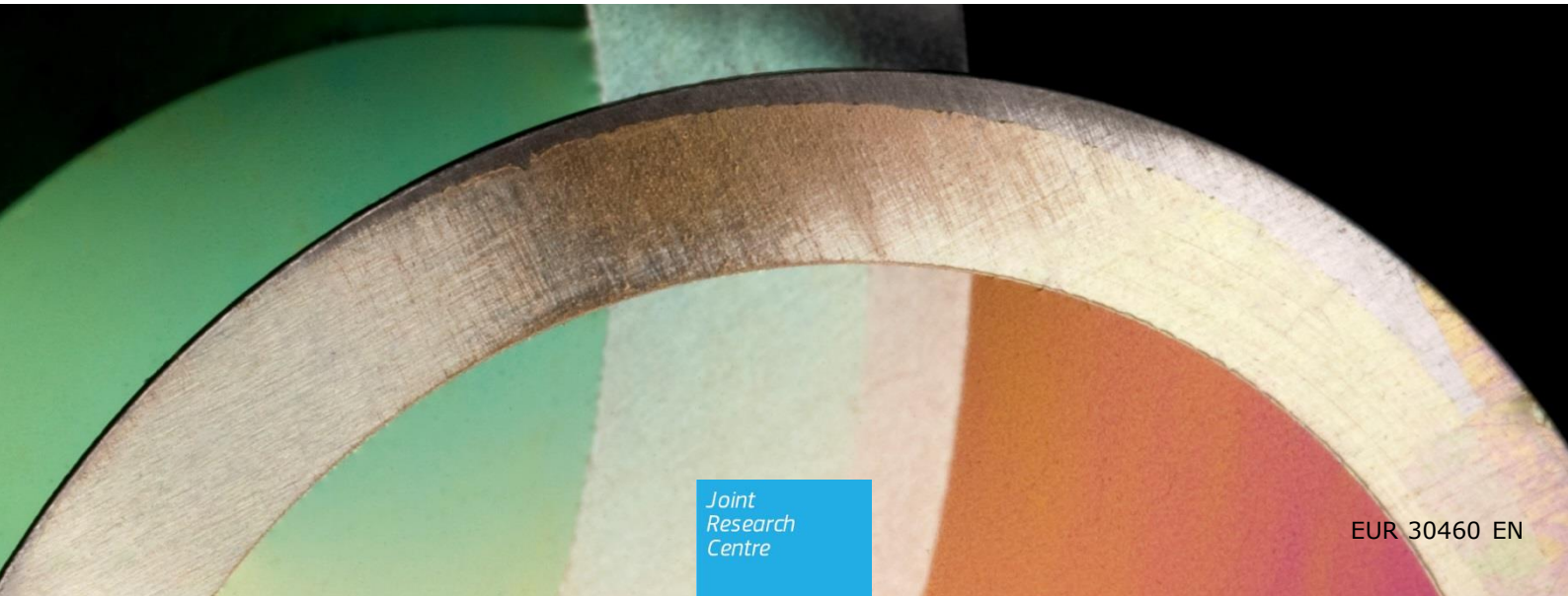
European Commission

JRC TECHNICAL REPORTS

Sectoral productivity vis-à-vis the US and heterogeneity within the EU27: the role of firm size distribution and firm demographics

Martínez Turégano, David

2020



EUR 30460 EN

This publication is a Technical report by the Joint Research Centre (JRC), the European Commission's science and knowledge service. It aims to provide evidence-based scientific support to the European policymaking process. The scientific output expressed does not imply a policy position of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use that might be made of this publication.

Contact information
Name: David Martínez Turégano
Address: C/Inca Garcilaso, 3. E-41092 Seville, Spain
Email: david.martinez-turegano@ec.europa.eu
Tel.: +34 954488334

EU Science Hub
https://ec.europa.eu/jrc

JRC122059

EUR 30460 EN

PDF ISBN 978-92-76-25439-3 ISSN 1831-9424 doi:10.2760/891199

Luxembourg: Publications Office of the European Union, 2020

How to cite this report: Martinez Turégano, D., Sectoral productivity vis-à-vis the US and heterogeneity within the EU27: the role of firm size distribution and firm demographics, EUR 30460 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-25439-3, doi:10.2760/891199, JRC122059.

Contents

Abstract

Labour productivity growth in developed economies has slowed down during the last decade relative to the pre-Great Recession period. The EU27 has been no exception to this trend, keeping both a large negative gap relative to the US and strong country heterogeneity following an uneven convergence process between Member States. Based on these stylized facts, in this paper we investigate which are the main explanatory variables accounting for productivity heterogeneity within the EU, both in level and growth terms. From a policy perspective, our findings suggest a number of areas in which action seems to be warranted, improving technological adoption, increasing innovation intensity, boosting the capital triad (human, tangible and intangible assets), and, with respect to the two micro-structural characteristics we put a focus on, eliminating barriers to growth in firm size and facilitating the entry and exit of enterprises. These same recommendations are even more valid in the specific case of business services, for which productivity performance and convergence seem more sensitive to progress in those policy areas.

JEL classification: E24, J24, L11, O47

Keywords: Productivity, convergence, sectoral heterogeneity, firm structure, business demographics.

1 Introduction

In the context of the economic crisis following the Covid-19 pandemic, in which fiscal and monetary buffers play a critical role, fostering productivity growth remains a key element to preserve living standards in the long-run. Hence, identifying and removing persistent obstacles for productivity convergence can contribute to a more sustainable economic recovery in future years. In this document we provide a comprehensive study of the variables that are thought to determine labour productivity differences both in level and dynamic terms.

A number of stylized facts over productivity developments in the last two decade provide further motivation to investigate the drivers of sectoral labour productivity across the EU27 Member States. First, we confirm that the aggregate gap relative to the US has remained persistently large. Second, there is strong sectoral and country heterogeneity in productivity levels within the EU27. And third, convergence among EU27 Member States, although in place, has not been a homogeneous process and we are still far away from closing the gap between laggards and the EU27 technological frontier.

Based on these stylized facts, we investigate which are the main explanatory variables accounting for productivity heterogeneity across EU27 Member States and economic activities, both in level and growth terms. In particular, this study focuses on micro-structural characteristics that are thought to have an impact on productivity levels and growth rates: firm size distribution and firm demographics (Chapter 7 in Bauer et al., 2020). On the one hand, productivity differences might arise not only due to divergence in overall efficiency conditions but also because of heterogeneous productivity across production units, including the observation that there is an overall positive relation between size and labour productivity. And on the other hand, if innovative firms with high growth potential enter the market in large numbers while low productivity firms exit, productivity improves by facilitating the reallocation of resources. Our analysis confirms the importance of these two characteristics and underline the case for policy action, particularly for those countries lagging behind in productivity performance.

When explaining labour productivity levels, firm size captures the strong role of sector and country effects, together with variables related to education, business R&D expenditure, capital-to-labour ratios and ICT use. In addition, we observe that, once we have accounted for both country and sector effects, higher shares of employment concentrated on larger firms appears to have a positive impact on both labour productivity levels and growth. On the other hand, we find that firm demographics are significant when explaining changes of labour productivity, with higher entry and exit rates not only contributing to higher growth but to convergence of productivity levels. Finally, when restricting the sample of economic activities to business services, the estimated sensitivity shows higher values than for regressions with all sectors in the case of firm size indicators accounting for country effects on productivity levels and firm demographics' variables when explaining productivity growth and convergence.

The remainder of this document is organized as follows. Section 2 describes the datasets used, both for the dependent variable (labour productivity) and the different blocs of explanatory variables. Section 3 provides the context for the analysis, starting with the comparison of the EU's productivity performance relative to other developed economies, then focusing on the persistent negative gap with the US and closing with the assessment of labour productivity convergence within the EU. Section 4 presents the regressions for both productivity levels and growth rates, with focus on the role of firm size distribution and demographics, as well as on results for business services. Section 5 concludes and provides the main takeaways from the policy perspective.

2 Data description

The variable of interest in our analysis is the apparent labour productivity at country-sector level, which is defined as value added divided by total hours worked. For the EU 27 Member States, we source the data from Eurostat covering 54 NACE Rev.2 economic activities (see Annex 1 for details) over the 1995-2019 period. We measure value added in constant euros (2005 or 2015 at convenience) and alternatively include an adjusted variable by industry output price levels using the GGDC Productivity Level Database (Inklaar and Timmer, 2008). For benchmarking, we complement data for EU countries with the corresponding information for the UK sourced from Eurostat and for the US and Japan from the 2019 release of EU KLEMS.

As mentioned, the focus of our analysis is on the impact of firm size distributions and business demographics on labour productivity levels and dynamics across EU country-sector pairs. For this purpose, we use a number of alternative variables in each dimension, all of them based on data from Eurostat. Namely, to capture different aspects of the firm size distribution, which potentially has an impact on differences in productivity levels, we compute the simple average size (total number of persons employed divided by the total number of establishments), the employment-weighted average firm size introduced in Kumar et al. (1999), which gives more weight to larger firms, the difference between the simple and the weighted average, and, finally, the employment share of those enterprises with less than 10 employees. On the other hand, as a potential driver of productivity changes, we capture business demographics with the birth rate (enterprise births divided by active enterprises), the death rate (enterprise deaths divided by active enterprises) and the churn rate (birth rate plus death rate), which we define for all legal forms and specifically for limited liability enterprises.

Variable	Units	Description	Underlying data source
lLP05	log	Value added over hours worked, constant euros of 2005	Eurostat
lLPppp'5	log	Value added over hours worked, constant euros of 2005, adjusted by sectoral price levels	Eurostat, Inklaar&Timmer (2008)
lLP15	log	Value added over hours worked, constant euros of 2015	Eurostat
lLPppp15	log	Value added over hours worked, constant euros of 2015, adjusted by sectoral price levels	Eurostat, Inklaar&Timmer (2008)
lFirmSize1	log	Persons employed over number of enterprises	Eurostat
lFirmSize2	log	Employment-weighted firm size	Eurostat
FirmSize3	log	lFirmSize2-lFirmSize1	Eurostat
Firm10sh	%	Share of firms with less than 10 persons employed	Eurostat
BirthRate	%	Enterprise births divided by active enterprises	Eurostat
DeathRate	%	Enterprise deaths divided by active enterprises	Eurostat
ChurnRate	%	Birth rate + Death rate	Eurostat
BirthRateLL	%	Birth rate for limited liability enterprises	Eurostat
DeathRateLL	%	Death rate for limited liability enterprises	Eurostat
ChurnRateLL	%	Churn rate for limited liability enterprises	Eurostat
lKMACHnHW	log	Net stock of machinery and equipment capital over hours worked	Eurostat
lKICTnHW	log	Net stock of ICT equipment capital over hours worked	Eurostat
lKINTnHW	log	Net stock of intellectual property capital (R&D, software and databases) over hours worked	Eurostat
Edu1	[0,1]	Education level: [0] primary, [1] secondary, [2] tertiary	Eurostat
Edu2	[0,1]	Education level with increasing marginal weights	Eurostat
RDY	%	Business expenditure on R&D over output	Eurostat
RDVA	%	Business expenditure on R&D over value added	Eurostat
ESALES	%	Turnover from e-commerce sales	Eurostat
ICTUSE1	%	Persons employed using computers	Eurostat
ICTUSE2	%	Persons employed using computers connected to WWW	Eurostat
ICTUSE3	%	Enterprises that employ ICT specialists	Eurostat
Foreign1	%	Turnover of foreign-controlled enterprises	Eurostat
Foreign2	%	Production of foreign-controlled enterprises	Eurostat
Foreign3	%	Value added of foreign-controlled enterprises	Eurostat
PMR1	[0,1]	Product Market Regulation (PMR) 2013 vintage, from 0 [open] to 1 [close]	OECD
PMR2	[0,1]	2018 PMR vintage	OECD
PMR3	[0,1]	1975-2018 PMR linked time series	OECD
STRI	[0,1]	Service Trade Restrictiveness Index	OECD
FDIR	[0,1]	Foreign Direct Investment Regulatory Restrictiveness Index	OECD

Table 1. Dependent and explanatory variables, units, description and source.

Next to these variables, and following a comprehensive approach as in Syverson (2011), we consider a number of additional explanatory variables that aspire to capture as many aspects as possible that could also have an impact on labour productivity levels and dynamics. Accordingly, we include several alternative indicators – mostly sourced from Eurostat – to capture the following characteristics: capital intensity relative to labour by asset type (stock of machinery and equipment, ICT equipment and intangibles divided by hours worked), employment quality (proxied by the weighted average of the educational level attainment of employees), business R&D expenditure (divided by output and value added), ICT and digital usage and skills (e.g. percentage of employees using computer, percentage of enterprises with in-house ICT specialists, percentage of e-commerce sales), degree of foreign control of enterprises (percentage of turnover, production and value added), and OECD regulation indicators at sectoral level (the indicators of Product Market Regulation (PMR), the Services Trade Restrictiveness Index (STRI) and the FDI Regulatory Restrictiveness Index).

3 Recent developments in the global context

In developed economies, we observe a generalized and significant slowdown of labour productivity growth following the Great Recession and subsequent crises (Figure 1), moving from a range of 1.5-2.2% average annual increases in the 1997-2007 period to less than 1% in all cases during the following decade. It´s worth noting that the EU27 doesn´t show the largest slowdown among the selected economies neither in absolute or relative terms (from 1.8% to 1.0%, 0.8 pp or 46% decline), although it´s indeed the economy falling most strongly behind in terms of labour productivity (Figure 2), showing a level relative to the US ranging between a minimum of 62% reached in 2009 and 2010 to a maximum of 68%, which in fact corresponds to the first years of the sample in the late 90s.

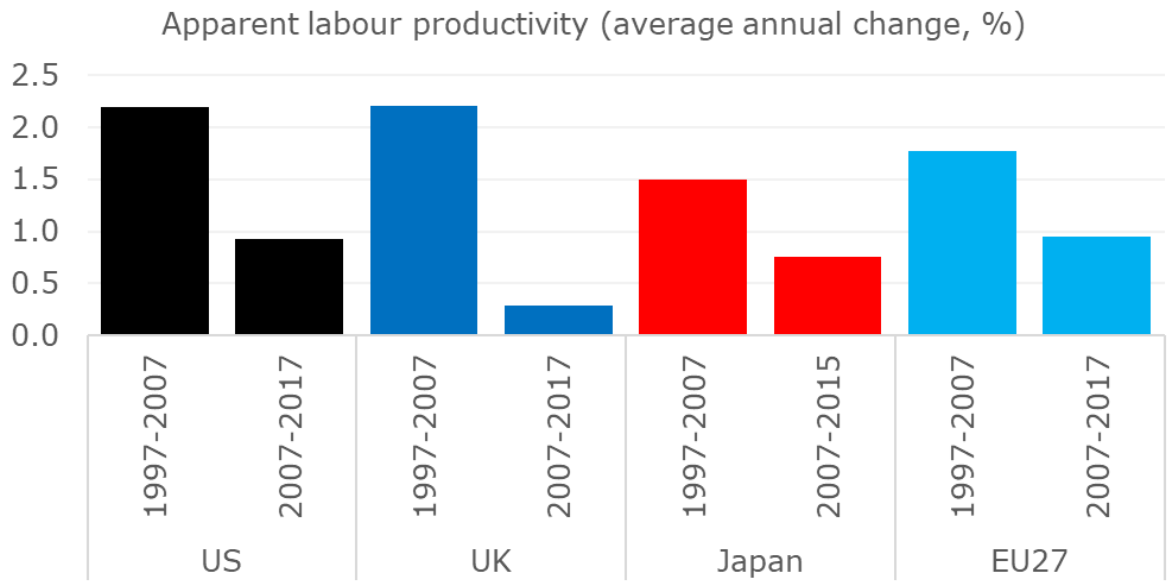


Figure 1. Value added of total economy in constant euros of 2005 divided by the total number of hours worked. Source: Eurostat, EU KLEMS.

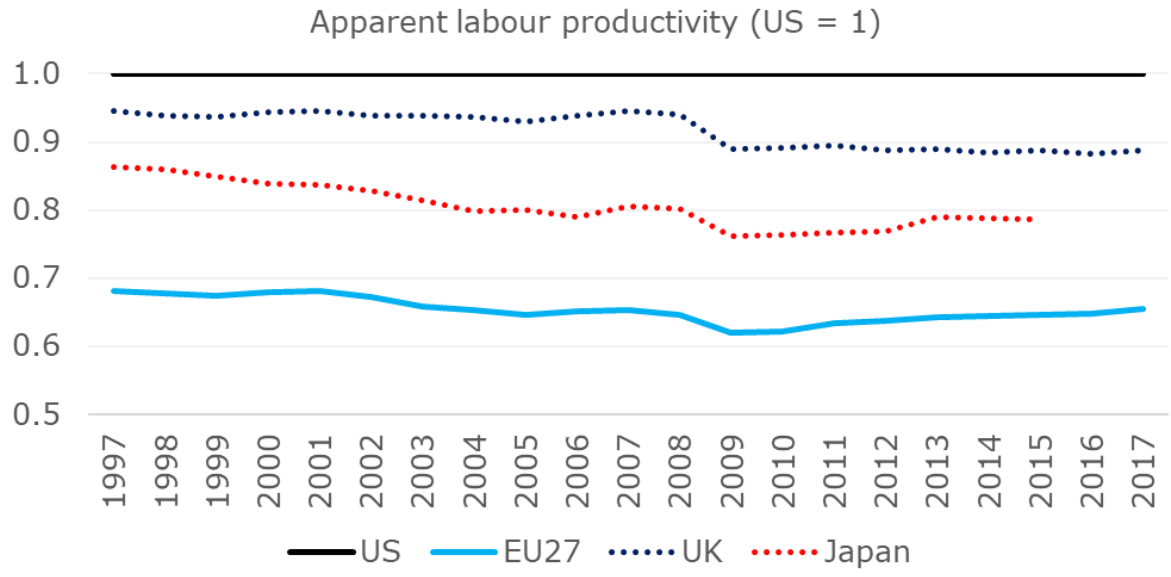


Figure 2. Value added of total economy in constant euros of 2005 divided by the total number of hours worked. Source: Eurostat, EU KLEMS.

We now investigate both the dynamics and the persisting productivity gap on a more disaggregated basis. For this purpose, and now focusing only on the comparison with the US, we decompose the contribution of sectors into a component related to the share of hours worked in the total economy, exploiting the heterogeneity of productivity levels across economic activities ('between component'), and a component accounting for

productivity differences at sectoral level relative to the benchmark ('within component'). Figure 3 illustrates these two components for three broad economic sectors (manufacturing, business services and all other activities; see Annex 1 for details), as well as the differences that arise due to divergent price levels at sectoral level.

First, productivity is highest in manufacturing and business services– hence a higher share of hours of these activities increases total productivity. Second, measured at market exchange rates, the largest productivity gap between the EU27 and the US is observed for manufacturing, although this is not the case when we restrict to the top EU10 productivity performers, for which convergence in manufacturing is almost full and the gap is larger for business services. And third, the productivity gap between the EU and the US is exacerbated in business services and, to a larger extent, in the manufacturing sector when taking into account that prices are lower in the US. This sectoral finding is consistent with divergences in the levels of economic development (Duarte and Restuccia, 2017), although the impact of switching to price-adjusted figures is very similar for the EU27 and the top EU10, suggesting the existence of additional factors that explain cheaper manufacturing products in the US – an issue that is out of the scope of this document.

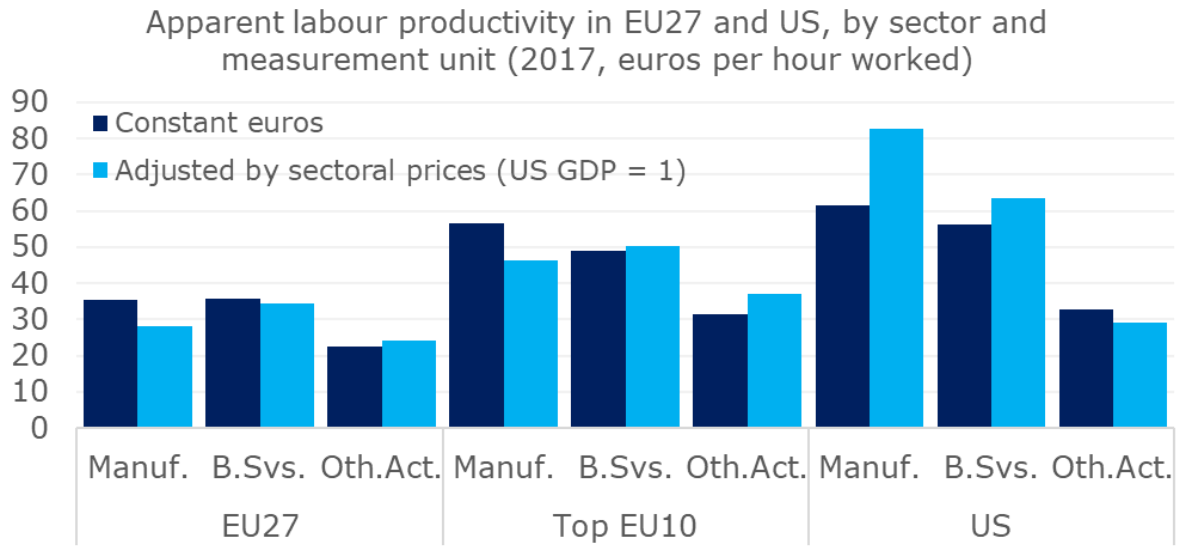


Figure 3. Value added of sectors in constant euros of 2005 divided by the total number of hours worked. Manuf. = Manufacturing, B.Svs. = Business Services, Oth.Act. = Other activities. Top EU10 is the aggregate of AT, BE, DE, DK, FI, FR, IE, LU, NL and SE. Source: Eurostat, EU KLEMS, Inklaar and Timmer (2008).

A decomposition analysis (see Annex 2 for details) shows which broad factors have been moving the overall EU27-US productivity gap drawn in Figure 2. We observe that while the net aggregate contribution of productivity gaps at sectoral level have kept increasing on average over the sample period ('within component'), the sectoral composition of the EU27 economy – in terms of hours worked - has moved to activities with higher productivity levels relative to the shift in the US economy (Figure 4), softening the former effect since 2010.

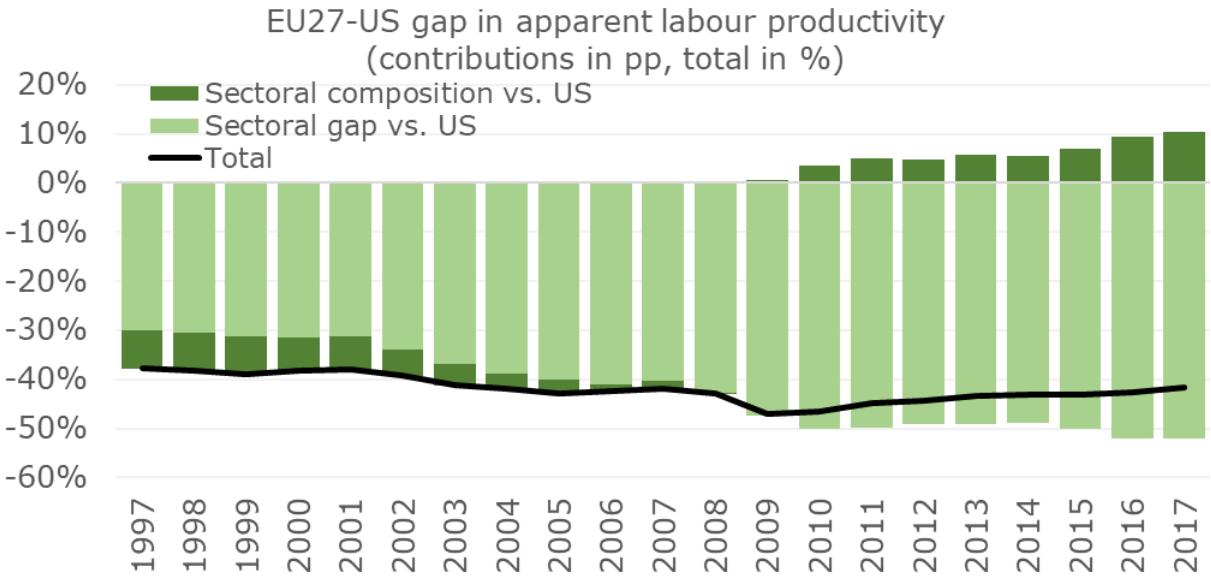


Figure 4. Apparent labour productivity defined as value added of total economy in constant euros of 2005 divided by the total number of hours worked. Source: Eurostat, EU KLEMS.

On a more disaggregated basis, dynamics in the EU27-US productivity gap during the last two decades have been dominated by developments in non-manufacturing activities (Figure 5). First, the sectoral productivity gap has widened for business services and narrowed for other economic activities (i.e. primary and non-tradables). Second, it´s worth differentiating the performance of ICT services, which show a positive contribution from the increasing share of hours worked in the EU27 towards an economic activity with very high productivity levels, but more than offset by the widening sectoral productivity gap relative to the US; this characterization intensified in the last decade.

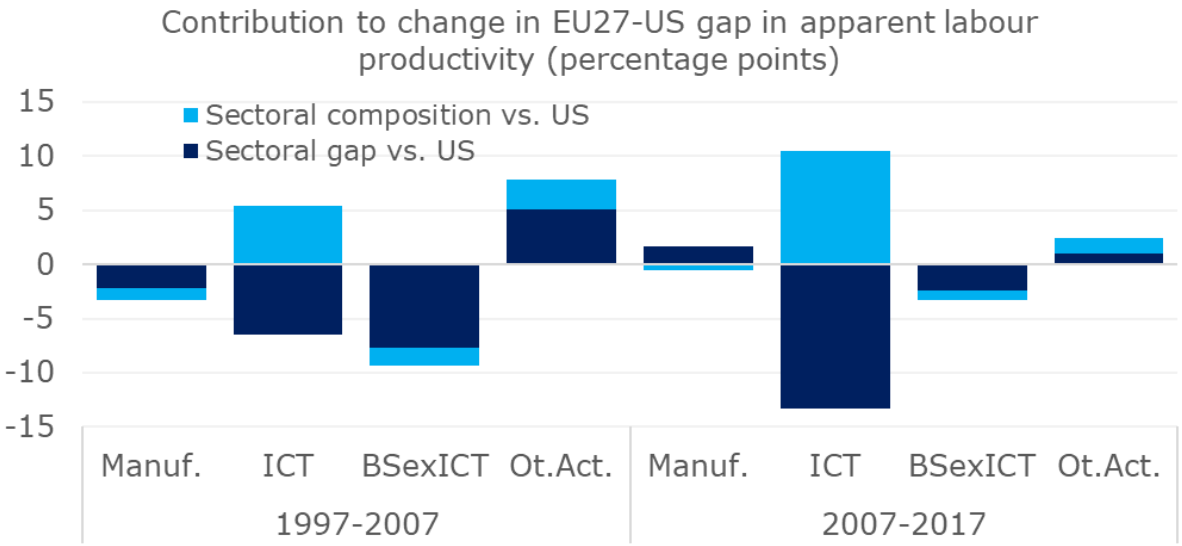


Figure 5. Apparent labour productivity defined as value added of total economy in constant euros of 2005 divided by the total number of hours worked. ICT services correspond to NACE sections J62&63, BSexICT is the aggregate of Business Services excluding ICT services. Source: Eurostat, EU KLEMS.

3.1 Heterogeneity and convergence within the EU27

One important aspect when analysing the productivity gap relative to the US is the dispersion of productivity levels across EU27 Member States. As shown in Figure 6 for 2017, a non-negligible number of countries (all of which belong to the Central and Northern European region) show a small negative gap, i.e. a similar labour productivity level than the US or even a higher one, but we still observe that the majority of Member States (located in Southern and Eastern Europe) have a significate negative gap, dragging the overall figure for the EU27 aggregate.

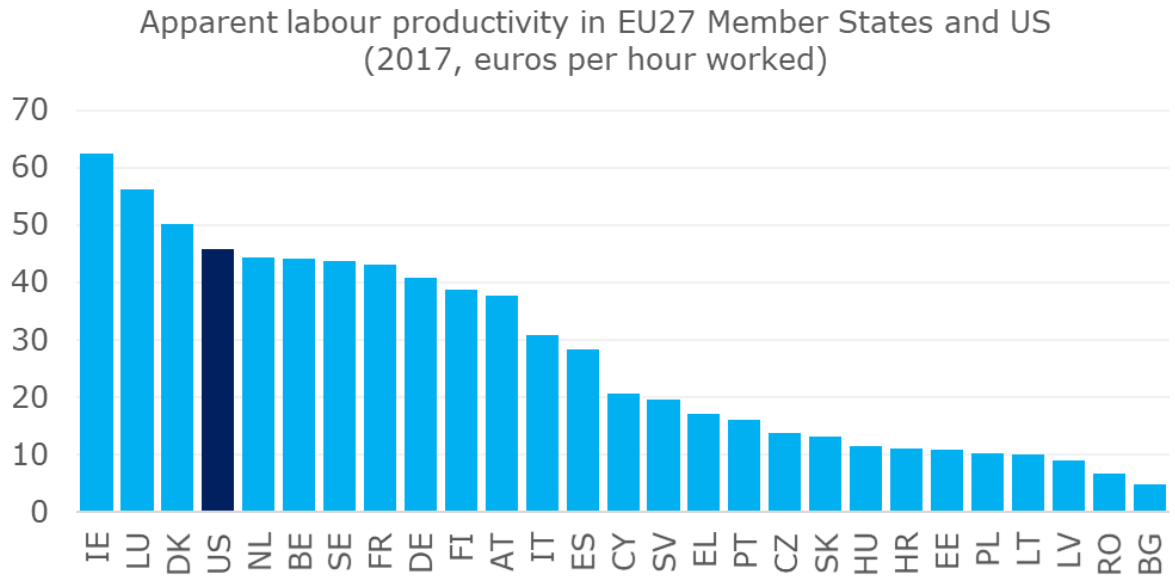


Figure 6. Value added of total economy in constant euros of 2005 divided by the total number of hours worked. No data available for Malta. Source: Eurostat.

Hence, convergence between EU27 Member States represents then an important step towards closing the labour productivity gap with the US. In that sense, progress has been observed since the late 90s, with those countries with the lowest initial productivity levels showing a larger average growth rate over two decades (Figure 7), including a higher rate than the US economy.

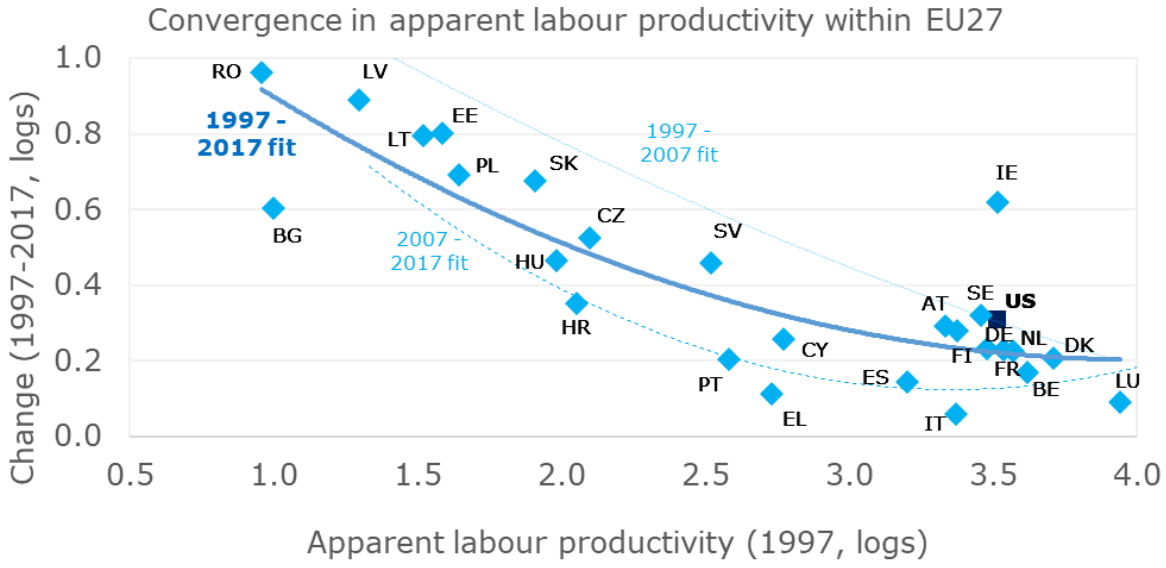


Figure 7. Value added of total economy in constant euros of 2005 divided by the total number of hours worked. No data available for Malta. Source: Eurostat.

However, a number of developments weaken the achievement of convergence. First, the process has slowed down after the Great Recession. Second, we observe some laggard countries with initial productivity at medium levels that do not seem to fulfil convergence, such as Portugal, Greece and Spain. And third, within the group of leading Member States – representing what we can consider the technological frontier of the EU27 -, only a couple of them (Ireland and Sweden) have been able to reach a higher productivity growth rate than the US, and none of the two belong to the largest EU economies, so the aggregate impact has been limited. On the contrary, Italy, which is the third largest economy in the EU27, clearly underperformed during the sample period.

4 Explaining productivity heterogeneity: the role of firm size distribution and demographics

In the previous section we have established a number of stylized facts that motivate an investigation of the drivers of sectoral labour productivity across the EU27 Member States. First, we confirmed that the aggregate gap relative to the US has remained persistently large over the last two decades. Second, there is strong sectoral and country heterogeneity in productivity levels within the EU27. And third, convergence among EU27 Member States, although in place, has not been a homogeneous process and we are still far away from closing the gap between laggards and the EU27 technological frontier.

Country and sector effects

As a first approach, and before incorporating the explanatory variables commented on before in the data section, we provide some initial estimations based on country and sectoral effects, as well as tests for the convergence hypothesis, both unconditional and conditional following Mankiw et al. (1992) and Rodrik (2013).

Table 2 shows the results of these regressions (see Annex 3 for specifications). Columns (1) to (4) correspond to the estimation of country and sector effects explaining the level of labour productivity in the years 2007 and 2017, respectively, first in constant euros at market exchange rates and second adjusted by sectoral price levels using the dataset in Inklaar and Timmer (2008). In all cases, the explanatory variables explain a substantial part of divergence in productivity levels among EU27 Member States, suggesting the existence not only of industry specific aspects (e.g. technical or technological requirements for production) generating heterogeneity in productivity levels across sectors (Figure 8), but also of important overall factors (e.g. of technological or institutional nature) conditioning a higher or lower productivity at country level (Figure 9).

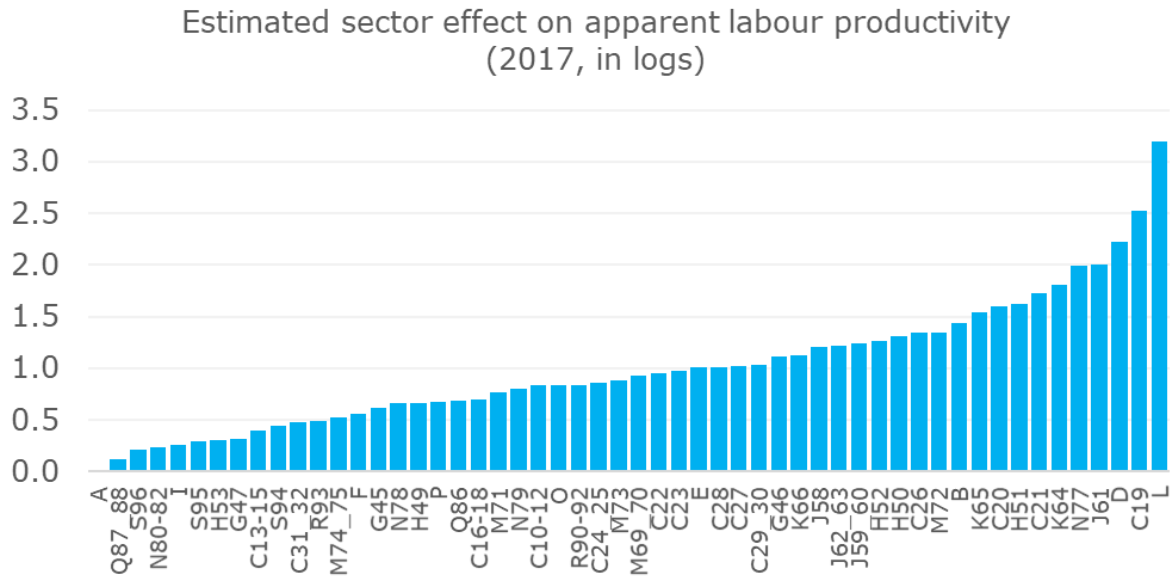


Figure 8. Estimated sector effect on apparent labour productivity measured as value added in constant euros of 2015 divided by the total number of hours worked, in logs relative to reference sector A. Source: own elaboration based on Eurostat data.

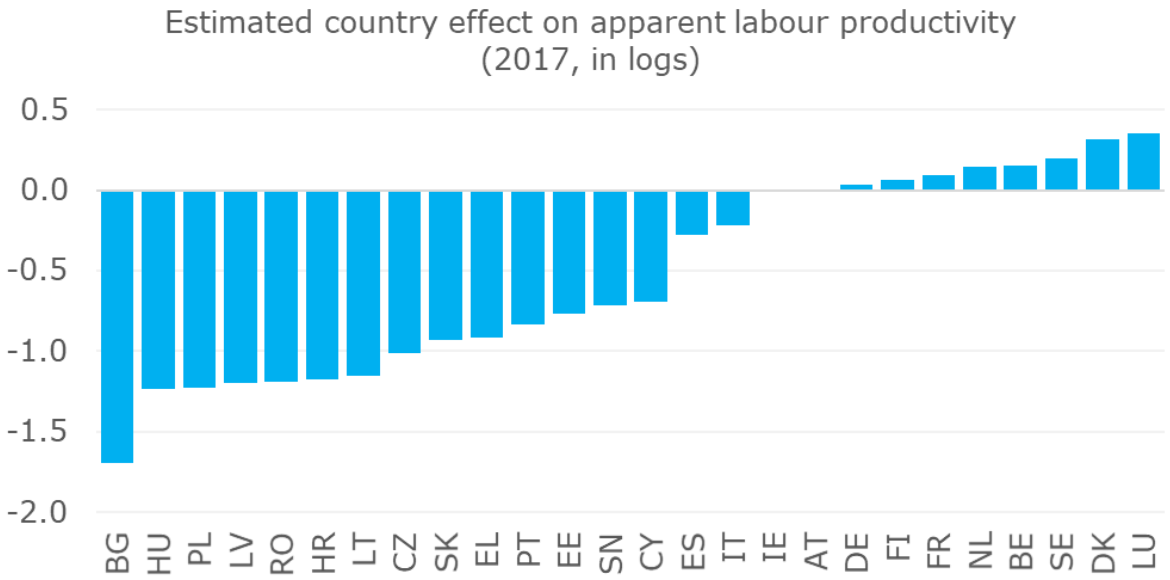


Figure 9. Estimated country effect on apparent labour productivity measured as value added in constant euros of 2015 divided by the total number of hours worked, in logs relative to reference country AT. No data available for Malta. Source: own elaboration based on Eurostat data.

On the dynamic side, in columns (5) to (10) we show estimations for the average annual change of labour productivity over two periods, 1998-2007 and 2008-2017. In each case we first estimate the results with country and sector effects and then we test for convergence including the initial level of labour productivity; a negative coefficient indicates the existence of convergence. Unconditional convergence is tested by taking out the country effect. For the two periods, we find that including a convergence factor significantly increases the explanatory power of regressions, in particular when we consider conditional convergence. The overall fit is better and the case for convergence stronger for the 1998-2007 average change, suggesting that idiosyncratic factors at country-sector level have gained weight in the explanation of productivity developments in the 2008-2017 period, as compared to more general drivers such as the degree of adoption of general purpose technological progress (Gordon and Sayed, 2019, 2020).

	Labour productivity level				Labour productivity average annual change					
Regression #	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	lLP05	lLPppp05	lLP15	lLPppp15	dLP05	dLP05	dLP05	dLP15	dLP15	dLP15
Year / Period	2007	2007	2017	2017	1998-2007	1998-2007	1998-2007	2008-2017	2008-2017	2008-2017
Initial value of dependent variable						-0.0275***	-0.0574***		-0.0249***	-0.0556***
Reference: sector A in AT	2.559***	2.337***	2.904***	2.983***	0.0354***	0.0862***	0.167***	0.0191***	0.0758***	0.171***
Country effect (EU27 Member State)										
BE	0.213***	0.219***	0.150***	-0.353***	-0.00156		0.0115***	-0.00176		0.00745***
BG	-2.109***	-2.686***	-1.698***	-3.053***	0.00335		-0.112***	0.0138***		-0.0878***
CY	-0.695***	-0.762***	-0.692***	-1.253***	-0.0125*		-0.0459***	0.0104		-0.0335***
CZ	-1.043***	-1.497***	-1.012***	-1.707***	0.0183***		-0.0512***	-0.00822		-0.0604***
DE	0.0869**	0.108***	0.0353*	-0.525***	-0.0124***		-0.000988	-0.00295		0.000494
DK	0.225***	0.414***	0.314***	-0.148***	-0.0132*		0.00653	0.00511		0.0200***
ES	-0.263***	-0.349***	-0.277***	-0.971***	-0.0191***		-0.0243***	0.00755		-0.0117***
EE	-1.305***	-1.716***	-0.768***	-1.868***	0.0237**		-0.0641***	0.0111		-0.0390***
FI	0.0469**	0.152***	0.0676***	3.243***	-0.00646**		-0.000431	-0.000576		0.00347
FR	0.159***	0.208***	0.0901***	-0.509***	-0.00380*		0.00728***	0.00551		0.00776*
EL	-0.598***	-0.747***	-0.913***	-1.604***	-0.00951		-0.0389***	-0.0308***		-0.0661***
HR	-1.127***		-1.172***		0.00418		-0.0627***	-0.00678**		-0.0686***
HU	-1.320***	-1.770***	-1.233***	-2.223***	0.0219***		-0.0652***	0.00541		-0.0755***
IE	0.0984*	0.226***	-0.00315	-0.548***	-0.000233		0.00551	0.000388		1.20e-05
IT	-0.0989***	-0.0972***	-0.221***	-0.616***	-0.0230***		-0.0168***	-0.00827***		-0.0150***
LT	-1.399***	-1.905***	-1.153***		0.0415***		-0.0583***	0.0129***		-0.0576***
LU	0.405***	0.406***	0.355***	-0.310***	-0.00730		0.0196***	-0.0115***		0.0138**
LV	-1.378***	-1.962***	-1.199***	-2.291***	0.0306***		-0.0641***	0.0177***		-0.0596***
MT										
NL	0.227***	0.239***	0.144***	-0.537***	-0.000785		0.0126***	0.000916		0.00845*
PL	-1.354***	-1.791***	-1.230***	-2.285***	0.0152*		-0.0687***	0.0146***		-0.0614***
PT	-0.691***	-0.780***	-0.833***	-1.626***	-0.00345		-0.0417***	-0.00582*		-0.0480***
RO	-1.811***	-2.303***	-1.189***	-2.326***	0.0256***		-0.0907***	0.0188**		-0.0553***
SK	-1.176***	-1.668***	-0.929***	-2.015***	0.0229***		-0.0574***	0.0135*		-0.0450***
SN	-0.676***	-0.915***	-0.718***	-1.571***	-0.00836		-0.0429***	0.000342		-0.0398***
SE	0.168***	0.251***	0.196***		0.00974*		0.0144***	0.00237		0.0122***
Sector effect (NACE code)										
B	1.529***	1.898***	1.435***	2.091***	-0.00207	0.0376***	0.0834***	-0.0210**	0.0195**	0.0693***
C10-C12	0.935***	1.045***	0.834***	1.153***	-0.00531	0.0224***	0.0503***	-0.0140**	0.0109*	0.0393***
C13-C15	0.427***	0.155**	0.399***	0.294***	-0.00441	0.00922	0.0212**	0.000869	0.0117**	0.0228***
C16-C18	0.830***	1.020***	0.699***	0.977***	0.00805	0.0288***	0.0490***	-0.000229	0.0181***	0.0383***
C19	2.332***	2.677***	2.522***	3.570***	-0.0678***	0.0102	0.0964***	0.0132	0.0772***	0.150***
C20	1.498***	1.654***	1.602***	1.943***	-0.00313	0.0368***	0.0817***	0.00864	0.0454***	0.0914***
C21	1.774***	1.961***	1.732***	2.133***	-0.000319	0.0464***	0.0992***	0.00352	0.0444***	0.0966***
C22	0.998***	1.143***	0.948***	1.287***	0.00954*	0.0350***	0.0610***	-0.00265	0.0220**	0.0495***
C23	1.148***	1.006***	0.981***	1.028***	0.00957*	0.0369***	0.0649***	-0.00383	0.0225***	0.0522***
C24_C25	0.911***	1.048***	0.856***	1.217***	0.00501	0.0278***	0.0518***	0.00659*	0.0269***	0.0505***
C26	1.637***	1.620***	1.346***	1.081***	0.0756***	0.102***	0.131***	0.0164	0.0463***	0.0829***
C27	1.110***	1.116***	1.018***	1.265***	0.0264**	0.0491***	0.0732***	-0.00610	0.0212*	0.0536***
C28	1.032***	1.090***	1.007***	1.348***	0.0218***	0.0428***	0.0650***	-0.00780*	0.0185**	0.0508***
C29_C30	1.089***	1.283***	1.033***	1.423***	0.0193***	0.0443***	0.0707***	-0.00836	0.0190**	0.0515***
C31_C32	0.582***	0.651***	0.484***	0.784***	0.00237	0.0166***	0.0314***	-0.00258	0.00993*	0.0252***
D	2.118***	2.460***	2.221***	3.026***	0.00285	0.0575***	0.120***	-0.00684	0.0501***	0.120***
E	1.087***	1.421***	1.006***	1.838***	-0.0374***	-0.00113	0.0409***	-0.0311***	0.000932	0.0404***
F	0.720***	0.965***	0.563***	1.056***	-0.0273***	-0.00358	0.0247***	-0.0139***	0.00322	0.0243***
G45	0.734***	0.951***	0.617***	1.157***	-0.0164	0.00568	0.0304***	-0.0112	0.00848	0.0295***
G46	1.207***	1.316***	1.109***	1.470***	0.00692	0.0358***	0.0679***	-0.00856	0.0220***	0.0566***
G47	0.442***	0.675***	0.311***	0.719***	-0.00998*	0.00244	0.0166**	-0.00277	0.00675	0.0153**
H49	0.746***	0.914***	0.668***	1.116***	-0.0128	0.00864	0.0332***	-0.0113**	0.00908	0.0312***
H50	1.502***	1.718***	1.306***	1.623***	0.0188	0.0524***	0.0918***	-0.0199	0.0197	0.0665***
H51	1.712***	2.183***	1.625***	2.751***	0.0154	0.0550***	0.0997***	-0.0433***	0.00338	0.0571***
H52	1.347***	1.449***	1.262***	1.681***	-0.0144	0.0220**	0.0669***	-0.0113*	0.0222**	0.0631***
H53	0.493***	0.783***	0.309***	1.027***	-0.0103	0.00211	0.0198**	-0.0277***	-0.0138**	0.00229
I	0.396***	0.593***	0.263***	0.756***	-0.0392***	-0.0214***	0.000394	-0.0190***	-0.00816**	0.00516
J58	1.351***	1.493***	1.209***	1.715***	-0.000788	0.0387***	0.0762***	-0.0150	0.0204	0.0602***
J59_J60	1.359***	1.526***	1.245***	1.688***	-0.00171	0.0354***	0.0740***	-0.0111	0.0226*	0.0633***
J61	2.370***	2.608***	2.010***	2.082***	0.0422***	0.0962***	0.153***	0.0143	0.0619***	0.118***
J62_J63	1.259***	1.448***	1.222***	1.595***	-0.0109	0.0246***	0.0626***	-0.00109	0.0300***	0.0670***
K64	1.874***	2.050***	1.808***	2.325***	0.000638	0.0494***	0.103***	-0.00584	0.0416***	0.0968***
K65	1.611***	1.840***	1.539***	2.081***	-0.0284**	0.0214**	0.0752***	-0.0145*	0.0277***	0.0765***
K66	1.177***	1.347***	1.127***	1.893***	-0.0353**	0.00348	0.0470**	-0.0346***	0.00287	0.0460***
L	3.364***	3.246***	3.197***	3.524***	-0.0470***	0.0542***	0.167***	-0.0149***	0.0681***	0.170***
M69_M70	1.038***	1.194***	0.925***	1.432***	-0.0268***	0.00915	0.0449***	-0.0161***	0.0126	0.0441***
M71	1.010***	1.149***	0.769***	1.219***	-0.0244***	0.00891	0.0418***	-0.0293***	-0.00209	0.0276**
M72	1.231***	1.350***	1.351***	1.900***	-0.0226*	0.0155*	0.0594***	-0.00252	0.0310***	0.0729***
M73	1.070***	1.200***	0.888***	1.249***	-0.00575	0.0254**	0.0559***	-0.0125	0.0135	0.0418***
M74_M75	0.665***	0.835***	0.526***	1.142***	-0.0601***	-0.0278***	0.00557	-0.0241***	-0.00477	0.0163
N77	2.039***	2.158***	1.996***	2.458***	0.00358	0.0557***	0.115***	-0.00730	0.0450***	0.107***
N78	0.719***	0.829***	0.664***	1.176***	-0.0314***	-0.00691	0.0226*	-0.0174	0.00519	0.0310**
N79	1.005***	1.189***	0.807***	1.535***	-0.0337***	-0.000775	0.0379**	-0.0352**	-0.00539	0.0293***
N80-N82	0.429***	0.619***	0.234***	0.841***	-0.0377***	-0.0196**	0.00289	-0.0274***	-0.0147**	-0.00113
O	0.934***	1.189***	0.840***	1.469***	-0.0339***	-0.00267	0.0338***	-0.0169***	0.00782	0.0383***
P	0.765***	1.093***	0.671***	1.386***	-0.0309***	-0.00505	0.0256***	-0.0201***	0.00110	0.0273***
Q86	0.710***	0.903***	0.683***	1.258***	-0.0296***	-0.00284	0.0243**	-0.0188***	0.00301	0.0281***
Q87_Q88	0.312***	0.523***	0.122*	0.787***	-0.0418***	-0.0214***	-0.00450	-0.0285***	-0.0167**	-0.00428
R90-R92	0.939***	1.105***	0.840***	1.371***	-0.0238***	0.00622	0.0397***	-0.0235***	0.00371	0.0359***
R93	0.639***	0.838***	0.495***	0.984***	-0.0253**	-0.00232	0.0223**	-0.0243***	-0.00570	0.0141**
S94	0.553***	0.698***	0.443***	0.962***	-0.0296***	-0.00700	0.0157*	-0.0179**	-0.00165	0.0154***
S95	0.507***	0.724***	0.291***	0.755***	-0.0349***	-0.0121	0.0104	-0.0229***	-0.00917	0.00469
S96	0.431***	0.604***	0.208***	0.750***	-0.0460**	-0.0250*	-0.000981	-0.0334***	-0.0198***	-0.00610
Observations	1,272	1,196	1,310	1,113	1,205	1,205	1,205	1,231	1,231	1,231
Adjusted R-squared	0.815	0.845	0.805	0.855	0.213	0.352	0.470	0.059	0.207	0.399

Table 2. Regressions of apparent labour productivity level and change over time on country and sector effects, including convergence test; coefficients are expressed relative to performance of sector A in Austria (AT).

Additional explanatory variables

The next step in the empirical strategy is to estimate productivity levels and dynamics with the inclusion of the specific country-sector variables introduced in the data section.

Table 3 shows the results of regressions for the productivity level in 2017 based on constant euros of 2015 at market exchange rates. Each row shows the results for a set of regressions including one explanatory variable in addition to sector or/and country effects. Column (1) includes sector effects, so the coefficient of the additional explanatory variable would be capturing the contribution to heterogeneity across countries, while an analogous interpretation applies to column (2), which incorporates country effects instead. Finally, column (3) includes both effects, being the coefficient of the explanatory variable associated with labour productivity levels that deviate from the average impact of overall factors at country level and the average sectoral characterization.

In the results, there are a number of variables that show a positive relation with labour productivity. In particular, the capital-to-labour intensity ratio is found to be significant for all types of assets (machinery, ICT and intangibles) in the three specifications. This variable makes a difference for labour productivity not only when providing a general characterization of countries and sectors – as shown by the significant coefficients in columns (1) and (2) - but also when explaining deviations of over- and underperforming country-sector pairs – column (3).

We also observe a positive significant coefficient for the three indicators accounting for ICT use in enterprises when considering sector effects, either alone or together with country effects, and for the degree of foreign control of enterprises in both specifications with only one of the effects, although with opposite signs, suggesting the presence of higher FDI intensity in catching-up countries and in sectors with higher productivity performance.

	Dependent variable = Labour productivity level in 2017						Statistics of explanatory variable (2017)		
Explanatory variable	(1) Sector effects		(2) Country effects		(3) Sector&Country eff.				
	Coeff.	Adj.R2-sq	Coeff.	Adj.R2-sq	Coeff.	Adj.R2-sq	Obs	Mean	Std.Dev.
lFirmSize1	0.158	0.417	0.108	0.373	-0.00577	0.797	943	2.23	1.22
lFirmSize2	0.223**	0.426	0.0577	0.437	-0.00980	0.846	601	5.61	1.05
FirmSize3	0.184	0.417	0.0220	0.433	0.0850*	0.848	601	3.23	0.88
Firm10sh	-1.571***	0.451	-0.38	0.363	0.0484	0.800	863	0.28	0.23
lKMACHnHW	0.517***	0.692	0.328***	0.526	0.202***	0.875	634	9.68	1.45
lKICTnHW	0.264***	0.606	0.285***	0.515	0.0506**	0.851	465	6.82	1.60
lKINTnHW	0.377***	0.769	0.249***	0.536	0.177***	0.882	570	7.89	2.08
Edu1	-0.202	0.431	0.559	0.447	1.120***	0.828	1082	0.58	0.14
Edu2	0.639	0.433	0.476	0.446	1.179***	0.828	1082	0.52	0.15
RDY	6.673	0.394	2.824*	0.475	0.345	0.849	826	0.01	0.03
RDVA	4.22	0.407	1.600*	0.476	0.141	0.849	826	0.03	0.06
ESALES	1.572**	0.410	-0.128	0.379	0.0144	0.782	806	0.15	0.13
ICTUSE1	3.410***	0.650	0.596	0.328	0.809**	0.774	764	0.60	0.23
ICTUSE2	3.389***	0.639	0.549	0.359	0.644**	0.793	889	0.56	0.24
ICTUSE3	1.572**	0.418	0.721	0.373	0.619**	0.790	875	0.27	0.18
Foreign1	-0.851**	0.433	0.765**	0.412	0.0857	0.816	835	0.33	0.20
Foreign2	-0.874**	0.434	0.746**	0.416	0.0462	0.821	812	0.33	0.21
Foreign3	-0.786**	0.423	0.872**	0.433	0.143	0.821	796	0.31	0.20
PMR1	-0.811	0.503	-1.405*	0.339	-0.118	0.829	195	0.36	0.19
PMR2	-1.108	0.526	-3.455***	0.390	-0.445	0.763	223	0.25	0.15
PMR3	-0.0143	0.507	-3.081*	0.381	0.792	0.721	77	0.22	0.16
STRI	0.481	0.369	-0.0914	0.357	0.217	0.762	282	0.24	0.10
FDIR	0.541	0.327	0.548	0.439	-0.341*	0.794	626	0.03	0.08

Table 3. Regressions of apparent labour productivity level in 2017 on country or/and sector effects and each individual explanatory variable; Edu1 and Edu2 defined at NACE section level, PMR1 data corresponds to 2013 and PMR2 to 2018.

Another set of variables show a significant positive coefficient only in one of the specifications. When including only sector effects (column 1), this is the case of the share of e-commerce sales, and, when including only country effects (column 2), the intensity of business R&D expenditure and, with a more restricted sample, the different vintages of the OECD PMR. These variables are significant contributors to, respectively, the country and sectoral characterization of labour productivity. On the other hand, both indicators measuring the level of educational attainment and the FDI regulatory restrictiveness index show a coefficient that is robustly significant only when including both country and sector effects (column 3).

In the case of the variables related to the firm size distribution. We observe that a higher average firm size and a lower presence of small firms are significant variables explaining productivity dispersion across countries. On the other hand, the only indicator capturing dispersion beyond country and sector effects is the difference between the employment-weighted and the simple average firm size, which could be interpreted as a sort of skewness indicator on how employment is distributed across existing firms. Therefore, given the

effect of the firm size average on productivity at country and sector level, higher shares of employment concentrated on larger firms appears to have a positive impact on labour productivity.

Now we turn to productivity dynamics. Table 4 shows the results of regressions for the average annual change of labour productivity between 2008 and 2017 based on constant euros of 2015 at market exchange rates. Based on the previous finding that the overall fit is better when accounting for conditional convergence, the row for each explanatory variable shows the regression results including both sector and country effects. Column (1) corresponds to the estimation using the 2008-2017 annual average of the individual explanatory variable, while column (2) adds the interaction of the latter with the value of labour productivity in the initial year (2008), testing then for a potential impact of the explanatory variable on the convergence process.

	Dependent variable = Annual average change of labour productivity between 2008 and 2017					**Statistics of explanatory variable (2008-2017 average)**		
	(1)		**(2)**					
Explanatory variable	**Coeff. Exp.var.**	**Adj.R2-sq**	**Coeff. Exp.var.**	**Coeff. Exp.var. x LP2008**	**Adj.R2-sq**	**Obs**	**Mean**	**Std.Dev.**
BirthRate	0.00716	0.465	0.233**	-0.0771***	0.472	854	0.10	0.05
DeathRate	0.0273	0.489	0.301***	-0.104***	0.496	751	0.08	0.04
ChurnRate	0.0157	0.528	0.0918	-0.0279	0.530	764	0.18	0.09
BirthRateLL	0.0651	0.473	0.289**	-0.0834**	0.480	807	0.09	0.05
DeathRateLL	0.0636	0.495	0.481**	-0.144*	0.501	703	0.06	0.03
ChurnRateLL	0.0294	0.539	0.122	-0.0320	0.540	726	0.14	0.07
lFirmSize1	0.00121	0.427	-0.00401	0.00154	0.427	691	2.33	1.19
lFirmSize2	-0.000116	0.361	-0.0210*	0.00640**	0.374	309	5.67	0.98
FirmSize3	0.00907**	0.372	0.00447	0.00131	0.370	309	3.08	0.77
Firm10sh	0.0109	0.473	0.0603	-0.0159	0.476	501	0.26	0.22
lKMACHnHW	0.0107**	0.462	0.0229**	-0.00324	0.474	604	9.75	1.40
lKICTnHW	0.00376	0.450	0.000626	0.000819	0.449	464	6.79	1.48
lKINTnHW	0.0110***	0.505	0.00783	0.000827	0.505	541	7.83	2.08
Edu1	0.0616**	0.446	0.0117	0.0148	0.446	950	0.55	0.13
Edu2	0.0630**	0.446	-0.0306	0.0273*	0.448	950	0.48	0.14
RDY	0.0370	0.413	-0.361***	0.111***	0.422	337	0.01	0.04
RDVA	0.0134	0.413	-0.290**	0.0752**	0.426	337	0.03	0.07
Foreign1	-0.0269	0.516	0.0104	-0.0112	0.517	505	0.32	0.19
Foreign2	-0.0130	0.516	0.0139	-0.00820	0.515	469	0.31	0.19
Foreign3	-0.00453	0.528	0.0240	-0.00863	0.528	464	0.30	0.18

Table 4. Regressions of the annual average change of apparent labour productivity between 2008 and 2017 on country and sector effects, the initial level of productivity and the 2008-2017 annual average of each individual explanatory variable; Edu1 and Edu2 defined at NACE section level.

In contrast with estimations of the productivity level, the overall results are less promising when explaining dynamics in the last decade and further research in certain dimensions would be needed to better understand results here shown or explore other specifications (e.g. testing the role of changes in explanatory variables).

This is the case for business expenditure in R&D, the average education level and the degree of foreign control of enterprises. The ratios of R&D intensity show a significant coefficient only when we account for the initial level of labour productivity but with negative sign and contributing also to further divergence. On the other hand, we find that both definitions of the average education level are significant when considered individually – column (1) - and the weighted average seem to contribute to labour productivity divergence as shown by the coefficient of the interaction term in column (2). And finally, none of the variables measuring the degree of foreign control of enterprises are found to be significant in any specification.

Results are more intuitive for the capital-to-labour intensity indicators, although significance is less robust than it was for estimates of productivity levels and we only observe it for machinery assets in both specifications and intangibles when considered individually. In addition, we find no systematic evidence of their contribution to the con- or divergence productivity process.

Regarding the firm structure, the simple average size and the share of smaller firms are no significant in any case, while the weighted average size shows coefficients with the unexpected sign and contributing to labour productivity divergence. On the other hand, the difference between the weighed and the simple firm size average, which we previously associated with the skewness of the employment distribution, is significant when considered individually, meaning that, once we account for both country and sector effects, higher shares of employment concentrated on larger firms appears to have a positive impact on labour productivity growth.

The most relevant insights come from variables related to firm demographics. When indicators are considered individually, they all show no significant coefficients, while churn rates are not significant in any specification. In contrast, we find a positive and significant coefficient for birth and death rates when the interaction with the initial level of productivity is included and we also observe a contribution to the convergence process. The values of the coefficients – both for the variable itself and the interaction term - are higher for death rates than birth rates, as well as for birth rates when restricted to limited liability enterprises.

4.1 A focus on business services

In Section 3 we identified business services as a group of sizable and growing economic activities, for which a significant and widening productivity gap relative to the US was observed. For this reason, we are now interested in focusing the analysis of the variables potentially driving productivity levels and growth on this particular sector.

Based on the type of descriptive estimates shown in Table 1, we start by characterizing the performance of the different services included in this broad sector in comparison with the rest of economic activities. Figure 10 represents the estimated sector effect of the labour productivity level in 2008 and the corresponding sector effect on the average annual change between 2008 and 2017.

On the one hand, the estimated sector effects on productivity levels are quite heterogeneous across business services, exposing, among other factors, the very different technical and technological requirements for providing each of these activities. And on the other hand, what is more relevant, only two classes of business services belong to the top 10 economic activities in terms of productivity growth during 2008-2017 (J61 - Telecommunications and J62_63 – ICT services), while in contrast seven of them are found in the lowest 10 (H51 – Air transport as the worst performer overall). In contrast, 13 out of 14 manufacturing activities are on the top 20 productivity performers.

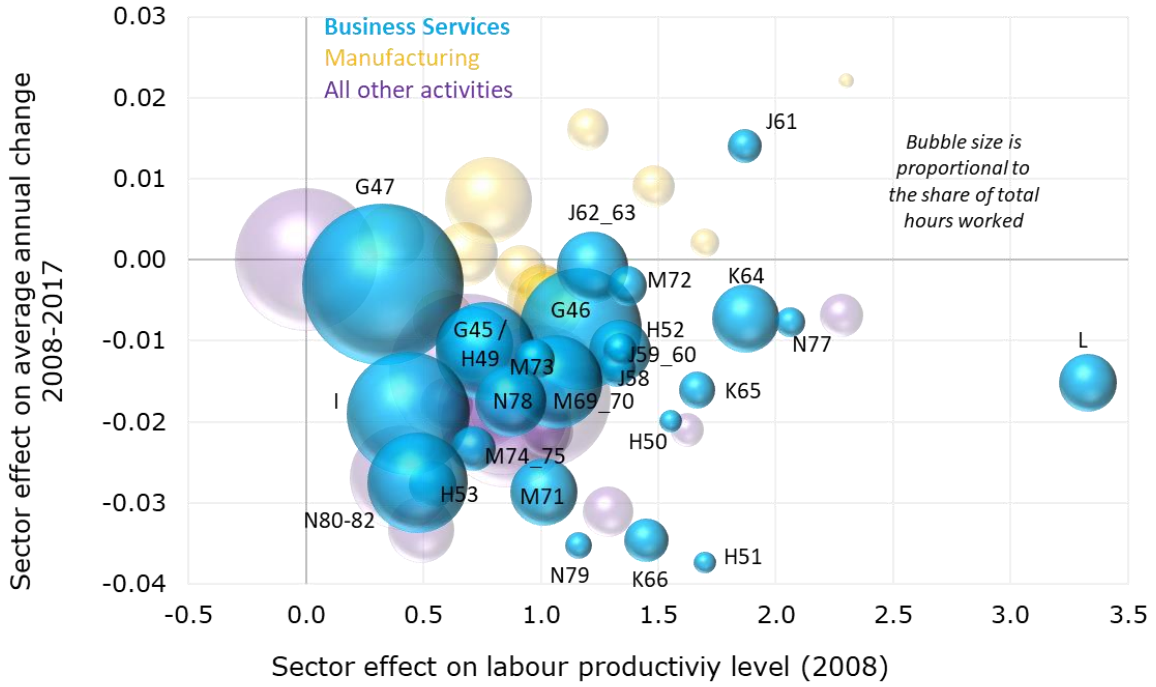


Figure 10. Estimated sector effect on the level of apparent labour productivity in 2008 and on the average annual change between 2008 and 2017, in logs relative to reference sector A, based on value added in constant euros of 2015 divided by the total number of hours worked. The sector effect on the average change considers conditional convergence and uses the sector effect on productivity level for 2008 as the initial value. Source: own elaboration based on Eurostat data.

Productivity levels

Having this overall picture in mind, we now investigate the role of the explanatory variables previously used for all sectors, in explaining productivity levels and growth in business services across EU countries.

Analogously to Table 3 but restricted to the 26 economic activities included in the broadly defined business services sector, Table 5 shows the results of regressions for the productivity level in 2017 based on constant euros of 2015 at market exchange rates. Although results are overall similar to what was found for the total economy, some differences are worth highlighting.

First, a number of coefficients change their significance. This is particularly the case for indicators for business R&D expenditure, which become both no significant when using country effects and one of them significant but with the opposite sign when both country and sector effects are included. Also, a number of variables that were significant when including country and sector effects, column (3), become either less significant (one of the ICT use shares and one of the education variables) or no significant (the other education variable, the ICT capital-to-labour ratio and the skewness of the employment distribution). And the opposite happens for the estimated coefficients for firm size indicators when considering only sector effects in column (1), which become either significant or more significant in all cases, underlining the relevance of firm size distribution within business services for productivity differences across countries.

Second, among those variables found to be significant both for all economic activities and the restricted sample of business services, the value of coefficients is generally higher in the latter case. This is particularly the case for variables related to firm size distribution when only sector effects are included, for the degree of foreign control of enterprises under the specification with country effects, and for two of the ICT use indicators and two capital-to-labour intensity ratios when both country and sector effects are considered.

	Dependent variable = Labour productivity level in 2017						Statistics of explanatory variable (2017)		
Explanatory variable	(1) Sector effects		(2) Country effects		(3) Sector&Country eff.				
	Coeff.	Adj.R2-sq	Coeff.	Adj.R2-sq	Coeff.	Adj.R2-sq	Obs	Mean	Std.Dev.
lFirmSize1	0.279**	0.493	-0.0511	0.272	0.00426	0.779	546	1.82	1.03
lFirmSize2	0.317***	0.569	-0.0871	0.360	-0.00301	0.850	330	5.50	1.18
FirmSize3	0.213*	0.538	-0.0164	0.349	0.0639	0.852	330	3.54	0.81
Firm10sh	-1.951***	0.553	0.300	0.267	-0.233	0.788	499	0.35	0.22
lKMACHnHW	0.496***	0.719	0.306***	0.385	0.228***	0.872	256	9.40	1.41
lKICTnHW	0.257***	0.644	0.261***	0.401	0.0466	0.835	189	7.05	1.71
lKINTnHW	0.416***	0.815	0.245***	0.407	0.273***	0.886	226	7.74	2.07
Edu1	-1.441	0.526	1.066	0.381	0.933	0.784	493	0.60	0.15
Edu2	-0.708	0.517	0.996	0.381	1.256*	0.785	493	0.54	0.16
RDY	-0.438	0.470	0.759	0.407	-1.208*	0.868	350	0.01	0.04
RDVA	0.500	0.470	0.346	0.406	-0.645	0.868	350	0.03	0.07
ESALES	1.798***	0.439	-1.064	0.328	-0.127	0.740	478	0.14	0.12
ICTUSE1	2.976***	0.583	0.571	0.274	0.570**	0.757	521	0.63	0.25
ICTUSE2	2.980***	0.586	0.545	0.238	0.758*	0.732	438	0.66	0.24
ICTUSE3	1.193	0.438	0.806	0.310	0.828**	0.757	513	0.28	0.20
Foreign1	-0.573	0.492	1.044*	0.318	0.249*	0.802	497	0.30	0.18
Foreign2	-0.679	0.498	1.083*	0.316	0.0817	0.805	479	0.29	0.18
Foreign3	-0.680	0.489	1.208**	0.335	0.158	0.804	463	0.28	0.18
PMR1	-0.614	0.427	-1.673*	0.465	0.0744	0.815	169	0.35	0.19
PMR2	-0.710	0.527	-3.351***	0.374	-0.212	0.758	197	0.26	0.16
PMR3	1.189	0.491	-3.149**	0.504	1.518	0.688	57	0.23	0.18
STRI	0.522	0.360	-0.155	0.348	0.211	0.744	260	0.24	0.10
FDIR	0.426	0.290	0.500	0.394	-0.378*	0.721	283	0.05	0.11

Table 5. Regressions of apparent labour productivity level in 2017 on country or/and sector effects and each individual explanatory variable, economic activities in Business Services; Edu1 and Edu2 defined at NACE section level, PMR1 data corresponds to 2013 and PMR2 to 2018.

Following the finding in Section 3 that divergences within the EU27 remain significant, we turn attention to differences in the variables we have identified as contributors to dispersion in productivity levels. For this purpose, Table 6 shows the differences in the average value between the top 10 performers and all other Member States for each individual business services (red indicate a negative gap for low performers).

Among those explanatory variables for which results seem more consistent, we observe that the negative gap is overall larger for capital-to-labour intensity ratios and ICT use measures, while its sizeable for specific activities in the case of size distribution indicators. In particular, both a significant lower average firm size and a higher share of small firms is found in trade (NACE division G) and professional activities (M).

Convergence gap, 2017	G45	G46	G47	H49	H50	H51	H52	H53	I	J58	J59_60	J61	J62_63	K64	K65	K66	L	M69_70	M71	M72	M73	M74_75	N77	N78	N79	N80-82
lFirmSize1	-0.49	-0.45	-0.56	-0.50	-0.23	-0.12	-0.37	-0.11	-0.25	-0.65	0.01	-0.48	-0.19				0.00	-0.24	-0.54	-0.81	-0.23	0.02	-0.24	-0.35	-0.51	-0.14
lFirmSize2	-1.10	-0.83	-0.61	-0.14	-0.04	-0.24	0.03	0.84	-0.32	-0.66	-0.17	-0.49	-0.22				-0.86	-0.80	-1.21	-0.44	-0.23		-0.98	-0.37	-0.96	-0.63
FirmSize3	-0.67	-0.36	-0.05	0.31	0.16	-1.07	0.33	1.29	0.04	0.03	0.54	0.00	0.09				-1.02	-0.53	-0.67	0.07	0.00		-0.95	-0.08	-0.69	-0.65
Firm10sh	-0.22	-0.17	-0.17	-0.13	0.02	0.00	-0.08	0.00	-0.05	-0.17	-0.11	-0.05	-0.10				-0.12	-0.18	-0.26	-0.20	-0.14	-0.07	-0.21	-0.03	-0.22	-0.09
lKMACHnHW	-1.19	-1.15	-1.27	-0.96	-0.88	-1.48	-1.28	-0.99	-0.79	-0.59	-0.11	-0.78	-1.01	-0.64	-0.74	-1.33	-1.12	-0.47	-0.30	-0.26	-0.06	0.14	-1.13	0.28	-0.37	-0.97
lKICTnHW	-1.67	-1.64	-1.53	-2.84	-2.14	-1.87	-3.28	-0.23	-0.63	-1.33	-0.70	-0.95	-1.49	-0.84	-0.92	-2.04	-1.08	-0.72	-1.30	-0.04	-1.01	-1.21	-1.28	-0.20	-1.68	-2.22
lKINTnHW	-2.18	-2.59	-1.95	-1.93	-2.28	-2.84	-2.19	-2.61	-1.46	-2.94	-0.64	-1.35	-1.10	-0.89	-1.79	-3.08	-1.39	-2.46	-1.98	-0.79	-1.52	-1.50	-2.26	-1.73	-2.71	-2.09
Edu1	0.02	0.02	0.02	0.04	0.04	0.04	0.04	0.04	0.03	-0.02	-0.02	-0.02	-0.02	0.00	0.00	0.00	-0.03	-0.05	-0.05	-0.05	-0.05	-0.05	-0.03	-0.03	-0.03	-0.03
Edu2	0.01	0.01	0.01	0.04	0.04	0.04	0.04	0.04	0.01	-0.03	-0.03	-0.03	-0.03	0.00	0.00	0.00	-0.12	-0.06	-0.06	-0.06	-0.06	-0.06	-0.03	-0.03	-0.03	-0.03
RDY	0.00	0.00	0.00						0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	-0.02	-0.03	0.00	0.00				-0.01
RDVA	0.00	0.00	0.00						0.00	-0.01	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	-0.04	-0.12	0.00	0.00				-0.01
ESALES	-0.11	-0.11	-0.07	-0.16	-0.16	-0.16	-0.16	-0.16	-0.04	-0.01	-0.01	-0.10	-0.05				0.03	-0.02	-0.02	-0.02	-0.02	-0.02	0.00	0.00	-0.19	0.00
ICTUSE1	-0.13	-0.13	-0.13	-0.14	-0.14	-0.14	-0.14	-0.14	-0.11	-0.06	-0.06	0.00	-0.03				-0.28	-0.09	-0.09	-0.09	-0.09	-0.09	-0.22	-0.22	-0.10	-0.22
ICTUSE2	-0.13	-0.13	-0.10	-0.15	-0.15	-0.15	-0.15	-0.15	-0.12	-0.06	-0.06	-0.04	-0.03				-0.24	-0.09	-0.09	-0.09	-0.09	-0.09	-0.27	-0.27	-0.12	-0.27
ICTUSE3	-0.04	-0.04	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	0.07	-0.11	-0.11	-0.04	0.01				-0.10	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.04	-0.03
Foreign1	0.09	-0.04	0.12	0.00	0.10	-0.19	0.02	0.09	0.02	-0.01	0.08	0.20	0.04		0.39	0.06	0.14	0.09	-0.01	-0.24	0.05	-0.09	0.13	0.09	-0.11	-0.07
Foreign2	0.02	-0.06	0.13	0.01	0.10	-0.17	0.03	0.09	0.02	0.00	0.08	0.18	0.05	-0.47			0.12	0.09	0.00	-0.19	0.06	-0.03	0.14	0.08	-0.15	-0.07
Foreign3	0.06	-0.05	0.13	0.00	0.00	-0.18	0.02	0.03	0.03	0.01	0.06	0.22	0.14				0.15	0.13	0.02	-0.15	0.13	-0.10	0.16	0.11	-0.09	-0.07
PMR1	0.12			0.01		-0.36		-0.07				0.03						-0.10	-0.21							
PMR2	-0.02			0.01	-0.03	-0.03						0.02					0.00	-0.01	-0.11							
PMR3				-0.04		0.02						0.06														
STRI	0.02			-0.05	0.01	-0.01	0.05	0.03		0.02		0.00	0.04	-0.01	0.01			-0.05	-0.04							
FDIR	0.01	0.00		0.07	-0.01	0.00			0.01	-0.05	-0.19	0.05		0.00	0.02	0.00		0.21								

Table 6. Difference between the 2017 average value of EU countries with lower levels of productivity and the top10 EU in Business Services; red-coloured cells correspond to variable-sector pairs in which the negative difference is larger, green-coloured cells where the negative difference is positive, and blank cells to unavailable data; the intensity of the colour code is scaled within each variable across sectors; the sign of the difference is inverted for Firm10sh, PMR1, PMR2, PMR3, STRI and FDIR; Member States included in each group is not homogenous across variable-sector pairs; Edu1 and Edu2 defined at NACE section level, PMR1 data corresponds to 2013 and PMR2 to 2018.

Productivity dynamics

We now look into productivity growth in business services and develop an analogous analysis as the one shown in Table 4 for the whole economy, using the same set of explanatory variables, sample period (2008-2017) and alternative specifications (with and without considering interaction with the convergence factor). Table 7 shows the results of the regressions.

First, as in the case of productivity levels, differences with respect to the estimates for the overall economy are pronounced, both in the significance of variables and the value of coefficients. This is the case of the indicators related to the business R&D expenditure and the firm size distribution, which become no significant except for one coefficient in each characteristic. In contrast, education levels and capital-to-labour ratios for ICT and intangible assets become significant when interacting with the initial level of productivity and contributing in this case to further divergence, column (2).

Second, estimations are more consistent for variables related to firm demographics, which keep their significant coefficients when the initial level of productivity included, with higher birth and death rates contributing to convergence. The values of the coefficients are also in all cases higher than for the sample with all economic activities. In addition, indicators of firm demographics for limited liability enterprises become significant when considered individually, column (1).

	Dependent variable = Annual average change of labour productivity between 2008 and 2017					Statistics of explanatory variable (2008-2017 average)		
	(1)		(2)					
Explanatory variable	**Coeff. Exp.var.**	**Adj.R2-sq**	**Coeff. Exp.var.**	**Coeff. Exp.var. x LP2008**	**Adj.R2-sq**	**Obs**	**Mean**	**Std.Dev.**
BirthRate	0.0241	0.505	0.321**	-0.0946**	0.505	444	0.11	0.05
DeathRate	0.115	0.540	0.463**	-0.114**	0.540	388	0.09	0.04
ChurnRate	0.0463	0.590	0.110	-0.0208	0.590	394	0.20	0.08
BirthRateLL	0.126*	0.518	0.480*	-0.120*	0.518	425	0.10	0.04
DeathRateLL	0.344***	0.550	1.177***	-0.248**	0.550	368	0.06	0.03
ChurnRateLL	0.124**	0.596	0.25	-0.0377	0.596	379	0.16	0.06
lFirmSize1	0.00328	0.440	0.0115	-0.00244	0.440	385	1.89	1.05
lFirmSize2	0.00438	0.396	-0.00429	0.00262	0.396	156	5.57	1.16
FirmSize3	0.00788*	0.400	-0.00189	0.00301	0.400	156	3.45	0.72
Firm10sh	-0.0164	0.492	-0.0266	0.00295	0.492	269	0.35	0.22
lKMACHnHW	0.0132*	0.437	0.0301**	-0.0041	0.437	234	9.51	1.39
lKICTnHW	0.00559	0.421	-0.0122*	0.00452***	0.421	188	7.09	1.57
lKINTnHW	0.0199***	0.515	0.00820*	0.00275***	0.515	220	7.65	2.01
Edu1	0.0703	0.436	-0.179*	0.0691***	0.436	423	0.57	0.14
Edu2	0.0796	0.437	-0.231**	0.0817***	0.437	423	0.51	0.15
RDY	-0.0546	0.449	-0.268	0.0681*	0.449	109	0.02	0.06
RDVA	-0.0311	0.450	-0.191	0.0436	0.450	109	0.04	0.09
Foreign1	-0.00760	0.578	0.00553	-0.00379	0.578	290	0.28	0.15
Foreign2	-0.00616	0.567	0.0661	-0.0204	0.567	266	0.27	0.15
Foreign3	0.000790	0.578	0.0812	-0.0226	0.578	263	0.26	0.15

Table 7. Regressions of the annual average change of apparent labour productivity between 2008 and 2017 on country and sector effects, the initial level of productivity and the 2008-2017 annual average of each individual explanatory variable, economic activities in Business Services; Edu1 and Edu2 defined at NACE section level.

5 Main findings and policy readings

Labour productivity growth has slowed down during the last decade relative to the pre-Great Recession period, a trend shared by most developed economies to which the EU27 made no exception. These developments have limited the possibility to close the existing productivity gap with respect to the US – considered to be the global technological frontier-which has remained at around 30-40% overall and even larger for manufacturing activities and business services. In fact, we observe that the productivity gap has kept on growing from a sector-by-sector perspective, but the EU27 has benefited from a shift of hours worked to activities with higher productivity levels, ICT services in particular.

One important aspect in this discussion is the persistent heterogeneity in labour productivity levels across EU27 Member States. For instance, when considering only the top 10 country performers, the gap relative to the US reduces to around 10%. Hence, convergence within the EU27 becomes an important requisite for reducing the distance with respect to the technological frontier. Our analysis shows that a convergence process has taken place in the last two decades, but it has slowed down in the aftermath of the Great Recession and has not been homogenous, with a number of laggard countries within the group of members with initially medium productivity levels.

Having identified these stylized facts, we then investigate econometrically which are the main explanatory variables accounting for productivity heterogeneity across EU27 Member States and economic activities, both in level and growth terms. We particularly focus on two dimensions, firm size distribution – motivated by the observation of an overall positive relation between size and productivity -, and firm demographics – higher entry and exit rates should facilitate the reallocation of resources and eventually increase productivity.

We derive a number of insights from our analysis:

- First, we observe strong country and sector effects explaining differences in labour productivity levels (over 80% of the variance within the EU) and, to a lesser extent, growth rates (around 40% of the variance). This observation confirms not only the importance of technical and technological requirements in production processes but also the role of overall institutional and technological factors across Member States.

- Second, the strong role of these sector and country effects is captured by the positive association of higher levels of productivity with higher education attainment of employees, business R&D expenditure, capital-to-labour ratios, ICT use intensity and firm size.

- Third, we confirm the significant role of firm demographics when explaining changes of labour productivity, with higher entry and exit rates not only contributing to higher growth but to EU convergence of productivity levels.

- Fourth, we observe that, once we have accounted for both country and sector effects, higher shares of employment concentrated on larger firms appears to have a positive impact on both labour productivity levels and growth.

- Fifth, when restricting the sample of economic activities to business services, the estimated coefficients that remain significant show higher values than for regressions with all sectors, including firm size indicators accounting for country effects on productivity levels and firm demographics´ variables when explaining productivity growth and convergence.

From a policy perspective, these findings suggest a number of areas in which action seems to be warranted, particularly for those countries lagging behind in productivity performance and convergence: improving technological adoption, increasing innovation intensity, boosting the capital triad (human, tangible and intangible assets), and, with respect to the two micro-structural characteristics we put a focus on, eliminating barriers to growth in firm size and facilitating the entry and exit of enterprises. These same recommendations are even more valid in the specific case of business services, for which productivity performance and convergence seem more sensitive to progress in those policy areas.

References

Bauer, P., Fedotenkov, I., Genty, A., Hallak, I., Harasztosi, P., Martínez-Turégano, D., and Sánchez-Martínez, M. (2020). Productivity in Europe: Trends and drivers in a service-based economy (No. JRC119785). Joint Research Centre, European Commission.

Duarte, M. and Restuccia, D. (2017). Relative prices and sectoral productivity (NBER Working Paper No. 23979). National Bureau of Economic Research, Cambridge, MA.

Gordon, R J and H Sayed (2019). The Industry Anatomy of the Transatlantic Productivity Growth Slowdown: Europe Chasing the American Frontier. International Productivity Monitor 37: 3-38.

Gordon, R J and H Sayed (2020). Transatlantic Technologies: The Role of ICT on the Evolution of U.S. and European Productivity Growth. International Productivity Monitor 38: 50-80.

Inklaar, R., and Timmer, M. P. (2008). GGDC productivity level database: International comparisons of output, inputs and productivity at the industry level (No. GD-104). Groningen Growth and Development Centre, University of Groningen.

Kumar, K. B., Rajan, R. G. and Zingales, L. (1999). What determines firm size? (NBER Working Paper No. 7208). National Bureau of Economic Research, Cambridge, MA.

Mankiw, N. G., Romer, D., and Weil, D. N. (1992). A contribution to the empirics of economic growth. The quarterly journal of economics, 107(2), 407-437.

Rodrik, D. (2013). Unconditional convergence in manufacturing. The Quarterly Journal of Economics, 128(1), 165-204.

Syverson, C. (2011). What determines productivity? Journal of Economic literature, 49(2), 326-65.

Annexes

Annex 1. NACE Rev. 2 economic activities

NACE code	Broad sector	Name of economic activity
A	Other activities	Agriculture, forestry and fishing
B	Other activities	Mining and quarrying
C10-C12	Manufacturing	Manufacture of food products; beverages and tobacco products
C13-C15	Manufacturing	Manufacture of textiles, wearing apparel, leather and related products
C16-C18	Manufacturing	Manufacture of wood, paper, printing and reproduction
C19	Manufacturing	Manufacture of coke and refined petroleum products
C20	Manufacturing	Manufacture of chemicals and chemical products
C21	Manufacturing	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22	Manufacturing	Manufacture of rubber and plastic products
C23	Manufacturing	Manufacture of other non-metallic mineral products
C24-C25	Manufacturing	Manufacture of basic metals and fabricated metal products, except machinery and equipment
C28	Manufacturing	Manufacture of machinery and equipment n.e.c.
C26	Manufacturing	Manufacture of computer, electronic and optical products
C27	Manufacturing	Manufacture of electrical equipment
C29-C30	Manufacturing	Manufacture of motor vehicles, trailers, semi-trailers and of other transport equipment
C31-C32	Manufacturing	Manufacture of furniture; other manufacturing
D	Other activities	Electricity, gas, steam and air conditioning supply
E	Other activities	Water supply; sewerage, waste management and remediation activities
F	Other activities	Construction
G45	Business Services	Wholesale and retail trade and repair of motor vehicles and motorcycles
G46	Business Services	Wholesale trade, except of motor vehicles and motorcycles
G47	Business Services	Retail trade, except of motor vehicles and motorcycles
I	Business Services	Accommodation and food service activities
H49	Business Services	Land transport and transport via pipelines
H50	Business Services	Water transport
H51	Business Services	Air transport
H52	Business Services	Warehousing and support activities for transportation
H53	Business Services	Postal and courier activities
K64	Business Services	Financial service activities, except insurance and pension funding
K65	Business Services	Insurance, reinsurance and pension funding, except compulsory social security
K66	Business Services	Activities auxiliary to financial services and insurance activities
L	Business Services	Real estate activities
J58	Business Services	Publishing activities
J59-J60	Business Services	Motion picture, video, television programme production; programming and broadcasting activities
J61	Business Services	Telecommunications
J62-J63	Business Services	Computer programming, consultancy, and information service activities
M69-M70	Business Services	Legal and accounting activities; activities of head offices; management consultancy activities
M71	Business Services	Architectural and engineering activities; technical testing and analysis
M72	Business Services	Scientific research and development
M73	Business Services	Advertising and market research
M74-M75	Business Services	Other professional, scientific and technical activities; veterinary activities
N77	Business Services	Rental and leasing activities
N78	Business Services	Employment activities
N79	Business Services	Travel agency, tour operator and other reservation service and related activities
N80-N82	Business Services	Security and investigation, service and landscape, office administrative and support activities
O	Other activities	Public administration and defence; compulsory social security
P	Other activities	Education
Q86	Other activities	Human health activities
Q87-Q88	Other activities	Residential care activities and social work activities without accommodation
R90-R92	Other activities	Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities
R93	Other activities	Sports activities and amusement and recreation activities
S94	Other activities	Activities of membership organisations
S95	Other activities	Repair of computers and personal and household goods
S96	Other activities	Other personal service activities

Annex 2. Apparent labour productivity gap between the EU27 and the US

$$LP_{EU27,t} - LP_{US,t} = \sum_{c,i}\left[\beta_{c,t} \times \alpha_{c,i,t} \times \left(LP_{c,i,t} - LP_{US,i,t}\right)\right] + \sum_{c,i}\left[\beta_{c,t} \times \left(\alpha_{c,i,t} - \alpha_{US,i,t}\right) \times \left(LP_{US,i,t} - LP_{US,t}\right)\right]$$

where $LP_{EU27,t}$ is the total apparent labour productivity for the EU27 aggregate in time t, $LP_{US,t}$ is the total productivity for the US, $LP_{c,i,t}$ is the productivity of sector i in EU27 Member State c, $LP_{US,i,t}$ is the productivity of sector i in the US, $\beta_{c,i,t}$ is the share of hours worked in Member State c as percentage of the EU27 aggregate, $\alpha_{c,i,t}$ is the share of hours worked in sector i of country c as percentage of total hours worked in country c, and $\alpha_{US,i,t}$ is the share of hours worked.

The first component in the equation captures the differences in sectoral productivity levels between EU27 Member Stares and the US ('within component') and the second one the differences in the sectoral shares between both economic areas given sectoral heterogeneity in productivity levels in the technological frontier, i.e. the US ('between component').

Annex 3. Apparent labour productivity in country-sector pairs of EU27 Member States

Regressions in Table 2:

$$lLP_{c,i,t} = \mu_c + \theta_i + \varepsilon_{c,i,t} \quad \textit{(1) to (4)}$$

$$\Delta lLP_{c,i,t} = \mu_c + \theta_i + \varepsilon_{c,i,t} \quad \textit{(5) \& (8)}$$

$$\Delta lLP_{c,i,t} = \theta_i + \gamma \times LP_{c,i,s} + \varepsilon_{c,i,t} \quad \textit{(6) \& (9)}$$

$$\Delta lLP_{c,i,t} = \mu_c + \theta_t + \gamma \times LP_{c,is} + \varepsilon_{c,i,t} \quad \textit{(7) \& (10)}$$

where $lLP_{c,i,t}$ is the log of labour productivity of sector *i* in EU27 country *c*, μ_c is the country effect, θ_i is the sector effect, γ is the convergence parameter relative to the initial period *s*, and $\varepsilon_{c,i,t}$ is the error term.

Regressions in Tables 3 and 5:

$$lLP_{c,i,t} = \theta_i + X_{c,i,t} + \varepsilon_{c,i,t} \quad \textit{(1)}$$

$$lLP_{c,i,t} = \mu_c + X_{c,i,t} + \varepsilon_{c,i,t} \quad \textit{(2)}$$

$$lLP_{c,i,t} = \mu_c + \theta_i + \alpha \times X_{c,i,t} + \varepsilon_{c,i,t} \quad \textit{(3)}$$

where α is the coefficient for the explanatory variable $X_{c,i,t}$ used in each individual regression.

Regressions in Table 4 and 7:

$$\Delta lLP_{c,i,t} = \mu_c + \theta_i + \alpha \times X_{c,i,t} + \gamma \times LP_{c,i,s} + \varepsilon_{c,i,t} \quad \textit{(1)}$$

$$\Delta lLP_{c,i,t} = \mu_c + \theta_i + \alpha \times X_{c,i,t} + \gamma \times LP_{c,i,s} + \beta \times X_{c,i,t} \times LP_{c,i,s} + \varepsilon_{c,i,t} \quad \textit{(2)}$$

where β is the coefficient for the interaction of the explanatory variable and the initial level of labour productivity).

Regressions are estimated with two-way cluster-robust errors by country and sector dimensions.

Country factsheets: Germany, France, Italy and Spain

Germany

Labour productivity growth has slowed down in Germany during the last decade relative to the pre-Great Recession period (0.8% per year between 2007 and 2017 compared to 1.2% between 1997 and 2007). This trend is shared by most Member States, with relative productivity levels in Germany remaining stable compared to the EU27 and the top 10 performers (blue lines in Figure 1). In contrast, labour productivity growth in Germany has remained below that of the USA in both sub-periods, contributing to consolidate a negative gap with respect to what we consider the world technological frontier (red line), with dynamics in recent years only correcting somewhat this trend.

At sectoral level, business services show a significant negative contribution to these developments relative to the USA, with labour productivity underperforming in information and communication services (NACE section J), professional, scientific and technical activities (M), and administrative and support services (N). This has been particularly the case of ICT services (negative sectoral gap in Figure 2), for which this effect is not fully compensated by the increasing share of this activity in the total number of hours worked in Germany (positive sectoral composition effect in Figure 2 given its higher productivity level relative to other activities).

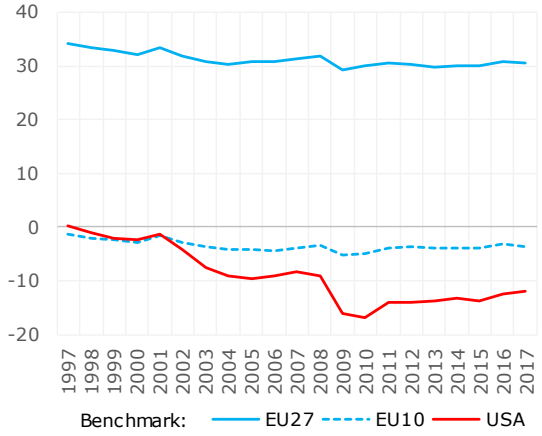


Figure 1. Apparent labour productivity in Germany relative to the EU27, top EU10 and the USA, in percentage; based on value added in constant euros of 2005 divided by the total number of hours worked; top EU10 is the aggregate of AT, BE, DE, DK, FI, FR, IE, LU, NL and SE. Source: own elaboration based on Eurostat and EU KLEMS data.

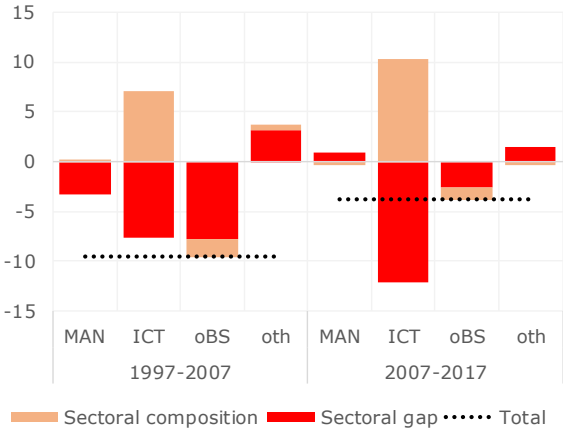


Figure 2. Contributions and total change in apparent labour productivity in Germany relative to the USA by sub-period, in percentage points; based on value added in constant euros of 2005 divided by the total number of hours worked; MAN = manufacturing, ICT services, oBS = Business services other than ICT, oth =all other economic activities. Source: own elaboration based on Eurostat and EU KLEMS data.

Within the EU27, overall framework conditions seem to support high productivity levels in Germany. After controlling for sectoral differences across Member States, the country effect is strongly positive for Germany, remaining among the top 10 EU performers (x-axis in Figure 3). This same effect estimated for the change during the last decade is low relative to the majority of Member States as a result of productivity convergence and the initial high level for Germany (y-axis). However, more importantly, the effect is lower when compared with most Member States in the EU technological frontier (i.e. those with similar initial productivity levels), signalling challenges in overall conditions for further productivity growth in Germany.

Among other factors, the firm size distribution and firm demographics seem to contribute to productivity heterogeneity across EU countries, also when restricting the analysis to business services. In this sense, the presence of large enterprises supports overall higher productivity levels and growth in Germany, with a similar employment-weighted average firm size across business services to other top 10 performers (green line compared to dotted circle in Figure 4). On the contrary, differences relative to this benchmark are higher for firm birth rates (purple line in Figure 4), with lower values in Germany for trade activities (NACE section G), some transport (H) and financial services (K), as well as for a number of the aforementioned business services underperforming relative to the USA. The closing of the existing gap in business services would benefit from removing existing barriers to firm dynamics and facilitating the reallocation of resources to more productive enterprises.

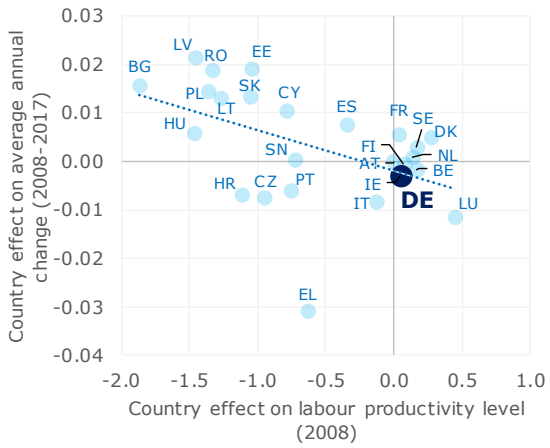


Figure 3. Estimated country effect on the level of apparent labour productivity in 2008 and on the average annual change between 2008 and 2017, in logs relative to reference country AT; based on value added in constant euros of 2015 divided by the total number of hours worked; the country effect on the average annual change considers conditional convergence and uses the productivity level for 2008 as the initial value. Source: own elaboration based on Eurostat data.

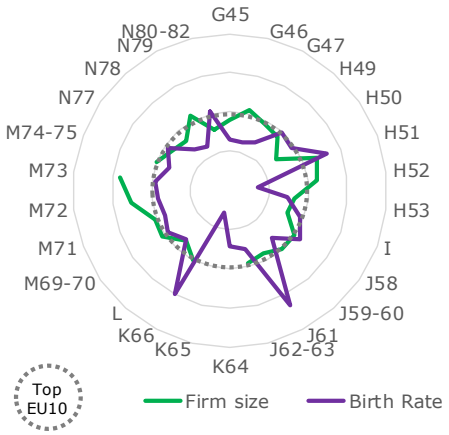


Figure 4. Value in Germany relative to top EU10 (dotted circle) by indicator and activity in business services, based on percentage differences for 2017 (firm size) and 2008-2017 average (birth rate); top EU10 is the aggregate of AT, BE, DE, DK, FI, FR, IE, LU, NL and SE; firm size is measured by the employment-weighted average. Source: own elaboration based on Eurostat data.

France

Labour productivity growth has significantly slowed down in France during the last decade relative to the pre-Great Recession period (0.8% per year between 2007 and 2017 compared to 1.5% between 1997 and 2007). This trend is shared by most Member States, with relative productivity levels in France remaining stable compared to the EU27 and the top 10 performers (blue lines in Figure 1). In contrast, labour productivity growth in France has remained below that of the USA in both sub-periods, contributing to consolidate a negative gap with respect to what we consider the world technological frontier (red line), with dynamics in recent years only correcting somewhat this trend.

At sectoral level, business services show a significant negative contribution to these developments relative to the USA, with labour productivity underperforming in trade activities (NACE section G), information and communication services (J) and administrative and support services (N). This has been particularly the case of ICT services (negative sectoral gap in Figure 2), for which this effect is not fully compensated by the increasing share of this activity in the total number of hours worked in France (positive sectoral composition effect in Figure 2 given its higher productivity level relative to other activities).

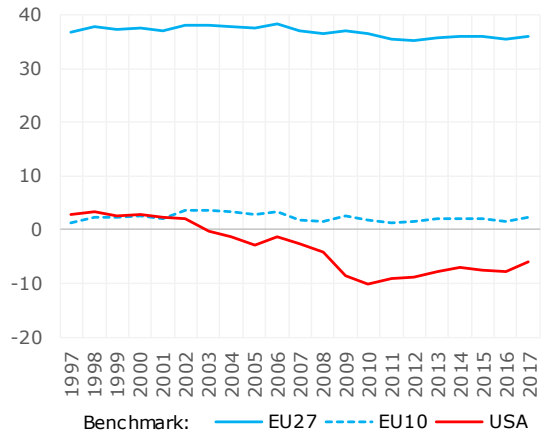


Figure 1. Apparent labour productivity in France relative to the EU27, top EU10 and the USA, in percentage; based on value added in constant euros of 2005 divided by the total number of hours worked; top EU10 is the aggregate of AT, BE, DE, DK, FI, FR, IE, LU, NL and SE. Source: own elaboration based on Eurostat and EU KLEMS data.

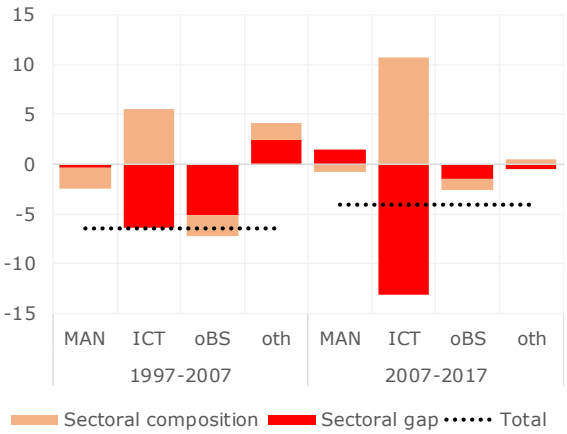


Figure 2. Contributions and total change in apparent labour productivity in France relative to the USA by sub-period, in percentage points; based on value added in constant euros of 2005 divided by the total number of hours worked; MAN = manufacturing, ICT services, oBS = Business services other than ICT, oth =all other economic activities. Source: own elaboration based on Eurostat and EU KLEMS data.

Within the EU27, overall framework conditions seem to support high productivity levels in France. After controlling for sectoral differences across Member States, the country effect is strongly positive for France, remaining among the top 10 EU performers (x-axis in Figure 3). This same effect estimated for the change during the last decade is low relative to the majority of Member States as a result of productivity convergence and the initial high level for France (y-axis). However, more importantly, this effect is higher when compared with most Member States in the EU technological frontier (i.e. those with similar initial productivity levels), signalling certain resilience in overall conditions for further productivity growth in France.

Among other factors, the firm size distribution and firm demographics seem to contribute to productivity heterogeneity across EU countries, also when restricting the analysis to business services.

In this sense, the presence of large enterprises supports overall higher productivity levels and growth in France, with a similar average firm size across business services to other top 10 performers (green line compared to dotted circle in Figure 4). We find however a number of outlying activities for which the average enterprise is smaller: trade (NACE section G), accommodation and food services (I) and some professional, scientific and technical activities (M). In terms of firm dynamics, differences relative to the top EU10 benchmark are higher for firm death rates (purple line in Figure 4), with lower values in France for the majority of business services. This is particularly the case for the section on administrative and support services (N), as well as for some individual activities within transport, hospitality and professional services.

Hence, in certain activities, including some of the aforementioned business services underperforming relative to the USA, we find that productivity in France would benefit from removing existing barriers to firm growth and facilitating the reallocation of resources to more productive enterprises.

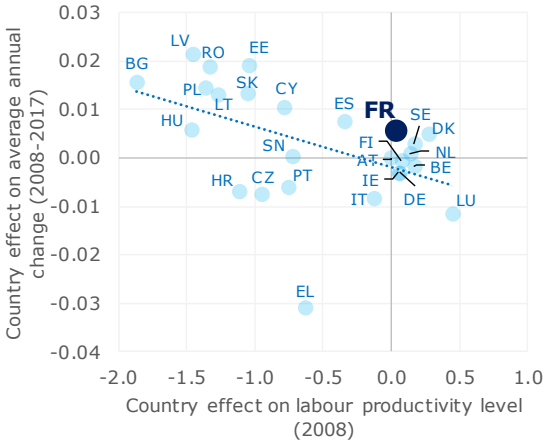


Figure 3. Estimated country effect on the level of apparent labour productivity in 2008 and on the average annual change between 2008 and 2017, in logs relative to reference country AT; based on value added in constant euros of 2015 divided by the total number of hours worked; the country effect on the average annual change considers conditional convergence and uses the productivity level for 2008 as the initial value. Source: own elaboration based on Eurostat data.

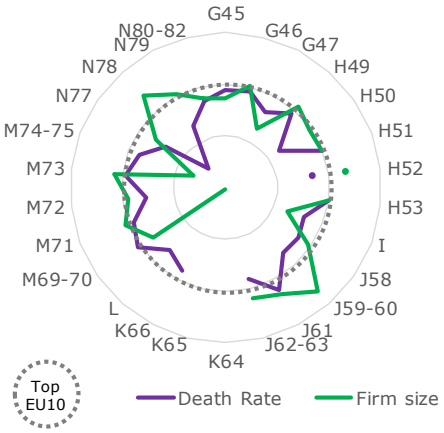


Figure 4. Value in France relative to top EU10 (dotted circle) by indicator and activity in business services, based on percentage differences for 2017 (firm size) and 2008-2017 average (death rate); top EU10 is the aggregate of AT, BE, DE, DK, FI, FR, IE, LU, NL and SE; firm size is measured by the simple average of persons employed per enterprise. Source: own elaboration based on Eurostat data.

Italy

Labour productivity growth has remained very low in Italy during the last decade, extending the trend already observed before the Great Recession (0.3% per year in both 1997-2007 and 2007-2017 sub-periods). Accordingly, relative productivity levels compared to other Member States have shown a persistent negative trend, particularly the gap compared to the top 10 performers, what we consider the EU technological frontier (dotted blue line in Figure 1). Only the overall slowdown of productivity growth in the EU has contributed to soften these dynamics in recent years.

A decomposition of these developments show a contrast in the main driver factor between both sub-periods: a widening of the productivity gap of Italy relative to the top EU10 across most sectors before the Great Recession (dark blue bar in Figure 2) and a shift of hours worked to activities with lower productivity levels during the last decade (light blue bar). On the positive side, the relative level of productivity in ICT services has increased over time, inverting the initial negative gap for Italy.

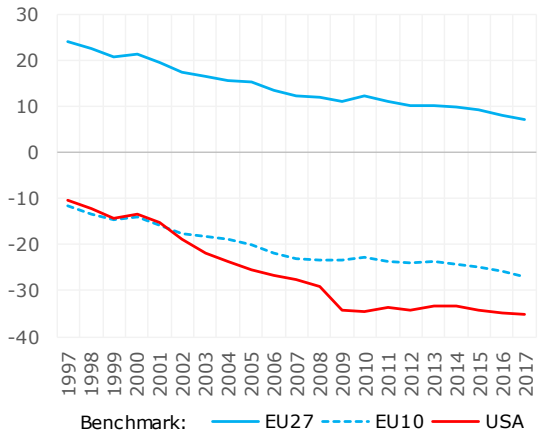


Figure 1. Apparent labour productivity in Italy relative to the EU27, top EU10 and the USA, in percentage; based on value added in constant euros of 2005 divided by the total number of hours worked; top EU10 is the aggregate of AT, BE, DE, DK, FI, FR, IE, LU, NL and SE. Source: own elaboration based on Eurostat and EU KLEMS data.

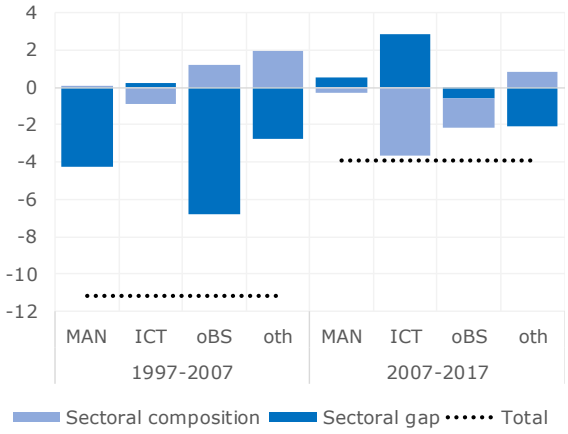


Figure 2. Contributions and total change in apparent labour productivity in Italy relative to the top EU10 by sub-period, in percentage points; based on value added in constant euros of 2005 divided by the total number of hours worked; MAN = manufacturing, ICT services, oBS = Business services other than ICT, oth =all other economic activities. Source: own elaboration based on Eurostat and EU KLEMS data.

Within the EU27, overall framework conditions seem to support medium-high productivity levels in Italy. After controlling for sectoral differences across Member States, the country effect is above the EU27 average and relatively close to those Member States in the top 10 performers (x-axis in Figure 3). However, this same effect estimated for the change during the last decade is lower than for the vast majority of Member States (y-axis), including those Member States with higher initial productivity levels and hence signalling challenges in overall conditions in Italy for productivity convergence to the EU technological frontier.

Among other factors, the firm size distribution and firm demographics seem to contribute to productivity heterogeneity across EU countries, also when restricting the analysis to business services. In this sense, the large share of small enterprises seems to hamper overall higher productivity levels and growth in Italy, with this indicator being significantly higher than in the top EU10 in the majority of business services (captured by points of the green line below the dotted circle in Figure 4). This is particularly the case of trade activities (NACE section G), food and accommodation services (I), and some information and communication (J) and professional activities (M).

In contrast, differences relative to the EU10 benchmark are less pronounced for firm birth rates (purple line in Figure 4), including higher values in Italy for most professional activities and telecommunication services (J61). On the other hand, firm birth rates are particularly lower for trade activities, as well as for those activities with a lower presence of small enterprises, namely transport services (H) and employment agency activities (N78).

The closing of the existing gap in business services would benefit from the improvement in overall conditions for productivity growth in Italy, and specifically from removing existing barriers to firm growth and facilitating the reallocation of resources to more productive enterprises.

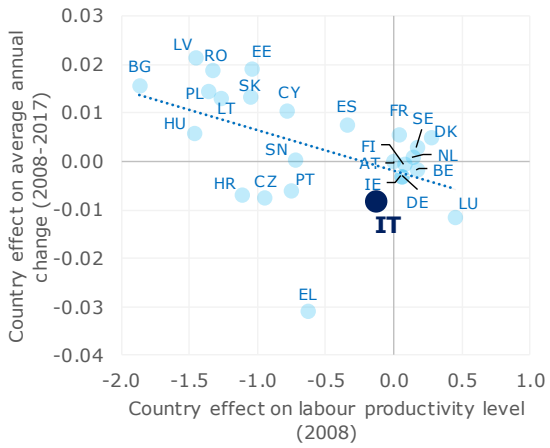


Figure 3. Estimated country effect on the level of apparent labour productivity in 2008 and on the average annual change between 2008 and 2017, in logs relative to reference country AT; based on value added in constant euros of 2015 divided by the total number of hours worked; the country effect on the average annual change considers conditional convergence and uses the productivity level for 2008 as the initial value. Source: own elaboration based on Eurostat data.

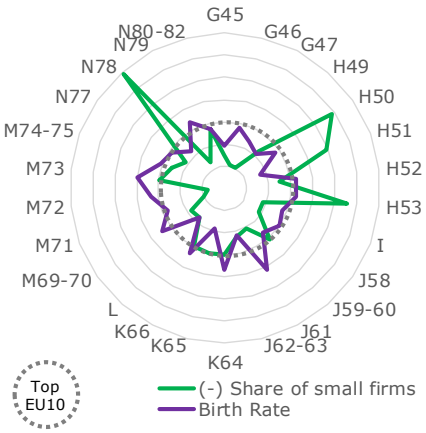


Figure 4. Value in Italy relative to top EU10 (dotted circle) by indicator and activity in business services, based on percentage differences for 2017 (share of small firms) and 2008-2017 average (birth rate); top EU10 is the aggregate of AT, BE, DE, DK, FI, FR, IE, LU, NL and SE; small firms correspond to enterprises with less than 10 persons employed. Source: own elaboration based on Eurostat data.

Spain

Labour productivity growth has significantly accelerated in Spain during the last decade relative to the pre-Great Recession (1.4% per year between 2007 and 2017 compared to 0.1% between 1997 and 2007). Accordingly, relative productivity levels compared to other Member States first stopped and then partially reversed the existing negative trend, particularly the gap compared to the top 10 performers, what we consider the EU technological frontier (dotted blue line in Figure 1).

A decomposition analysis shows the prevalent role of sectoral productivity gaps as the driving factor of these developments (dark blue bar in Figure 2), first widening significantly in business services before the Great Recession and then having an overall positive contribution during the last decade. In contrast, the shift of hours worked to activities with different productivity levels did not have a significant net impact on the total productivity gap relative to the top EU10 (light blue bar). Nevertheless, in the case of ICT services, its increasing share in the total economy has been limited compared to other Member States, more than compensating the consolidation of a positive productivity gap for Spain.

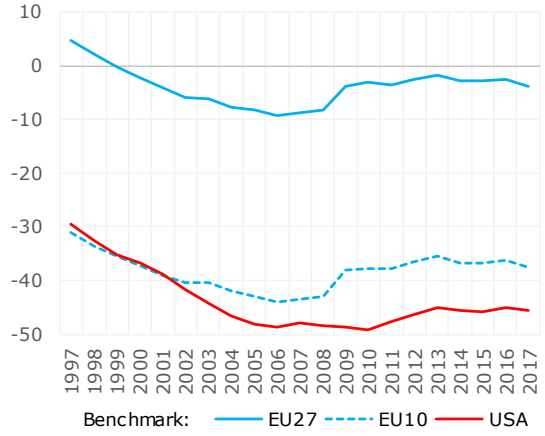


Figure 1. Apparent labour productivity in Spain relative to the EU27, top EU10 and the USA, in percentage; based on value added in constant euros of 2005 divided by the total number of hours worked; top EU10 is the aggregate of AT, BE, DE, DK, FI, FR, IE, LU, NL and SE. Source: own elaboration based on Eurostat and EU KLEMS data.

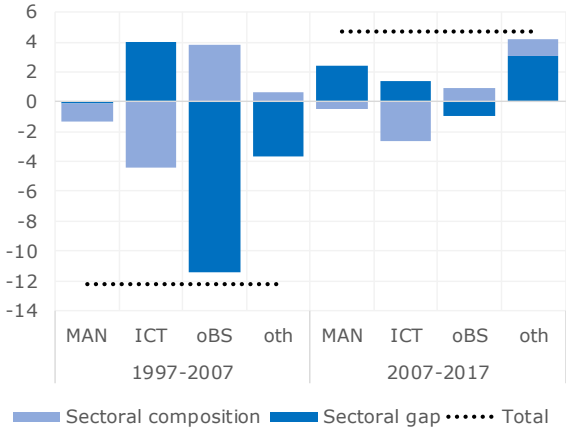


Figure 2. Contributions and total change in apparent labour productivity in Spain relative to the top EU10 by sub-period, in percentage points; based on value added in constant euros of 2005 divided by the total number of hours worked; MAN = manufacturing, ICT services, oBS = Business services other than ICT, oth =all other economic activities. Source: own elaboration based on Eurostat and EU KLEMS data.

Within the EU27, overall framework conditions seem to support medium-high productivity levels in Spain. After controlling for sectoral differences across Member States, the country effect is above the EU27 average but not close to those Member States in the top 10 performers (x-axis in Figure 3). This same effect estimated for the change during the last decade is above the median average of Member States and only lower than in most countries that started to join the EU in 2004 and had significantly lower initial levels of productivity (y-axis). More importantly, this effect is higher when compared with Member States with initial medium productivity levels that were expected to be converging to Spain´s levels, such as Portugal or Greece. In any case, in light of the counter-cyclical condition of labour productivity in Spain[1], it remains to be seen whether these developments are sustained in the future in case the labour market tightens significantly.

Among other factors, the firm size distribution and firm demographics seem to contribute to productivity heterogeneity across EU countries, also when restricting the analysis to business services. In this sense, the large share of small enterprises seems to hamper overall higher productivity levels and growth in Spain, with this indicator being significantly higher than in the top EU10 in the majority of business services (captured by points of the green line below the dotted circle in Figure 4). This is particularly the case of all trade activities (NACE section G), as well of some transportation and storage services (H) and information and communication activities (J). In the latter two cases, however, we also find examples in the opposite direction within the same section, with the presence for instance of a lower share of small firms in air transportation (H51) and ICT services (J62-63) when compared to the benchmark.

[1] www.bbvaresearch.com/en/publicaciones/spain-unproductivity-the-spanish-disease/

In contrast, differences relative to the EU10 benchmark are less pronounced for firm birth rates (purple line in Figure 4), including higher values in Spain for a number of activities in different sections. On the other hand, firm birth rates are particularly lower for land transport (H49), warehousing and support activities for transportation activities (H52) and insurance services (K65).

The closing of the existing gap in business services would benefit from the extension of overall conditions for productivity growth in Spain beyond the recovery following the Great Recession, and specifically from removing existing barriers to firm growth and facilitating the reallocation of resources to more productive enterprises.

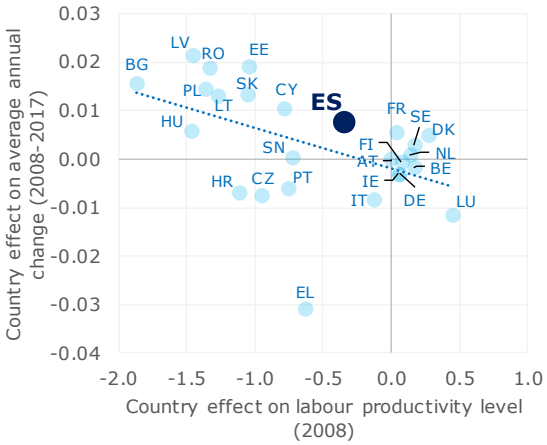


Figure 3. Estimated country effect on the level of apparent labour productivity in 2008 and on the average annual change between 2008 and 2017, in logs relative to reference country AT; based on value added in constant euros of 2015 divided by the total number of hours worked; the country effect on the average annual change considers conditional convergence and uses the productivity level for 2008 as the initial value. Source: own elaboration based on Eurostat data.

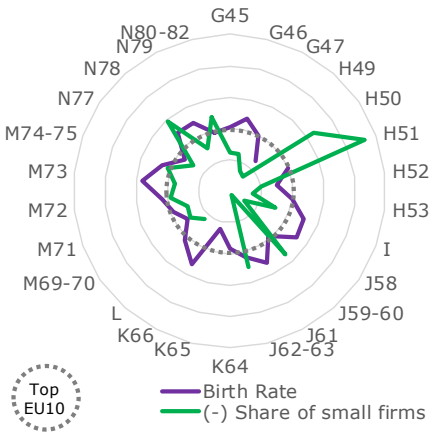


Figure 4. Value in Spain relative to top EU10 (dotted circle) by indicator and activity in business services, based on percentage differences for 2017 (share of small firms) and 2008-2017 average (birth rate); top EU10 is the aggregate of AT, BE, DE, DK, FI, FR, IE, LU, NL and SE; small firms correspond to enterprises with less than 10 persons employed. Source: own elaboration based on Eurostat data.

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

- at the following standard number: +32 22999696, or

- by electronic mail via: https://europa.eu/european-union/contact_en

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications
You can download or order free and priced EU publications from EU Bookshop at: https://publications.europa.eu/en/publications. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

KJ-NA-30460-EN-N

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

EU Science Hub

ec.europa.eu/jrc

@EU_ScienceHub

EU Science Hub - Joint Research Centre

Joint Research Centre

EU Science Hub

Publications Office of the European Union

doi:10.2760/891199

ISBN 978-92-76-25439-3