0.42	0.12	0.07
Professional services	-1.05	-0.28	-0.41	0.66	0.26	0.02	-0.90	-0.95	-0.20	-0.07
Arts and other services	2.68	-0.37	1.29	0.85	0.66	0.13	0.72	-1.35		
Arts, entert., recreation	4.97	0.00	3.38	0.40	0.32	0.25	1.27	-0.65	0.10	-0.01
Other services	1.05	-0.73	0.52	1.25	0.19	0.01	0.33	-1.99	0.02	-0.03

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Table 13: Italy

	Labor productivity growth		Contributions of components: Labor		Capital		MFP		Contribution to aggregate labor productivity growth	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Food, beverages, tob.	0.04	2.03	0.29	0.29	0.93	0.29	-1.18	1.91	0.00	0.05
Textiles	1.32	4.40	0.53	0.29	1.33	0.69	-0.53	4.63	0.06	0.11
Wood and paper	1.22	3.50	0.42	0.32	0.11	0.79	0.69	3.05	0.03	0.06
Chemicals	1.47	4.57	0.45	0.23	1.51	0.66	-0.49	4.25	0.02	0.08
Rubber and plastics	1.58	3.42	0.55	0.30	0.17	0.77	0.87	2.24	0.04	0.07
Metals	1.91	4.25	0.58	0.32	0.36	0.37	0.96	4.30	0.08	0.16
Electrical and optical	2.48	1.78	0.56	0.27	1.27	0.63	0.66	0.61	0.05	0.03
Machinery, equip. n.e.c.	2.26	2.70	0.55	0.28	0.56	0.24	1.14	2.79	0.08	0.09
Transport equip	1.56	3.68	0.58	0.28	0.84	1.51	0.15	1.04	0.03	0.06
Other manufacturing	1.12	0.25	0.47	0.33	0.22	-0.26	0.42	0.11	0.02	0.01
Electricity, gas, water	0.31	-4.01	0.41	-0.05	2.02	-0.64	-2.13	-4.03	0.01	-0.16
Construction	-0.91	0.09	-0.27	0.43	-0.06	0.60	-0.59	-0.75	-0.17	0.11
Wholesale, retail trade	0.72	2.29	0.05	0.07	0.91	-0.14	-0.24	2.30	0.11	0.45
Transportation, storage	1.93	-0.93	0.59	0.03	0.75	0.10	0.58	-0.92	0.15	-0.08
Accomodation, food	-2.16	-0.43	-0.15	-0.09	-0.16	-0.40	-1.84	-0.02	-0.18	-0.04
Publishing, audiovisual	-0.17	-4.00	-0.10	0.19	1.04	1.49	-1.11	-5.66	0.01	-0.05
Telecommunications	10.90	4.16	0.12	0.08	4.25	6.56	6.53	-1.09	0.26	0.02
IT, other information	-0.03	-0.03	-0.04	0.22	-0.25	-0.02	0.25	0.99	0.01	0.00
Finance and insurance	2.25	2.21	0.39	-0.04	0.43	0.36	1.42	2.15	0.19	0.13
Professional services	-2.08	-1.75	-0.12	-0.09	0.22	-0.52	-2.18	-1.25	-0.25	-0.26
Arts and other services	-1.39	-1.18	0.69	0.02	0.89	-0.31	-2.97	-0.16		
Arts, entert., recreation	-1.04	-0.89	1.22	0.01	0.35	-0.36	-2.62	0.53	-0.01	-0.02
Other services	-1.87	-1.31	0.24	0.09	1.22	-0.25	-3.34	-0.62	-0.06	-0.04

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Table 14: Netherlands

	Labor productivity growth		Contributions of components: Labor		Capital		MFP		Contribution to aggregate labor productivity growth	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Food, beverages, tob.	6.81	-4.51	0.18	0.32	0.85	-0.69	5.79	-4.14	0.17	-0.11
Textiles	3.31	1.06	0.64	0.56	0.20	-0.77	2.47	1.26	0.04	0.02
Wood and paper	4.20	5.96	0.15	0.33	0.87	-0.49	3.19	6.11	0.25	0.22
Chemicals	3.09	3.32	0.09	0.18	1.00	0.13	1.99	3.01	0.07	0.09
Rubber and plastics	3.37	1.41	0.24	0.34	0.32	-0.08	2.81	1.15	0.08	0.02
Metals	4.38	3.22	0.09	0.38	0.01	-0.03	4.28	2.87	0.20	0.11
Electrical and optical	13.32	-1.09	0.63	0.25	4.93	1.33	7.76	-2.67	1.46	-0.25
Machinery, equip. n.e.c.	4.75	-0.07	0.11	0.30	-0.53	0.49	5.17	-0.86	0.18	0.00
Transport equip	0.60	3.45	0.10	0.41	-0.27	0.23	0.77	2.81	0.01	0.03
Other manufacturing	2.09	0.55	0.31	0.45	0.56	-0.89	1.22	0.98	0.05	0.02
Electricity, gas, water	2.50	1.51	-0.09	0.04	0.96	2.18	1.62	-0.71	0.09	0.07
Construction	-0.29	0.08	-0.27	0.10	0.36	0.00	-0.38	-0.03	-0.13	0.00
Wholesale, retail trade	3.96	1.21	0.26	0.23	-0.49	-0.02	4.19	0.99	0.53	0.19
Transportation, storage	0.39	3.44	0.12	-0.04	-0.36	0.31	0.64	3.17	0.03	0.31
Accomodation, food	2.75	-2.85	0.27	-0.09	0.02	0.00	2.46	-2.76	0.04	-0.09
Publishing, audiovisual	0.74	-1.53	0.44	0.46	-0.37	0.85	0.66	-2.84	0.02	-0.03
Telecommunications	10.71	6.90	0.22	0.23	2.10	-0.93	8.39	7.60	0.28	0.12
IT, other information	2.18	5.73	0.38	0.57	0.95	1.79	0.85	3.37	0.06	0.27
Finance and insurance	-0.79	0.63	-0.56	0.42	-1.89	-0.72	1.67	0.93	-0.01	0.02
Professional services	-0.64	-0.47	-0.65	0.56	-0.04	-0.18	0.06	-0.85	-0.18	-0.10
Arts and other services	-0.21	-2.00	0.24	0.05	-0.03	-0.20	-0.42	-1.86		
Arts, entert., recreation	-0.43	-1.77	0.03	0.04	0.07	-0.18	-0.53	-1.63	-0.02	-0.04
Other services	-0.02	-2.14	0.40	0.07	-0.09	-0.19	-0.33	-2.02	-0.03	-0.09

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Table 15: Sweden

	Labor productivity growth		Contributions of components: Labor		Capital		MFP		Contribution to aggregate labor productivity growth	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Food, beverages, tob.	3.60	2.74	-0.17	0.05	2.36	0.93	1.41	1.76	0.08	0.06
Textiles	3.85	1.61	0.00	0.07	0.79	-0.06	3.06	1.60	0.02	0.00
Wood and paper	2.63	1.44	0.00	0.05	1.27	0.22	1.36	1.16	0.12	0.05
Chemicals										
Rubber and plastics	4.53	2.74	0.45	0.05	0.64	0.43	3.44	2.25	0.07	0.03
Metals	2.88	7.14	-0.01	0.05	1.09	0.79	1.80	6.29	0.13	0.24
Electrical and optical	14.93	6.72	1.05	0.03	4.35	2.52	9.54	4.16	0.72	0.29
Machinery, equip. n.e.c.	6.48	6.30	1.31	0.05	1.59	2.90	3.58	3.35	0.23	0.18
Transport equip	6.02	6.54	0.90	0.05	1.14	1.39	3.97	5.11	0.26	0.22
Other manufacturing	4.76	0.01	0.28	0.06	1.13	1.34	3.35	-1.39	0.09	0.00
Electricity, gas, water	-0.54	1.28	-0.24	-0.14	-0.31	0.01	0.00	1.41	0.04	0.11
Construction	1.93	-1.31	-0.13	-0.05	0.93	-0.58	1.14	-0.67	0.12	-0.16
Wholesale, retail trade	4.69	3.10	0.42	0.17	1.12	0.04	3.15	2.89	0.71	0.48
Transportation, storage	2.08	2.46	0.11	0.16	2.22	0.58	-0.25	1.72	0.19	0.21
Accomodation, food	0.29	-1.41	0.23	-0.05	0.27	-0.68	-0.21	-0.68	-0.02	-0.15
Publishing, audiovisual	2.42	3.75	0.85	0.24	2.09	0.84	-0.52	2.66	0.05	0.08
Telecommunications	10.76	7.20	0.28	0.13	2.88	0.36	7.60	6.71	0.23	0.12
IT, other information	4.16	4.00	1.76	0.27	1.56	1.65	0.84	2.08	0.17	0.21
Finance and insurance	3.80	4.61	0.77	0.35	1.52	1.55	1.52	2.71	0.24	0.28
Professional services	2.52	1.80	1.20	-0.43	1.69	-0.14	-0.37	2.38	0.32	0.28
Arts and other services	1.41	0.67	1.47	-0.01	0.88	0.04	-0.94	0.64		
Arts, entert., recreation	0.02	-0.43	0.45	0.05	1.26	-0.34	-1.68	-0.15	-0.02	-0.04
Other services	2.38	1.65	2.41	0.13	0.29	0.22	-0.32	1.30	0.07	0.04

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Table 16: UK

	Labor productivity growth		Contributions of components: Labor		Capital		MFP		Contribution to aggregate labor productivity growth	
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Food, beverages, tob.	2.71	1.25	0.61	0.49	1.19	0.04	0.91	0.72	0.07	0.03
Textiles	7.57	-2.25	1.00	0.55	1.00	-0.90	5.56	-1.90	0.09	-0.01
Wood and paper	2.84	-1.03	0.32	0.56	0.22	-0.45	2.31	-1.13	0.05	-0.01
Chemicals	6.73	-0.52	0.41	0.33	3.06	0.24	3.27	-1.10	0.11	-0.05
Rubber and plastics	4.23	-0.28	0.71	0.56	0.63	-0.29	2.88	-0.56	0.08	0.00
Metals	4.46	2.13	0.61	0.58	0.58	-0.50	3.28	2.05	0.11	0.04
Electrical and optical	4.14	0.51	0.95	0.56	0.07	-0.32	3.12	0.26	0.07	0.00
Machinery, equip. n.e.c.	5.38	0.68	0.84	0.63	0.58	0.05	3.97	-0.01	0.07	0.00
Transport equip	4.51	7.20	0.80	0.56	1.26	-0.16	2.45	6.81	0.08	0.13
Other manufacturing	3.62	2.09	0.35	0.50	1.00	-0.19	2.28	1.78	0.07	0.03
Electricity, gas, water	0.60	-2.46	-0.55	-0.50	2.61	1.17	-1.45	-3.13	0.05	-0.03
Construction	0.36	2.61	-0.12	0.30	-0.19	0.09	0.68	2.22	0.01	0.23
Wholesale, retail trade	2.71	2.15	0.28	0.46	1.25	0.65	1.18	1.05	0.48	0.32
Transportation, storage	2.69	1.31	1.10	0.39	0.71	-0.05	0.89	0.97	0.18	0.09
Accomodation, food	1.09	-0.51	0.01	0.32	0.34	-0.03	0.74	-0.80	-0.01	-0.11
Publishing, audiovisual	2.50	2.25	0.81	0.51	-0.02	-0.52	1.71	2.26	0.07	0.07
Telecommunications	10.53	-1.00	0.31	0.38	1.55	-1.16	8.67	-0.21	0.31	-0.01
IT, other information	3.51	2.07	0.37	0.57	0.85	-0.28	2.29	1.77	0.15	0.12
Finance and insurance	5.07	-1.52	0.77	0.74	1.28	1.02	3.02	-3.28	0.51	-0.24
Professional services	2.98	2.48	0.90	0.30	0.27	-0.45	1.81	2.63	0.42	0.31
Arts and other services	-0.44	-0.28	-0.15	0.22	1.06	0.09	-1.34	-0.58		
Arts, entert., recreation	-0.21	-1.68	0.15	0.42	1.23	0.26	-1.60	-2.35	-0.02	-0.06
Other services	-0.53	0.80	-0.32	0.28	0.90	-0.06	-1.11	0.58	-0.02	0.03

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Table 17: USA

	Labor productivity growth		Contributions of components						Contribution to aggregate labor productivity growth	
			Labor		Capital		MFP			
	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015	2000-2007	2010-2015
Food, beverages, tob.	2.41	-3.00	0.14	0.16	1.30	0.52	0.98	-3.68	0.05	-0.07
Textiles	3.03	1.54	0.95	1.02	1.12	-0.29	0.96	0.81	0.06	0.01
Wood and paper	3.27	-0.05	0.26	0.29	0.96	-0.05	2.05	-0.29	0.07	0.00
Chemicals	4.84	-1.13	0.27	0.05	4.26	1.94	0.31	-3.12	0.10	-0.02
Rubber and plastics	1.45	-0.55	0.31	0.04	1.32	-0.41	-0.18	-0.19	0.02	-0.01
Metals	2.01	1.05	0.42	0.28	0.47	-0.75	1.12	1.52	0.05	0.01
Electrical and optical	16.77	4.30	0.67	-0.15	2.13	0.80	13.97	3.64	0.51	0.13
Machinery, equip. n.e.c.	4.28	0.49	0.50	0.30	0.91	-0.23	2.87	0.43	0.06	0.01
Transport equip	6.31	4.52	0.40	-0.49	1.57	-0.89	4.34	5.90	0.15	0.12
Other manufacturing	3.68	-0.61	0.43	-0.17	1.53	0.23	1.72	-0.67	0.05	-0.01
Electricity, gas, water	-1.05	-0.10	-0.03	-0.01	1.61	0.69	-2.64	-0.78	-0.03	0.02
Construction	-2.21	-0.42	0.00	0.15	0.48	-0.32	-2.69	-0.25	-0.22	-0.07
Wholesale, retail trade	2.85	1.65	0.16	0.12	1.47	0.12	1.21	1.41	0.55	0.31
Transportation, storage	1.52	-1.14	0.11	-0.03	0.31	0.02	1.10	-1.13	0.08	-0.07
Accomodation, food	1.05	0.17	0.06	-0.01	0.43	-0.61	0.57	0.79	0.00	-0.16
Publishing, audiovisual	6.71	3.72	0.36	0.44	3.64	2.01	2.71	1.27	0.39	0.21
Telecommunications										
IT, other information	6.47	3.20	0.45	0.27	0.37	0.96	5.64	1.97	0.16	0.11
Finance and insurance	2.97	0.09	0.40	0.55	1.72	0.39	0.85	-0.86	0.38	0.05
Professional services	1.26	1.19	0.48	0.14	0.91	0.00	-0.14	1.05	0.15	0.14
Arts and other services	-0.66	0.65	-0.15	0.18	0.75	0.06	-1.26	0.41		
Arts, entert., recreation	0.75	1.47	0.22	0.26	0.68	-0.14	-0.16	1.36	0.01	0.02
Other services	-1.28	0.12	-0.36	0.03	0.76	0.09	-1.68	0.00	-0.06	-0.01

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