

# Articles

## 1 The slowdown in euro area productivity in a global context

*Higher labour productivity growth is a key factor in raising living standards in advanced economies. However, labour productivity growth in the euro area has long been low, even before the recent global slowdown. Against such a backdrop, this article assesses the slowdown in euro area productivity growth from a wide range of theoretical perspectives used to explain the global deceleration. These include the role of changes in sectoral composition of the economy, the impact of the global financial crisis, the possibility of measurement errors, a deceleration in the rate of technological progress and diffusion, declines in business dynamism, and the misallocation of factors of production. The article also considers more specific local factors which may account for the longer-lasting productivity weaknesses in the euro area, and argues that structural reforms are necessary to counter the area's long-standing productivity deficit with the United States.*

### 1 Introduction

**Higher labour productivity growth is a key factor in raising living standards in advanced economies.** This is particularly the case in the euro area, in view of the rapid increase projected in the age of the workforce. Recent research suggests that while demographic effects have so far had only a modest impact on euro area productivity growth, rates of workforce ageing over coming decades are projected to increase, equivalent to forgoing around one-quarter of projected productivity growth over the 2014-35 horizon.<sup>40</sup>

**Recent labour productivity growth in the euro area has, however, been low – by both historical and international standards – albeit against the backdrop of a generalised slowdown in global labour productivity growth.** Given this broader deceleration, considerable debate remains as to the underlying causes. Some argue that the slowdown reflects factors which are mainly cyclical, related to the impact of the global financial crisis, while others emphasise longer-standing structural drivers such as changes in the sectoral composition of the economy, measurement errors, a deceleration in the rate of technological progress and diffusion, or declines in business dynamism and misallocation of factors of production.

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<sup>40</sup> See Aiyar, S., Ebeke, C. and Shao, X., "The impact of workforce aging on euro area productivity", IMF Country Report No 16/220, July 2016.

**This article assesses the post-crisis<sup>41</sup> slowdown in euro area productivity growth from a global perspective.** Section 2 presents a number of stylised facts concerning the recent slowdown in euro area productivity growth. Section 3 provides a growth accounting decomposition, showing that the slowdown in euro area labour productivity growth can be traced – at least since the global financial crisis – to reductions in the rates of both capital deepening and total factor productivity (TFP) growth. Section 4 assesses the ability of current explanations emerging in the wider literature to explain the global productivity slowdown, while Section 5 considers area-specific reasons behind the ongoing productivity deficit with the United States. The box considers the contribution of structural reforms to productivity growth and assesses the potential role of the recently created national productivity boards. Section 6 concludes.

## 2 Some stylised facts on euro area productivity growth

**Regardless of the metric chosen to measure productivity, euro area labour productivity growth has slowed markedly since the onset of the global economic and financial crisis (see Chart 1).** Over the period 2008-16, annual growth in euro area labour productivity per person employed slowed to an average of around 0.5% (based on a three-year moving average), from an average of around 1.1% over the course of the decade to 2007. If we consider only the post-crisis period of recovery from 2013 to 2016, euro area labour productivity growth averaged just 0.6% per year. Moreover, the slowdown is evident – albeit to varying degrees – regardless of whether productivity is measured as output per person employed, as output per hour worked, or in terms of TFP.

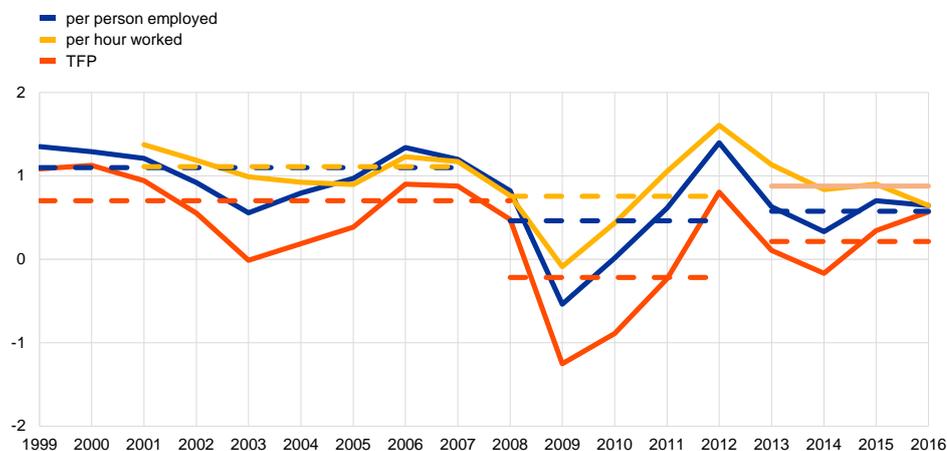
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<sup>41</sup> Throughout this article the “pre-crisis period” ends in 2007 and references to the “crisis period”, without additional qualification, relate to the euro area crisis which runs from 2008 to 2012, encompassing the two euro area recessions and the intervening period. The terms “post-crisis period” and “recovery” refer to the period from 2013 onwards (as far as the relevant available data permit). References to the “Great Recession” and the “global financial crisis” are to the synchronised global recession of 2008-09.

## Chart 1

### Euro area productivity growth

(annual percentage changes, three-year moving averages; dashed lines: period averages for pre-crisis (1999 to 2007), crisis (2008-12) and post-crisis (2013-16) intervals)



Sources: Eurostat, the European Commission's AMECO database and ECB staff calculations.

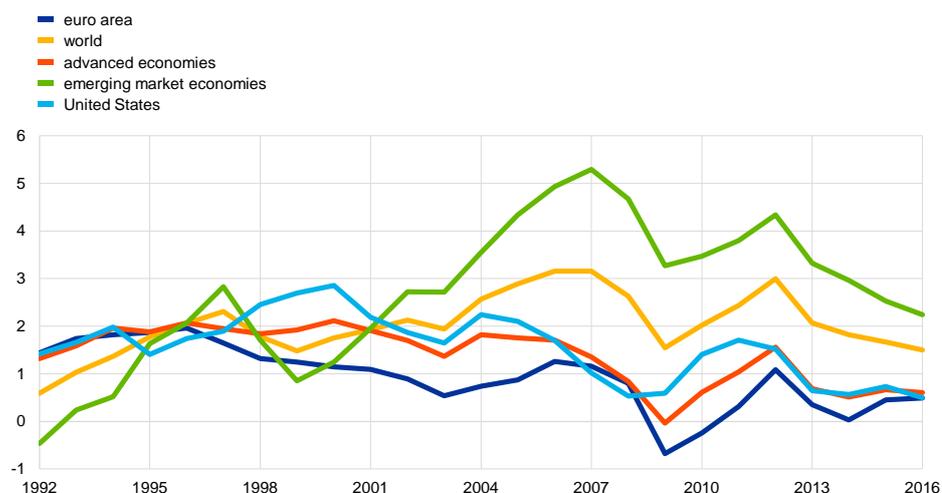
Note: TFP is computed from estimates of output per person employed (taken from the European Commission's AMECO database, which includes an estimate for 2016 on the basis of the European Commission's Winter Forecast 2016).

**Recent euro area labour productivity growth has been low, both by historical and international standards.** Chart 2 shows that the marked slowdown seen in euro area labour productivity growth since the crisis reflects a wider generalised trend across advanced (and emerging) economies since the Great Recession of 2008-09. Nevertheless, from the early 1990s to the present, the euro area has gone from being one of the regions of fastest-growing labour productivity, to one of the slowest.

## Chart 2

### Labour productivity growth in the euro area, the world and global regions

(annual percentage changes, three-year moving averages)



Sources: The Conference Board and ECB staff calculations.

Note: Labour productivity is defined as output per person employed.

**The decline in euro area labour productivity growth is widespread at the sector level, reflecting a marked slowdown in within-sector rates, rather than a shift in industrial structure towards sectors with low labour productivity.** The secular trend towards services as an ever-greater proportion of the total economy might be expected to result in a reduction in aggregate labour productivity growth, as productivity growth in these sectors is typically lower than in other (mainly industrial) sectors. However, a shift-share analysis shows that the decline in aggregate labour productivity growth at the euro area level owes rather more to a marked slowing of within-sector rates of labour productivity growth than to compositional effects. Using the standard ten-sector national accounts breakdown of economic activities (NACE A10<sup>42</sup>), Table 1 decomposes the 0.71 percentage point decline in average annual labour productivity growth between the pre-crisis period 1996-2007 and the period 2008-16 into (i) the share due to a slowing of within-sector rates of labour productivity growth (holding employment shares constant at 2007 levels); (ii) the decline due to the effects of a changing employment composition (holding sectoral labour productivity growth at pre-crisis averages); and (iii) the cross effect, whereby aggregate labour productivity growth is typically boosted by faster employment growth in high labour productivity growth sectors.<sup>43</sup> The table shows that since the onset of the crisis, within-sector rates of labour productivity growth have fallen considerably, while sectoral employment shifts have slightly supported aggregate labour productivity growth, as the labour adjustment which occurred over the crisis was concentrated in sectors with lower productivity. The predominance of the slowdown in within-sector rates of growth as the main driver of the aggregate deceleration also holds if the crisis period is excluded (i.e. when considering the 2013-16 period of recovery only).

**Table 1**  
Decomposition of the slowdown in aggregate euro area labour productivity growth: 1996-2016

(annual percentage changes; percentage point contributions to changes)			
	1996-2007	2008-2016	2013-2016
<b>Overall labour productivity growth (period averages)</b>	1.07	0.35	0.54
<b>difference compared to 1996-2007 average</b>		-0.71	-0.53
<b>of which:</b>			
within-sector effect		-0.90	-0.80
employment composition effect		0.15	0.22
cross effect		0.08	0.02

Sources: Eurostat and ECB staff calculations.

Notes: Based on a shift-share analysis using the NACE A10 sector breakdown. Published starting dates use the previous year as the base year for growth calculations.

<sup>42</sup> As defined in *Nomenclature statistique des activités économiques dans la Communauté européenne* (Statistical classification of economic activities in the European Community (NACE)).

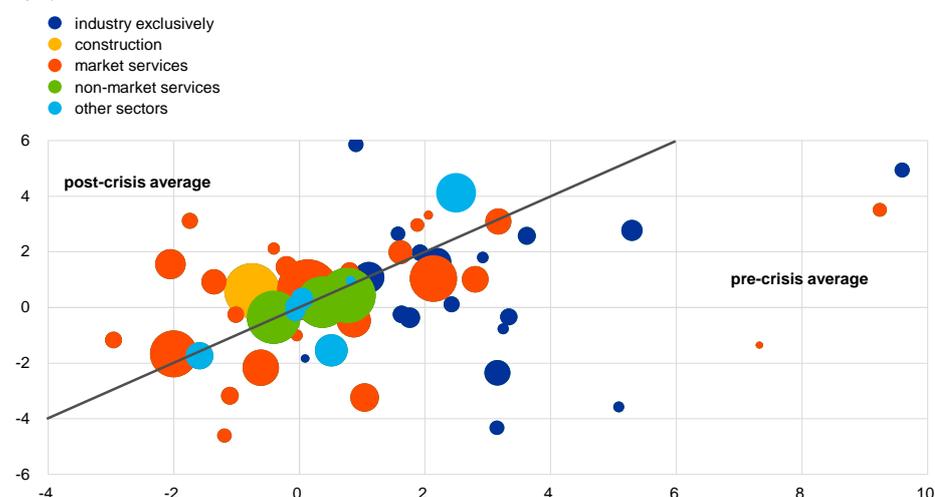
<sup>43</sup> The analysis builds on work of Antipa, P., "Productivity decomposition and sectoral dynamics", *Quarterly Selection of Articles: Banque de France Bulletin*, Banque de France, Spring 2008, pp. 51-64.

The pattern of weak labour productivity growth at the sectoral level can also be seen using a more detailed NACE 64-sector breakdown (available on an annual basis, currently ending in 2014). As shown in Chart 3, almost two-thirds of the 61 sectors for which data were available show falls (often significant) in average rates of labour productivity growth between the two periods (see the sectors to the right of the 45° line), particularly in the manufacturing sectors and the more traded market services (such as wholesale trade, financial and insurance services, legal and managerial services, and travel-related services).<sup>44</sup>

### Chart 3

#### Pre- and post-crisis labour productivity growth by sector

(annual percentage changes (period averages); colours indicate the main NACE A10 sectoral groups; bubble sizes reflect the share of euro area employment for each sector in 2016; sectors on the 45° line are those in which pre- and post-2013 average growth rates are equal)



Sources: Eurostat and ECB staff calculations.

Notes: Labour productivity is defined as output per person employed. "Pre-crisis" refers to 2000-07; "post-crisis" to 2013-14 (in line with data availability). "Others" includes those attributed to "other services" (primarily private-sector acyclical sectors, such as arts, entertainment and recreation activities, household services and activities of extraterritorial organisations) and agriculture, forestry and fishing.

## 3 A growth accounting approach for the euro area and the United States

### 3.1 Decomposing labour productivity growth

**Taking a growth accounting approach shows that the post-crisis decline in average growth in labour productivity in the euro area and the United States can be traced back to both a marked reduction in TFP growth in comparison with pre-crisis rates and, since 2013, a virtual absence of capital deepening.**

Using data from the European Commission's AMECO database, Chart 4 decomposes the rate of labour productivity growth for the two economies into drivers

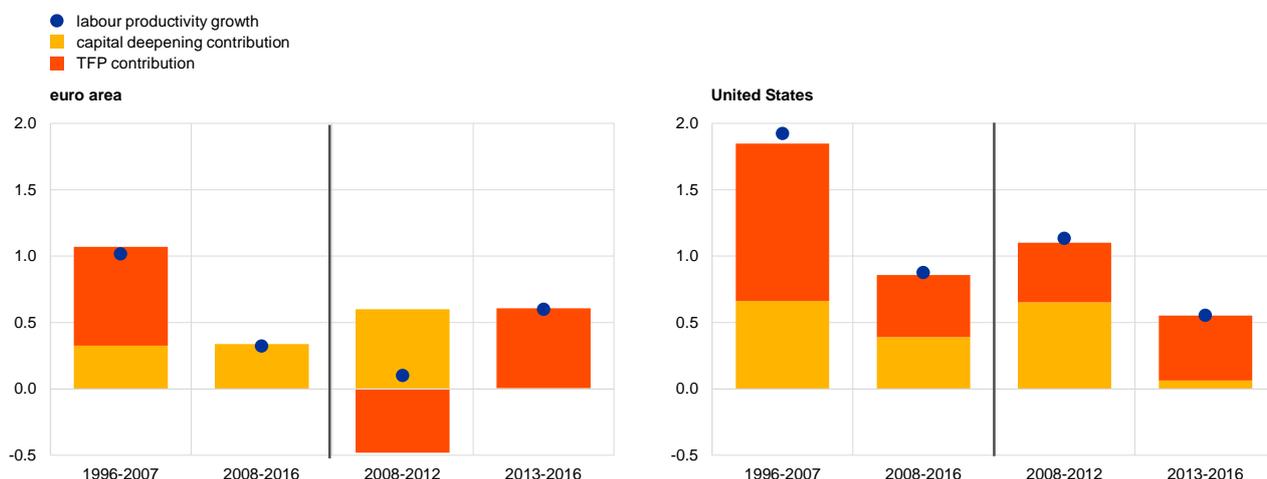
<sup>44</sup> Results are similar when productivity is measured on an hourly basis, although the picture is less comprehensive, owing to the number of sectors for which data are available (only 22 out of 64).

of capital deepening (i.e. the rate at which the capital-labour ratio is increased) and of TFP (reflecting underlying productivity growth from greater efficiencies in production processes and technological progress), for the pre-crisis period 1996-2007 and for the period 2008-16, since the onset of the global financial crisis. A comparison between developments in both economies in the periods before and after the onset of the Great Recession in 2008 shows, overall, (see the first two columns for each economy in Chart 4) that the marked decline in labour productivity growth looks to be driven by a sharp reduction in the underlying rate of TFP growth in both economies. Over the 2008-16 period as a whole, capital deepening did not decline in the euro area and suffered only a moderate decline in the United States; this was largely as a result of significant shedding of labour during the depths of the crisis period (in particular during the period 2008-09).

## Chart 4

### Labour productivity growth and decomposition for the euro area and the United States

(period averages of annual percentage changes and percentage point contributions\*)



Sources: The European Commission's AMECO database and ECB staff calculations.

Notes: Productivity is measured in terms of output per person employed; \* contributions are computed using a Cobb-Douglas production function, with capital deepening contributions estimated using two-period average factor shares; TFP contribution is taken as the residual. Observations for 2016 are estimates based on the European Commission's Winter 2016 Economic Forecast.

**However, over the period 2013-16, capital deepening virtually stagnated in the euro area and the United States.** Although it is of interest to compare the periods before and after the onset of the global financial crisis, it is worth noting that the latter period can be divided into two distinct sub-periods. The first of these periods (2008-12 inclusive) was marked by strong declines in real GDP in both economies (albeit these declines did not last as long in the United States as in the euro area, where they spanned both the Great Recession and the sovereign debt crisis). The second period covers the recovery, which began in 2013. Decomposing the interval since the onset of the crisis into these two sub-periods confirms the broad slowdown in TFP growth in the post-crisis period compared with pre-crisis averages (see the first and final columns for each economy in Chart 4), and suggests an almost complete absence of capital deepening in the aftermath of the crisis in both economies over the 2013-16 interval.

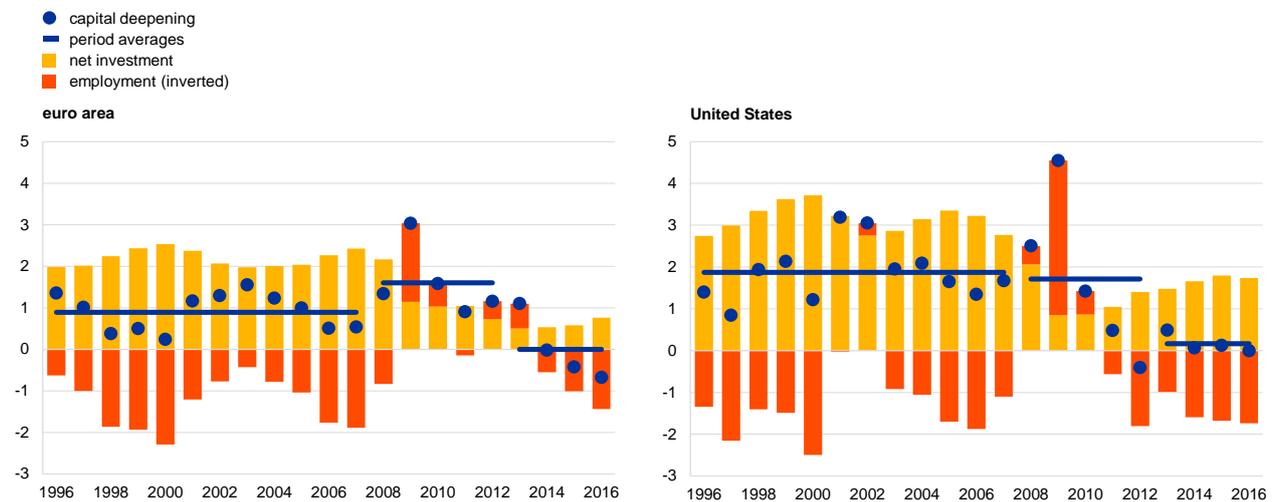
### 3.2 Factors behind the post-crisis slowdown in capital deepening

**Capital deepening refers to the process of increasing the capital-labour ratio by giving labour more capital to work with.** However, the capital-labour ratio may also indicate “artificial” capital deepening in periods of low net investment if significant shedding of labour mechanically increases the ratio of the existing net capital stock to a reduced workforce. Chart 5 shows that during the depths of the crisis, both economies saw some support to capital deepening – and, indeed, a slight increase in the rate of capital deepening in the euro area – mainly as a result of heavy shedding of labour in some countries and sectors (which mechanically supported capital deepening, notwithstanding markedly reduced net investment<sup>45</sup>).

**Chart 5**

#### Capital deepening in the euro area and the United States

(annual percentage changes)



Sources: The European Commission's AMECO database and ECB staff calculations.

Notes: Observations for 2016 are estimates based on the European Commission's Winter 2016 Economic Forecast. Period averages correspond to 1996-2007, 2008-12, and 2013-16, respectively.

**The slowdown in capital deepening since 2013 reflects both a slower rate of net investment and a recovery in employment growth.** Net investment has almost halved in the United States from pre-crisis rates, to around 1.7% per year over the 2013-16 period, but has fallen much more in the euro area (and from a lower starting rate) to just 0.6% per year – which is around one-quarter of the euro area's pre-crisis average annual rate of net investment.<sup>46</sup> However, the decline in capital deepening in both economies since 2013 also reflects a marked offsetting effect arising from growth in employment, which has been relatively strong in relation to the extent of the rebound in activity. This effect has contained the rate of capital deepening and, in fact, fully offset the low (albeit now modestly expanding) rate of investment growth in the euro area.

<sup>45</sup> Net of depreciation and of any accounting for obsolescence of existing capital.

<sup>46</sup> See also the article entitled “Business investment developments in the euro area since the crisis”, *Economic Bulletin*, Issue 7, ECB, 2016. The article includes a box on the implications for capital deepening.

**A number of reasons have been put forward to explain the slowdown in capital deepening since 2013.** These include (i) the strong concentration of the recovery in consumer-driven sectors (common to both economies) where growth is heavily concentrated in those services that are often the most labour-intensive<sup>47</sup> and in which the potential for capital-labour substitution remains somewhat limited, coupled with a persisting weakness in investment in construction (particularly in the euro area); (ii) the impact of the global financial crisis and ongoing credit constraints in its aftermath (discussed in Section 4.1, below); and (iii) some further potential for offset to the “artificial” degree of capital deepening seen over the depths of the crisis. All three of these elements are likely to help explain the lower rates of capital deepening seen in both the United States and euro area economies over the period of recovery.

### 3.3 A broader trend decline in TFP growth

**Considered over the longer term, and from a more global perspective, it is the slowdown in TFP growth which seems to have been the key contributor to the slowdown in labour productivity growth since the mid-1990s (see Chart 6).**

While estimates vary as to the magnitudes of pre- and post-crisis rates of TFP growth seen in each of the euro area and the United States (due mainly to differences in methodology<sup>48</sup>), a consistent finding is that TFP growth in both has decelerated significantly since the crisis. Including estimates for 17 other advanced economies (see the shaded area in Chart 6), it becomes clear that a generalised decline in average rates of TFP growth is broadly detectable across advanced economies for the period since the mid-1990s (albeit with a modest rebound from the negative rates of growth seen in the euro area during the depths of the global financial crisis). Euro area TFP performance had been lacklustre, in comparison with most advanced economies, since the mid-1990s.

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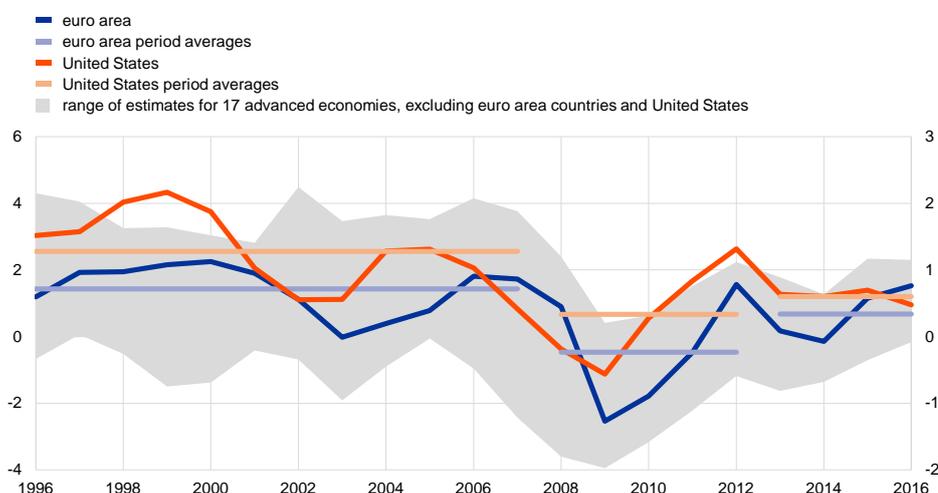
<sup>47</sup> Such as retailing, healthcare and other non-market services, and the professional and administrative services sectors. See also the article entitled “What is behind the recent rebound in euro area employment?” *Economic Bulletin*, Issue 8, ECB, 2015.

<sup>48</sup> Estimates vary due primarily to differences in the specification of the production function underlying growth accounting decompositions. Nevertheless, a common feature of (i) the various estimates available for both the euro area and the United States (principally from the AMECO database and The Conference Board, respectively), and (ii) the country-level estimates from other international organisations such as the IMF and the OECD, is that they typically suggest a marked decline in post-crisis TFP growth rates compared with pre-crisis rates.

**Chart 6**

**Total factor productivity (TFP) growth in advanced economies**

(three-year moving averages of annual percentage changes; right-hand scale: euro area and United States; left-hand scale: other advanced economies)



Sources: The European Commission's AMECO database and ECB staff calculations.

Notes: The shaded area shows the range of estimates for 17 advanced economies (excluding euro area countries and the United States): Australia, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Hungary, Iceland, Japan, Mexico, New Zealand, Norway, Poland, Romania, Sweden, Switzerland and the United Kingdom. Period averages are computed for 1996-2007, 2008-12, and 2013-16, respectively.

## 4 Causes of the productivity slowdown: contrasting views

**A range of competing explanations has been put forward in the literature to explain the secular decline over recent years in headline productivity growth generally, and in TFP growth in particular.** This section assesses the potential of each of these factors in helping to explain the euro area's recent slowdown in productivity growth in the context of the wider global deceleration.

### 4.1 The impact of the crisis on euro area productivity growth

**The global financial crisis which began in 2008 is likely to have contributed to the slower average rate of euro area productivity growth since the crisis.**

Several mechanisms are typically associated with slower productivity growth following financial boom-bust cycles. First, the reallocation of resources previously associated with the build-up of housing imbalances in some euro area economies prior to the onset of the Great Recession may be hindered by ongoing credit supply constraints in a slow-to-recover financial system.<sup>49</sup> These constraints are likely to limit the expansion of small and young, but highly productive, firms. Second, regulatory forbearance and inadequate insolvency regimes may also lock capital into

<sup>49</sup> See Borio, C., Kharroubi, E., Upper, C. and Zampolli, F., "Labour reallocation and productivity dynamics: financial causes, real consequences", *BIS Working Papers*, No 534, January 2016; and Reinhart, C. and Rogoff, K., *This Time is Different: Eight Centuries of Financial Folly*, Princeton University Press, 2009.

firms with low levels of productivity, so that the cleansing effects typically associated with recessions do not occur. Lastly, risks of hysteresis, associated with protracted periods of private sector balance sheet repair, may weaken domestic demand and investment, thereby potentially limiting technological innovation.<sup>50</sup>

**Significant though the crisis may have been in further reducing euro area productivity growth in the period since 2008, it does not, however, shed light on the more fundamental issue; why euro area productivity growth was comparatively slow (from an international perspective) before then.** This can be explained by an examination of the underlying determinants of labour productivity growth; these are explored in detail below.

## 4.2 Measurement errors in outputs and inputs

**It is often suggested that mismeasurement may simply underestimate the real rate of productivity growth now seen in advanced economies.** A number of areas of concern regarding mismeasurement are discussed in the literature. These include the mismeasurement of information and communications technology (ICT)-related goods and services, arising from the difficulty in measuring improvements in the quality of ICT hardware and software – in the United States, in particular, measured hardware prices have recently shown falls which some see as implausibly small in comparison with historical data. The literature also identifies the lack of an encompassing measurement of intangible investments in the national accounts<sup>51</sup>; and considers the broader notion that many recent innovations are simply not marketed and therefore not captured in the national accounts, so that the growth in GDP, on which productivity dynamics are based, is significantly understated.

**Notwithstanding the benefits of innovations associated with increasing numbers of free digital goods and the “sharing economy”, market-based TFP growth has slowed considerably over several consecutive decades.** As Robert Gordon notes, far-reaching welfare implications for consumers associated with earlier innovations – including the invention of electricity and the telephone – have been around since well before the ICT revolution.<sup>52</sup>

Potentially more relevant are the concerns regarding inadequate measurement of both intangible investments and improvements in the quality of ICT-related goods and services and of labour, which may bias estimates of outputs and inputs and result in misleading conclusions regarding labour productivity and TFP growth. Attempts to mitigate these deficiencies are ongoing and include (i) concerted efforts

<sup>50</sup> Recent work by staff at the IMF suggests that the crisis had a “significantly negative impact” on post-crisis euro area TFP growth. See “Gone with the headwinds: global productivity”, IMF presentation, 2 February 2017. IMF Staff discussion note to be published March/April 2017. The IMF estimates that policy uncertainty alone is likely to have shaved around 0.1-0.2 percentage point annually from post-crisis TFP growth in advanced economies generally, with the impact in Europe being particularly pronounced.

<sup>51</sup> See Corrado, C., Hulten, C. and Sichel, D., “Intangible Capital and Economic Growth”, *NBER Working Paper Series*, No 11948, January 2006.

<sup>52</sup> See Gordon, R., *The Rise and Fall of American Growth: The U.S. Standard of Living since the Civil War*, Princeton University Press, 2016.

aimed at creating better measures of “intangible assets” in national accounts data sources via the inclusion of “intellectual property products” in the European System of National and Regional Accounts (ESA 2010)<sup>53</sup>; (ii) attempts to reassess the development of ICT-based prices (and the wider link between ICT and productivity growth); and (iii) greater efforts to better isolate the impact of improvements in skills. However, given the internationally synchronised slowdown in TFP growth seen since the onset of the Great Recession across countries at varying levels of economic development and with differing economic structures and varying degrees of educational attainment, mismeasurement seems unlikely to be a major cause of either the slowdown in TFP growth which has been measured across economies, or the marked decline in euro area TFP growth observed since the onset of the crisis.

### 4.3 A decline in the rate of technical progress

**A widely-held view suggests that the decline in aggregate productivity growth across advanced economies is likely due to a slowing in the rate of technological progress across sectors, with technological innovations of recent years simply less “revolutionary” than in the past.**<sup>54</sup> As a result, it is argued, recent technological innovations may simply be less pervasive compared with earlier inventions such as the railway, electricity or the telephone, so that the impact on TFP growth is likely to be much lower.

**In a similar vein, others explain the slowdown in US TFP growth since the early 2000s as a sign that the productivity-enhancing effect of ICT innovations has run its course** – as suggested by the fact that the slowdown in US productivity growth is most pronounced in sectors in which ICT is produced or intensively used.<sup>55</sup> However, many counter that the full impact of the ICT revolution has not yet been realised and point to the potential yields from, for example, miniaturised products with embedded connectivity, artificial intelligence, robotics, self-driving cars, drones, 3D printing, cloud services and big data, arguing that substantial gains in aggregate productivity are likely to be seen only with a considerable lag<sup>56</sup>. Moreover, the argument that a slowdown in the pace of technological progress explains the marked deceleration in euro area TFP growth since the crisis seems somewhat unconvincing, not least because the euro area saw less of a boost to TFP growth from the ICT revolution than that seen in, for example, the United States.

<sup>53</sup> European System of National and Regional Accounts, which uses aggregation levels of the NACE Rev. 2 classification (2010).

<sup>54</sup> Gordon, R., op. cit..

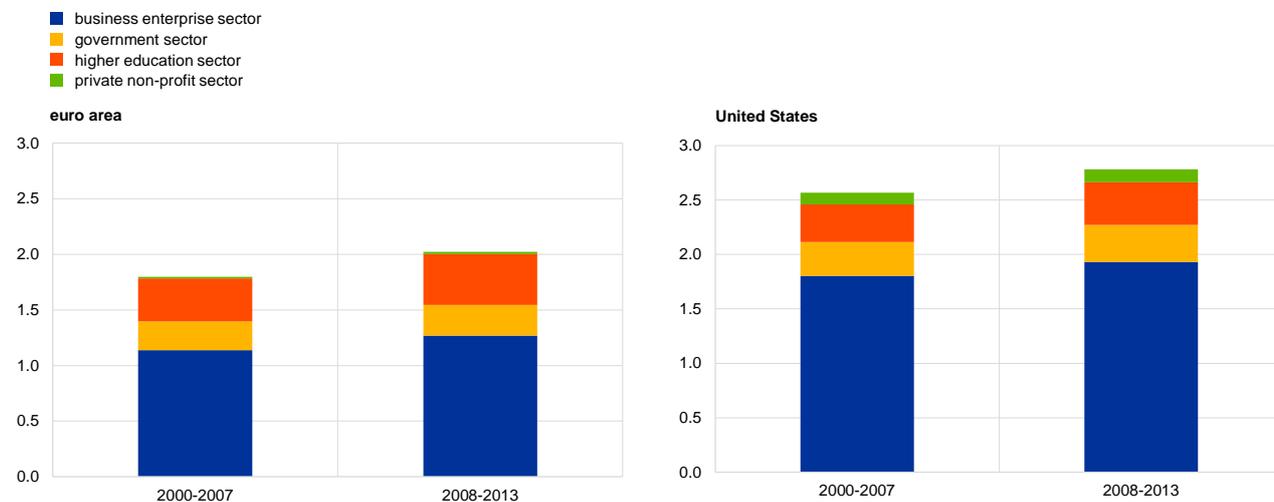
<sup>55</sup> See Fernald, J., “Productivity and potential output before, during, and after the Great Recession”, *Federal Reserve Bank of San Francisco Working Paper Series*, September 2012; and Cetty, G., Fernald, J. and Mojon, B., “The pre-Great Recession slowdown in productivity” *Federal Reserve Bank of San Francisco Working Paper Series*, April 2016.

<sup>56</sup> See, for example, Mokyr, J., “Is technological progress a thing of the past?”, available at <http://voxeu.org/article/technological-progress-thing-past>; Nordhaus, W., “Productivity growth and the new economy,” *NBER Working Paper Series*, No 8096, January 2001; Brynjolfsson, E. and McAfee, A., *Race Against the Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy*, Digital Frontier Press, Massachusetts, 2011; and Brynjolfsson, E. and McAfee, A., *The Second Machine Age: Work, Progress, and Prosperity in a time of Brilliant Technologies*, W. W. Norton & Company, New York, 2014.

## Chart 7

### R&D expenditure by sector in the euro area and the United States

(Expenditure on R&D as a percentage of GDP)



Sources: Eurostat and ECB staff calculations.

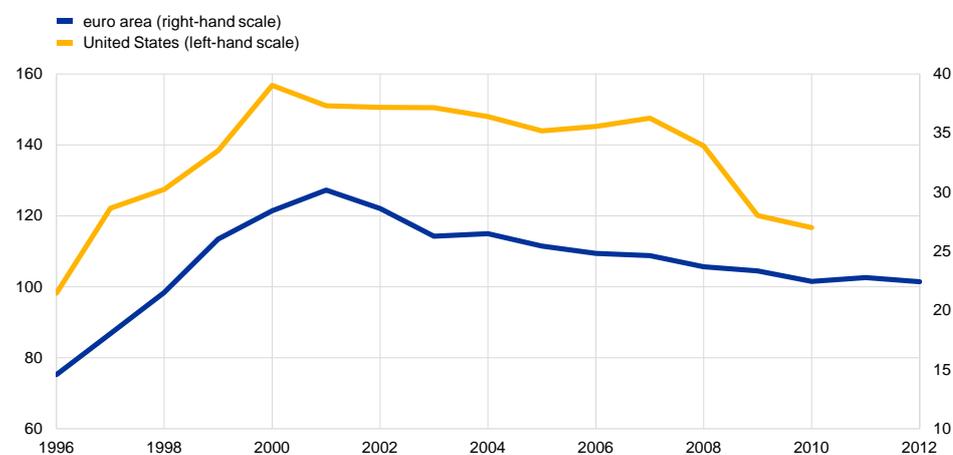
Note: Periods are limited by data availability.

**More generally, the available evidence – in terms of research and development (R&D) expenditure and high technology patents – does not point to a sharp slowdown in global technological progress in recent years.** As shown in Chart 7, R&D expenditure relative to GDP typically increased in both the euro area and the United States following the onset of the Great Recession (i.e. during the period 2008-13 (interval limited by data availability)), suggesting that there has not been a major decrease in the resources devoted to innovation. Similarly, while high-tech patent applications submitted and granted have declined somewhat from their respective peaks in the early 2000s, they remain high by historical standards (see Chart 8). However, in explaining the euro area's longer-term "productivity deficit" with the United States, the higher incidence of US high-tech patenting activity per inhabitant remains notable (as does a higher absolute number of patent applications to the European Patent Office by US enterprises in comparison with euro area-based firms).

## Chart 8

### High-tech patent applications/grants in the euro area and the United States

(patent submissions/grants per million inhabitants)



Sources: Eurostat and ECB calculations.

Note: US data show patents granted by the US Patent and Trademark Office (USPTO) to US companies, while euro area data show patent applications made to the European Patent Office (EPO) by euro area companies.

**More anecdotally, there have been important technological advances in recent years which may still bring substantial gains in aggregate productivity, albeit with a lag.** These advances are likely to enhance networking and cooperation, as well as to increase the accessibility of products and services and the speed at which they can be supplied.

#### 4.4 A decline in the rate of technology diffusion and an increase in input misallocation

**Potentially more important than any possible waning of innovation may be the fact that the pace of technology diffusion has declined, so that the latest inventions are not incorporated into the production processes of businesses as rapidly as in previous years.** For technological innovations to have a noticeable impact on the TFP growth of businesses, corresponding changes in organisational structures and business models are often needed. One possible indicator of the extent of technology diffusion, as proposed by the OECD, is the gap between the labour productivity growth of global frontier firms – those creating the new knowledge – and non-frontier firms, also called “laggards”, operating in the same sector.<sup>57</sup> According to this indicator, technology diffusion declined in the early 2000s in advanced OECD economies (when comparable cross-country firm-level data for Europe became available), as shown by the increasing gap in the labour productivity performance of frontier and non-frontier firms operating in the same sector (see Charts 9a and 9b).

**The slowdown in technology diffusion has been particularly pronounced in services in the euro area, relative to other advanced economies.** Using the

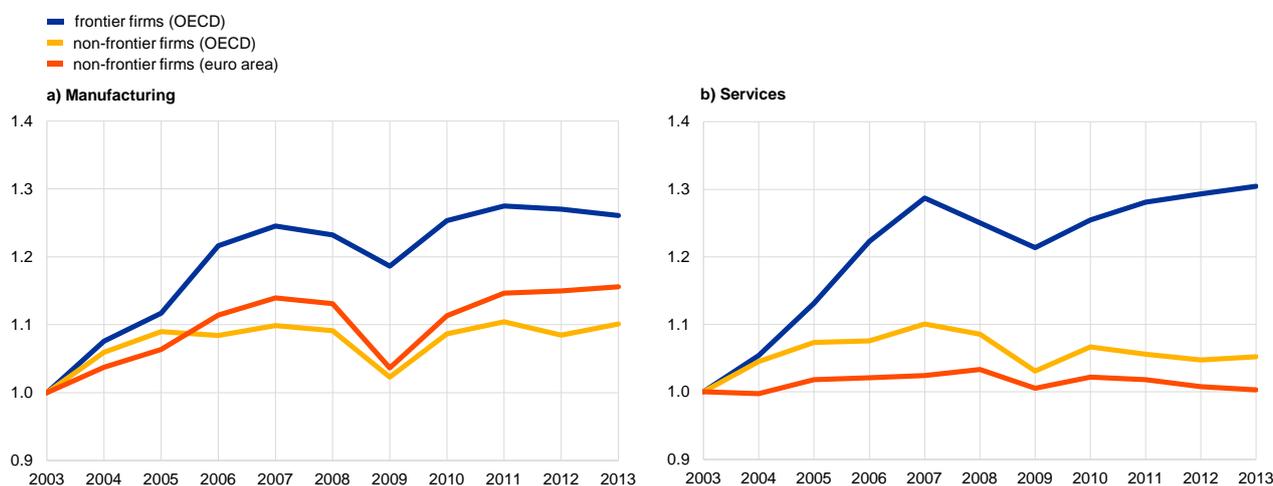
<sup>57</sup> See *The future of productivity*, OECD, 2015.

CompNet dataset<sup>58</sup> to analyse the labour productivity performance of firms in five large euro area countries (Belgium, Spain, France, Italy and Finland) and approximating the labour productivity growth of non-frontier firms using the performance of the median firm<sup>59</sup> in each sector, Charts 9a and 9b show that the gap in labour productivity between the frontier firms operating in the OECD and the non-frontier firms operating in euro area countries widened prior to the global financial crisis. Although evident in both manufacturing and services, technological diffusion looks to have been noticeably slower in euro area services than in services in other advanced economies. This productivity gap declined moderately during the crisis, possibly due to the exit from the market of the least productive non-frontier firms, but it appears to have widened again – at least as far as services are concerned.

## Chart 9

### Technology diffusion in manufacturing and services in selected euro area countries

(annual labour productivity growth of frontier and non-frontier firms; 2003 = 1)



Source: ECB staff calculations based on OECD data and the 5th vintage of CompNet data.

Notes: The OECD frontier and non-frontier productivity developments are taken from *The future of productivity*, OECD, 2015. The productivity growth of the euro area is proxied as the unweighted average, across Belgium, Spain, France, Italy and Finland, of the median firm in each 1-digit sector (using the NACE Rev. 2 classification). NACE Rev.2 1-digit services sectors are then aggregated with value added shares.

**Three key explanations for these developments are (i) the increasing importance of so-called “tacit” learning-by-doing knowledge; (ii) a slowdown in the rate of laggard firms’ investment in intangibles; and (iii) a decrease in business dynamism.** While the factors behind the slowdown in technology diffusion are still not fully clear, various mutually consistent explanations have been put forward. The literature emphasises the increasing importance of investment by firms

<sup>58</sup> The CompNet micro-aggregated dataset is based on administrative data from company registers and provides harmonised cross-country information on the main moments (e.g. mean, median, standard deviation) of the distribution of a number of variables related to firm performance and competitiveness for each sector. The data refer to firms with more than 20 employees and are population-weighted. For details, see Lopez-Garcia, P., di Mauro, F. and the CompNet Task Force, “Assessing European competitiveness: the new CompNet micro-based database”, *Working Paper Series*, No 1764, ECB, 2015.

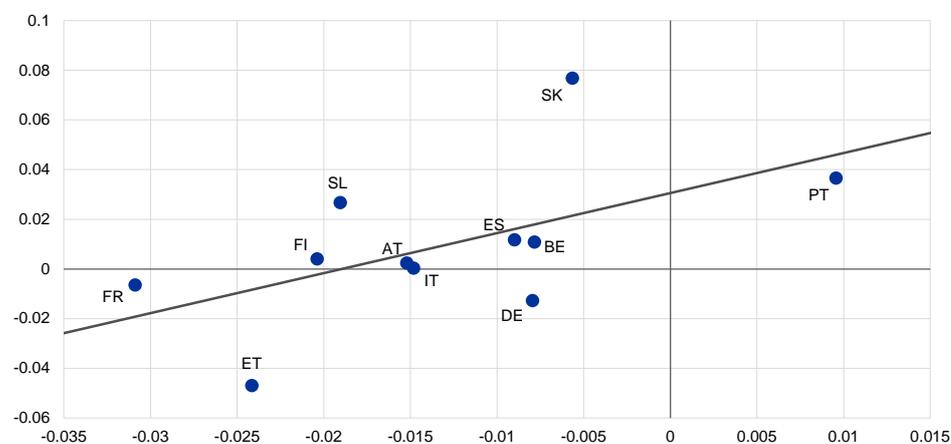
<sup>59</sup> The median firm was chosen since its labour productivity dynamics very closely follow the weighted labour productivity growth average of firms that are not in the frontier in a given sector.

in human capital so as to enhance their absorptive capacity.<sup>60</sup> Furthermore, among non-frontier firms, investment in intangible assets (e.g. R&D activity, firm-specific skills and various forms of intellectual property), which is another crucial determinant of the absorptive capacity of firms, has not kept pace with technological innovation and is thus likely to have negatively affected technology diffusion.<sup>61</sup> Chart 10 shows that the labour productivity growth gap between frontier and non-frontier firms is larger where investments by laggards in intangibles are lower relative to investments by frontier firms (after controlling for NACE sector).

### Chart 10

#### Technology absorption and investment in intangibles of non-frontier firms in 11 euro area countries

(x-axis: gap in intangibles between national frontier and laggard firms (annual average 2010-13); y-axis: gap in labour productivity growth (annual average 2010-13))



Source: ECB staff calculations based on Amadeus data.

Notes: The gap in labour productivity growth and investment in intangibles between frontier and non-frontier firms are computed at the NACE Rev.2 2-digit sector level. Country averages are obtained with weights based on the share of each sector in total value added. Investment in intangibles is measured as the ratio of real intangible fixed assets + depreciation over lagged real intangible fixed assets.

#### A further reason for the slowdown in technological diffusion may be related to a fall in business dynamism, or the extensiveness of “creative destruction”.

Given that young and high-growth firms can be key drivers of innovation – not least, by exerting pressure on incumbents to innovate and become more productive, and by speeding up labour reallocation – the literature finds a significant link between business entry rates and technological creation and diffusion.<sup>62</sup> While comparable cross-country data on business closures and openings are not available for the entire euro area, data for the EU-14 suggest a downward trend in the rate of business “churn” (i.e. the process of firms exiting the market and being replaced with

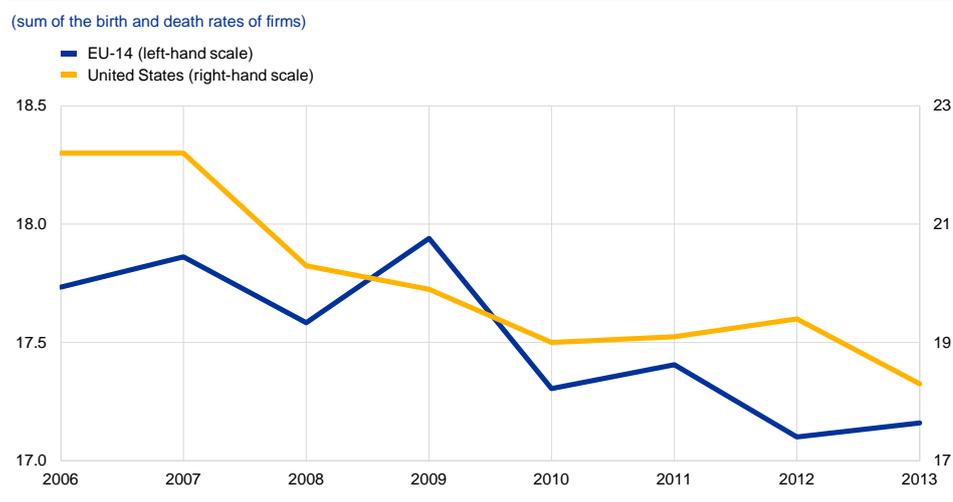
<sup>60</sup> See, for example, Griffith, R., Redding, S. and Van Reenen, J., “Mapping the two faces of R&D: productivity growth in a panel of OECD industries”, *The Review of Economics and Statistics*, Vol. 86, Issue 4, November 2004, pp. 883–95.

<sup>61</sup> See, for example, Corrado, C., Haskel, J., Jona-Lasinio, C. and Iommi, M. “Intangible capital and growth in advanced economies: measurement methods and comparative results”, available at <http://www.intan-invest.net>.

<sup>62</sup> See, for example, Haltiwanger, J., Jarmin, R., Kulick, R. and Miranda, J., “High growth young firms: contribution to job, output and productivity growth”, unpublished manuscript, 2016; and Baumann, U., and Vasardani, M., “The slowdown in US productivity – what explains it and will it persist?”, *Bank of Greece Working Paper Series*, No 215, November 2016.

new firms); a similar decline has also been recorded in the United States (see Chart 11).

**Chart 11**  
Business churn in the United States and Europe



Source: ECB staff calculations based on US Census Bureau and Eurostat data.  
Notes: EU-14 denotes the countries that had joined the EU by 1995, with the exception of Greece (given the lack of data). 2006 is the earliest year with complete data for all EU-14 countries.

**Business dynamism affects the allocation of capital and/or labour across firms and this can have a direct impact on within-sector labour productivity growth.**

A significant determinant of labour productivity growth is the degree of efficiency with which such production inputs are allocated across firms, even within narrowly defined sectors (“allocative efficiency”).<sup>63</sup> Given the heterogeneity in the performance of firms, significant aggregate labour productivity gains can stem from the reallocation of resources (including labour and capital) from low- to high-productivity firms; research suggests that this may explain up to half of the aggregate labour productivity growth in a mature economy.<sup>64</sup> The most frequently used, albeit imperfect, indicator of capital and labour misallocation is the dispersion in the marginal revenue product of capital and labour across firms within a given sector.<sup>65</sup> The intuition underlying this measure is that for allocative efficiency to be achieved in a given sector where firms are assumed to face the same marginal costs, resources should flow across firms until the marginal productivity of inputs is equalised. However, the presence of frictions in labour, product and credit markets may hinder reallocation and can thus significantly dampen labour productivity dynamics. The larger the dispersion in the marginal revenue product of capital and labour, the greater the potential drag on aggregate labour productivity growth.

<sup>63</sup> See the article entitled “Firm heterogeneity and competitiveness in the European Union”, *Economic Bulletin*, Issue 2, ECB, 2017.

<sup>64</sup> Estimates of the relative importance of these components of TFP growth are highly dependent on the country, sector, period and decomposition methodology used. The indicative percentages reported here are based on selected studies on the US manufacturing sector provided in Gamberoni, E., Giordano, C. and Lopez-Garcia, P., “Capital and labour (mis)allocation in the euro area: some stylized facts and determinants”, *Working Paper Series*, No 1981, ECB, November 2016.

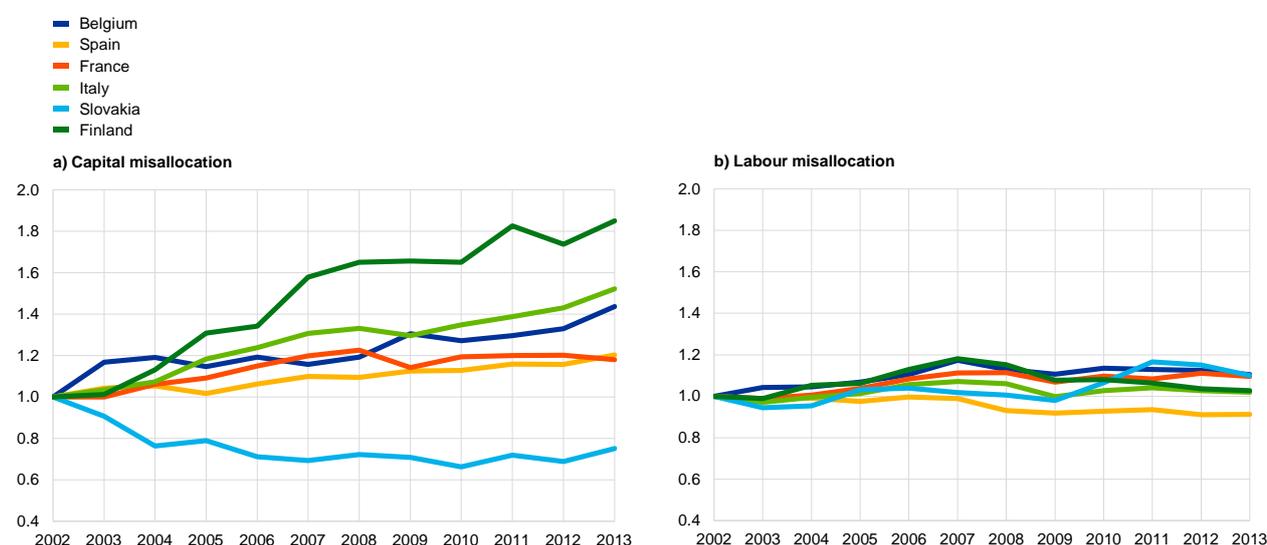
<sup>65</sup> See Hsieh, C.-T. and Klenow, P.J., “Misallocation and manufacturing TFP in China and India”, *The Quarterly Journal of Economics*, Vol. 124, Issue 4, November 2009, pp. 1403-48.

**There is evidence in several euro area countries of rising inefficiency in the allocation of capital, compared with flatter dynamics for the misallocation of labour.** Again using the cross-country, cross-sector CompNet data, capital misallocation appears to have been rising since the early 2000s in most euro area countries for which data are available (with the exception of Slovakia; see Chart 12a). Moreover, this upward trend has been mainly driven by the services sectors. Meanwhile, the increase in labour misallocation has been much less marked (see Chart 12b), with Spain even recording a slight decrease. Similar trends have been noted for capital and for labour in other mature economies, such as the United States and Japan.<sup>66</sup>

## Chart 12

### Developments in capital and labour misallocation in six euro area countries in the period 2002-13

(weighted averages of dispersion in the marginal revenue product across firms within a given sector; 2002 = 100)



Source: ECB staff calculations based on the 5th vintage of CompNet data.

## 5 Additional constraints in the euro area

**Aside from the global factors considered above, there may be a number of additional European-specific factors, resulting from structural rigidities, which help to explain the long-standing labour productivity gap between the euro area and the United States.** These may be connected with more highly regulated product, labour and financial markets, legal and regulatory obstacles to sectoral reallocation, or wider structural impediments such as a lower prevalence of ICT-relevant skills in the euro area. Similarly, there may be a tendency in the euro area towards a less wholesale approach to restructuring (in order to better exploit the full

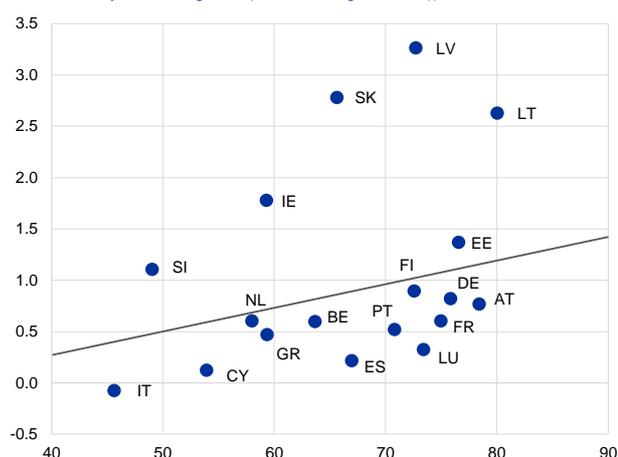
<sup>66</sup> For Japan, see Fujii, D. and Nozawa, Y., "Misallocation of capital during Japan's lost two decades", *DBJ Discussion Paper Series*, No 1304, June 2013. For the United States, see Hsieh, C.-T. and Klenow, P.J., op. cit. The latter study also shows that in emerging economies such as China and India, resource misallocation is comparatively much greater than in mature economies, but is set on a downward trend.

range of benefits from ICT investments). Recent research has also highlighted the role of managerial quality, given the need to reorganise production processes to adjust to new technologies.<sup>67</sup>

**Highly regulated product and labour markets and “business unfriendly” framework conditions constitute a significant impediment to TFP growth.** In many structural areas euro area countries are often very far from best practice. For example, on the basis of indicators related to the “ease of doing business” – undoubtedly, a major prerequisite for innovative and productive activity, – only one euro area country (Finland) features in the global top ten, while many are not even among the top 30.<sup>68</sup> Similarly, a simple correlation analysis shows that across the euro area countries, a higher TFP growth trend is typically associated with better contract enforcement mechanisms and fewer impediments to obtaining credit (Charts 13 and 14).

**Chart 13**  
Relationship between trend TFP growth and contract enforcement

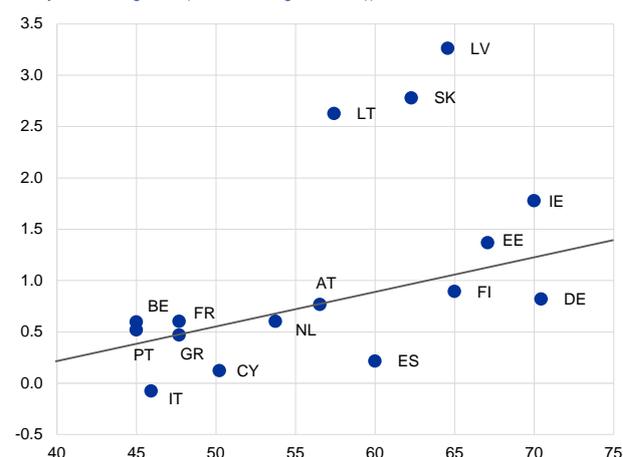
(x-axis: contract enforcement (annual average 2003-15); distance to frontier, where frontier = 100; y-axis: TFP growth (annual average 2000-15))



Sources: European Commission and World Bank data on enforcing contracts.

**Chart 14**  
Relationship between trend TFP growth and getting credit

(x-axis: getting credit (annual average 2003-15); distance to frontier, where frontier = 100; y-axis: TFP growth (annual average 2000-15))



Sources: European Commission and World Bank data on getting credit.

**Recent work by the OECD also highlights the adverse consequences of administrative and bureaucratic impediments** which are manifested in an increase in the overall costs of debt workout (the process of repaying, restructuring or reshaping the profile of a debt), and in impediments to firm entry and exit, which are in turn an important determinant of cross-country differences in labour productivity (see Box). Improvements in areas such as regulatory quality, insolvency regimes, licencing, employment protection, public procurement rules and quality of public administration would be likely to spur labour productivity growth in the euro

<sup>67</sup> See, for example, Garicano, L. and Heaton, P., “Information technology, organization, and productivity in the public sector: evidence from police departments”, *Journal of Labor Economics*, Vol. 28, No 1, January 2010, pp. 167-201; and Bloom, N., Sadun, R. and Van Reenen, J. “Americans do IT better: US multinationals and the productivity miracle” *American Economic Review*, Vol. 102, No 1, February 2012, pp. 167-201.

<sup>68</sup> See *Doing Business 2017: Equal Opportunity for All*, World Bank, 2017.

area by improving the allocation of resources across sectors and firms, and fostering innovation and its diffusion.

## Box

### The contribution of structural reforms to TFP growth and an assessment of the role of national productivity boards

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Over the past decade a growing body of literature has sought to assess the impact of structural and institutional conditions on TFP growth. The seminal work of Aghion and Howitt<sup>69</sup> showed that non-frontier countries could gain from structural policies favouring cost-efficient adoption of existing technologies, while countries operating at the frontier would profit more from policies to promote innovation (e.g. investment in higher education, and research and development). Robust evidence has since been collected showing how excessive regulation in certain sectors negatively affects TFP growth and helps explain the productivity gap between countries operating at the frontier and the followers.

Improving institutional and structural factors can lead to higher TFP growth. Cetto et al.<sup>70</sup> suggest that euro area countries could achieve significantly higher TFP growth if all moved towards best euro area practice in reducing tariff barriers and reducing employment protection, with gains potentially largest for those countries with the most regulated markets. Work carried out by the ECB<sup>71</sup> also suggests that the soundness of economic institutions (as evidenced, for example, by application of the rule of law, control of corruption, government effectiveness, regulatory quality), the complexity of the business environment (in terms of starting a business, obtaining credit, trading across borders), and the level of employment protection, all contribute to the differences in TFP performance across euro area countries.

Structural and institutional reforms can improve TFP via different channels. They improve the allocation of resources by promoting more efficient product and labour markets and better institutional frameworks (including those addressing insolvency). Recent OECD work<sup>72</sup> has shown that improving the efficiency of insolvency regimes is a particularly important structural policy in shaping aggregate TFP growth, as it lessens the obstacles to orderly exit for failing firms. A more competitive and business-friendly environment also increases dynamic efficiency, as higher levels of competition increase incentives to innovate, thus facilitating technological progress. Structural reforms tend to reduce the labour productivity gap between those firms operating at the frontier and the followers, since removing protection and barriers to entry promotes the diffusion of ideas to laggard firms and encourages improvements in management quality. There could also be important spillover effects of these reforms, particularly if they are concentrated in upstream services sectors and lead to cost and efficiency savings for downstream producers. The role of the newly established

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<sup>69</sup> Aghion P. and Howitt P., “Joseph Schumpeter Lecture – Appropriate growth policy: A unifying framework”, *Journal of the European Economic Association* Vol. 4, Nos 2-3, May 2006, pp. 269-314.

<sup>70</sup> Cetto G., Lopez, J. and Mairesse, J., “Market Regulations, Prices and Productivity”, *American Economic Review: Papers and Proceedings*, Vol. 106, No 5, May 2016, pp. 104-8.

<sup>71</sup> See, for instance, the article entitled “Increasing resilience and long-term growth: the importance of sound institutions and economic structures for euro area countries and EMU”, *Economic Bulletin*, Issue 5, ECB, 2016.

<sup>72</sup> Andrews D., Criscuolo, C. and Gal P.N., “The global productivity slowdown, technology divergence and public policy: a firm level perspective”, *Hutchins Center Working Paper Series*, No 24, September 2016.

national productivity boards (NPBs) may contribute to fostering productivity-enhancing reforms across the euro area countries.

### **The role of national productivity boards**

On 20 September 2016 the European Council recommended the establishment of productivity boards at the national level across the EU. These boards are expected to be operational by March 2018. The recommendation was laid down in the Five Presidents' Report<sup>73</sup>, which stressed the importance of convergence as a means of improving and equalising resilience of European economic structures. NPBs are expected to be a key element of Stage 1 of European Monetary Union deepening, which aims to strengthen the current institutional setting and encourage greater progress of euro area countries towards best practice, leading to higher aggregate performance.

The Council's recommendation specifies that "these boards should analyse productivity and competitiveness developments including relative to global competitors, taking into account national specificities and established practices." It also stresses that the notions of productivity and competitiveness should be considered comprehensively, paying attention to their long-term drivers such as innovation and the capacity to attract investment, the quality of businesses and human capital, and cost and non-cost factors. The recommendation allows for different types of institutional design (for example the tasks of NPBs may be carried out by bodies which already exist), provided that certain minimum requirements are met with regard to, in particular, functional independence, analytical rigour and transparency.

Some euro area countries – for example Belgium, Germany, Ireland, France and the Netherlands – already have bodies that perform tasks of a similar nature to the remit of the productivity boards. While there are differences across the countries mentioned, each of these bodies generally has both an ex ante role (in that it evaluates policies proposed by the relevant government) and an ex post role (it monitors the implementation of such policies).

The NPBs are expected to contribute to the concrete design and foster national ownership of productivity-enhancing structural reforms. It appears to be crucial that awareness within individual euro area countries of the benefit of structural reforms is enhanced and that independent technical bodies assist in the design of these reforms and in monitoring their implementation. These boards are also expected to increase coordination of structural reform implementation at the euro area level. To meet this objective, the Council's recommendation proposes a regular exchange of views and best practice among the productivity boards of the euro area countries. Moreover, it is also envisaged that the work and recommendations of the productivity boards could be assisted by the Commission at the supranational level, within the framework of the European Semester. Strong information sharing, exchange of best practice and a deeper understanding of the obstacles to higher growth in labour productivity and competitiveness should make it easier to align policies that are both in the best interests of the European Union as a whole and which target specific needs at the country level.

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<sup>73</sup> Juncker, J.-C. et al., *Completing Europe's Economic and Monetary Union*, European Commission, 22 June 2015.

## 6 Concluding remarks

**The slowdown in euro area productivity growth since the economic and financial crisis is likely to stem from a combination of cyclical and secular forces.** On the cyclical side, increased uncertainty and credit restrictions arising from the long-running crisis are likely to have held back some innovative activities and growth of firms with high productivity, slowed the reallocation of resources from less to more productive units, as well as reduced the willingness of firms to take on entrepreneurial risk. Nevertheless, the marked slowdown seen since the crisis represents the continuation of a downward trend in labour productivity growth across advanced economies, which began in the mid-1990s.

**From a longer-term perspective, labour productivity growth in the euro area has been weak by international standards for two decades.** This deficit is likely to reflect long-standing structural rigidities – including more highly-regulated product and labour markets – which constrain business growth and innovation in the euro area to a greater extent than in many other advanced economies. There is now a significant and growing body of evidence highlighting the mechanisms and extent of “business unfriendly” administrative and bureaucratic burdens on labour productivity growth. These relate, inter alia, to deficiencies in institutional and regulatory quality, impediments to entry and exit of firms, limitations on credit availability, higher debt workout costs, deficiencies in systems of contract enforcement, and the design of employment protection legislation.

**Structural reforms to boost labour productivity growth in the euro area are particularly pressing in the light of the area’s aging population and because the full beneficial effects of such reforms are only visible over the medium term.** While the economic recovery is firming, a reinvigoration of the reform process is needed to translate the cyclical pick-up into a stronger trend productivity growth. Reforms addressing key institutional weaknesses such as bottlenecks and inefficiencies in the regulatory system, inefficiencies and waste in public administration, poor control of corruption and malfunctioning judicial systems appear to be critical in many euro area countries. Better debt workout mechanisms, including enhanced efficiency of judicial processes and out-of-court mechanisms, would help alleviate the debt burden of viable, productive firms, facilitate exit of unviable firms and open markets for new start-ups. In many cases, these reforms are likely to entail relatively low short term economic costs, yet are key to instilling confidence, improving the business environment, and boosting labour productivity. The completion of a capital markets union would also provide entrepreneurs and innovators with alternative sources of financing for innovative projects. Finally, enhancing further efforts to improve skills acquisition and mobility would aid sectoral reallocation and thus allow all citizens to benefit from a higher growth economy.

**By placing labour productivity growth firmly at the core of post-crisis economic policy, the newly created National Productivity Boards could help to increase the impetus for further structural reforms which are needed to boost labour productivity growth in the euro area – in a sustainable way – over coming decades.** The success of the NPBs will, however, depend in large part on the various agents involved being willing to undertake the necessary reforms.