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The UK productivity puzzle through the magnifying glass: A sectoral perspective

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THE UK PRODUCTIVITY PUZZLE THROUGH THE MAGNIFYING GLASS: A SECTORAL PERSPECTIVE

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By Rafał Kierzenkowski, Gabriel Machlica and Gabor Fulop

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ABSTRACT/RÉSUMÉ

The UK productivity puzzle through the magnifying glass: A sectoral perspective

Since the start of the Great Recession, labour productivity growth has been weak in the United Kingdom, weaker than in many other OECD countries. The productivity shortfall, defined as the gap between actual productivity and the level implied by its pre-crisis trend growth rate, was nearly 20% for output per hour at the end of 2016. This study assesses the UK productivity puzzle and discusses its possible determinants at the sectoral level. Most of the UK productivity underperformance is structural rather than cyclical. Half of the productivity shortfall is explained by non-financial services (with information and communication being the largest contributor), a fourth by financial services, and another fourth by manufacturing, other production and construction. All but non-financial services and the construction sectors contribute disproportionately to the productivity shortfall compared to their shares in overall output and hours worked of the UK economy. In non-financial services, large increases in self-employed with no employees, reduced matching of skills to jobs and a lower capital-output ratio may have been a drag on productivity. Stagnant productivity in the financial sector is mainly linked to reduced risk-taking and leverage, as reflected by declining total factor productivity following its steep increases in the run-up to the crisis. Greater substitution of labour for capital and weak corporate restructuring have both held back productivity improvements in the manufacturing sector. Some causes of the productivity puzzle pre-date the crisis, including low tangible investment, too rapid expansion of financial services, weak innovation in the manufacturing sector, and a secular decline of oil and gas industries.

This Working Paper relates to the 2018 OECD Economic Survey of the United-Kingdom (www.oecd.org/eco/surveys/economic-survey-united-kingdom.htm).

JEL classification: D24; L6; L7; L8

Keywords: United Kingdom, growth, productivity, hours, employment, output, investment, capital, sectors

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L'énigme de la productivité au Royaume-Uni à travers la loupe : une perspective sectorielle

Depuis le début de la Grande Récession, la croissance de la productivité du travail a été faible au Royaume-Uni, plus faible que dans beaucoup d'autres pays de l'OCDE. Le déficit de productivité, défini comme l'écart entre la productivité réelle et le niveau induit par la croissance tendancielle d'avant la crise, était de près de 20% pour la production par heure fin 2016. Cette étude évalue l'énigme de la productivité au Royaume-Uni et discute ses déterminants possibles au niveau sectoriel. La majeur partie de la sous-performance de productivité au Royaume-Uni est structurelle plutôt que conjoncturelle. La moitié du déficit de productivité s'explique par les services non financiers (l'information et la communication étant le principal contributeur), un quart par les services financiers et un quart par les industries manufacturières, la production et la construction. Tous les secteurs sauf les services financiers et la construction contribuent de manière disproportionnée au déficit de productivité par rapport à leur part dans la production globale et les heures travaillées de l'économie britannique. Dans les services non financiers, les augmentations importantes du nombre de travailleurs autonomes sans employés, la réduction de la concordance entre les compétences et l'emploi, et la baisse du ratio capital-production ont pu être un frein pour la productivité. La productivité stagnante du secteur financier est principalement liée à la réduction de la prise de risque et de l'effet de levier, comme en témoigne la baisse de la productivité totale des facteurs après les fortes hausses de la période précédant la crise. Une plus grande substitution de la main-d'œuvre au capital et une faible restructuration des entreprises ont freiné l'amélioration de la productivité dans le secteur manufacturier. Certaines causes de l'énigme de la productivité sont antérieures à la crise, notamment un investissement matériel peu élevé, une expansion trop rapide des services financiers, une faible innovation dans le secteur manufacturier, et un déclin séculaire des industries pétrolière et gazière.

Ce Document de travail se rapporte à l'Étude économique de l'OCDE du Royaume-Uni, 2018 (www.oecd.org/fr/eco/etudes/etude-economique-royaume-uni.htm).

Classification JEL: D24; L6; L7; L8

Mots clefs: Royaume-Uni, croissance, productivité, heures, emploi, production, investissement, capital, secteurs

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THE UK PRODUCTIVITY PUZZLE THROUGH THE MAGNIFYING GLASS: A SECTORAL PERSPECTIVE

Rafał Kierzenkowski, Gabriel Machlica and Gabor Fulop[1]

Introduction

1. **The productivity slowdown has been observed in many OECD and non-OECD economies and is becoming a key issue in the economic debate on the future of productivity.** Some authors argue that the weakness in productivity growth is linked to the slowdown in technological progress (Brynjolfsson and McAfee 2011; Bloom et al. 2017), others put forward that economic growth has been miss-measured because of the rapid expansion of the digital economy (Syverson, 2017), but there are also authors who point out that globalisation and structural adjustment implied by the economic convergence of China may have reduced the pace of innovation (Autor et al., 2016, Bloom et al., 2016).

2. **This paper focuses on the productivity slowdown in the United Kingdom since the global financial crisis.** The paper adopts a sectoral approach to assess the underlying forces behind the weakness in productivity growth in the United Kingdom. The analysis takes into account changes in the composition of labour using indicators of labour quality (Blunden and Franklin, 2016), relies on net capital stock series excluding dwellings, and excludes imputed rents from the gross value added of real estate activities to avoid artificially inflating labour productivity in the real estate sector (Tenreyro, 2018). The sample period is until the end of 2016 for a data vintage released on the 5th of April 2017. The rest of the paper is structured as follows. The first section assesses the magnitude of the productivity puzzle at the aggregate level and provides some evidence about the extent of the weakness in productivity across the OECD. The second section analyses the contributions of key sectors to the aggregate productivity shortfall in the United Kingdom since 2007. The last section discusses the drivers of productivity developments in the main sectors of the UK economy.

Assessing the productivity puzzle at the aggregate level

Emergence of a persistent gap in UK productivity since the start of the Great Recession

3. **Labour productivity has been stagnant in the United Kingdom since the global financial crisis.** Labour productivity fell at the onset of the crisis and has failed to recover since then, being at end-2016 only close to the pre-crisis peak (Figure 1, Panel A). This levelling off is unprecedented and gives rise to the so-called productivity puzzle. Actual output per hour is almost 20% below its counterfactual level, had it continued to rise according to its pre-crisis trend growth rate of 2.2%. Stagnant labour productivity contrasts with previous recovery profiles from previous recessions over the last forty years or so (Figure 1, Panel B). Historically, productivity had been 15-25% higher almost a decade after GDP had peaked.

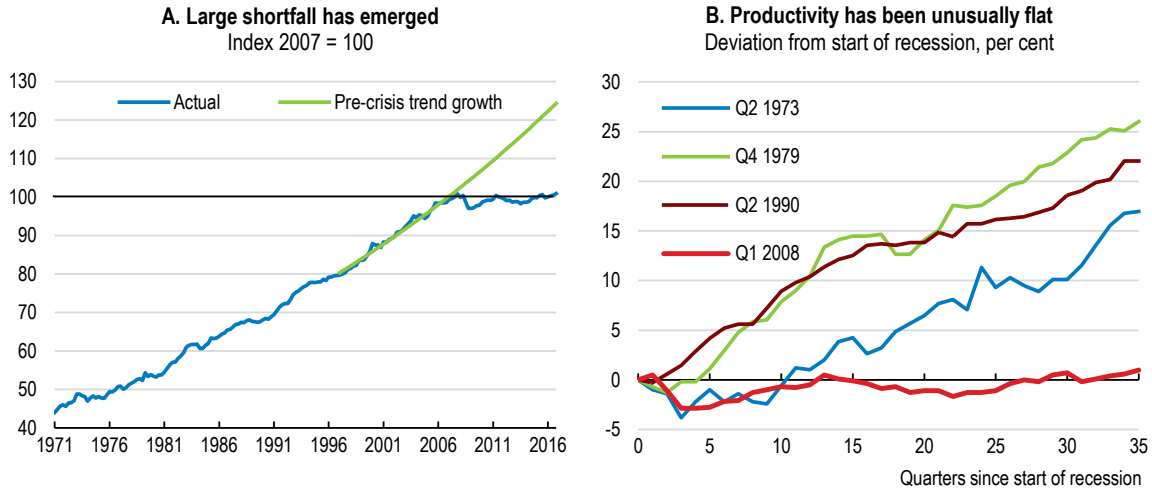
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1. The authors were respectively Senior Economist, Economist and Statistician in the Economics Department at the OECD when preparing the paper. They would like to thank Eric Dubois and OECD colleagues Pierre Beynet (Economics Department), Peter Gal (Economics Department), Matej Bajgar (Directorate for Science, Technology and Innovation) and Jonathan Timmis (Directorate for Science, Technology and Innovation) for useful comments and suggestions. Special thanks go to Elisabetta Pilati for editorial assistance (also from the Economics Department). The authors are grateful to participants of seminars organised by the NIESR and HM Treasury for useful comments and suggestions on earlier drafts of this paper.

4. **At the aggregate level, subdued labour productivity is explained by the lack of catch-up of output to its pre-crisis trend growth, while hours worked have outperformed their trend growth.** Compared to the counterfactual level of output assuming a continuation of pre-downturn trend growth, there is a large shortfall which has stabilised when growth has picked up (Figure 2, Panel A). By contrast, the labour market has been resilient over the crisis and strong job creation has allowed total hours to exceed their counterfactual level (Figure 2, Panel B). Therefore, the level of output is surprisingly weak given total hours worked in the economy. A sectoral perspective provides insights about the determinants of this productivity puzzle.

Figure 1. Labour productivity has disappointed since the financial crisis

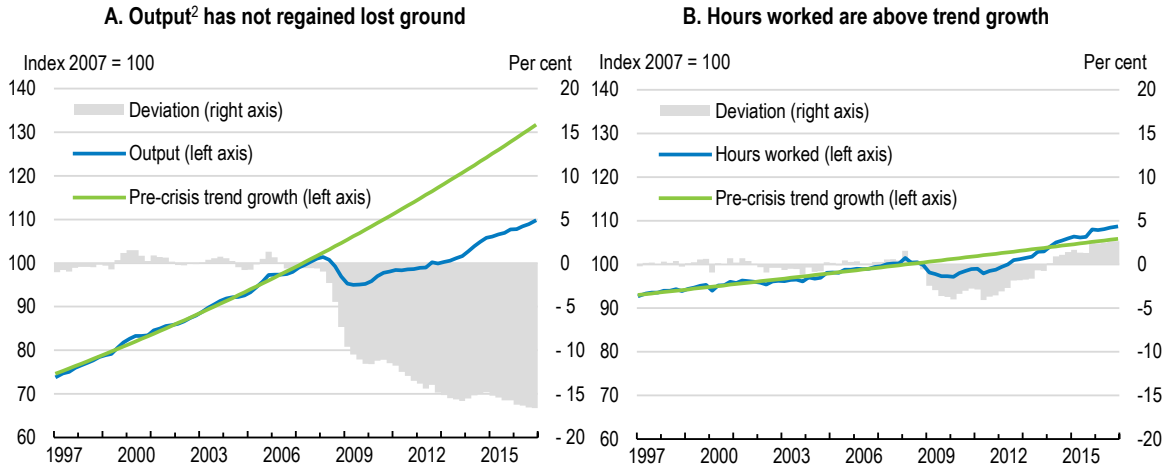
Output per hour[1]



1. Output refers to real gross value added. Pre-crisis trend growth is calculated between 1997 and 2007, and is projected from 2008 onwards.

Source: OECD calculations based on ONS (2017), "Labour productivity: Oct to Dec 2016", Office for National Statistics, April.

Figure 2. Weak output is the main drag on productivity at the aggregate level[1]



1. Pre-crisis trend growth for output and hours worked are calculated between 1997 and 2007, and are projected from 2008 onwards.

2. Real gross value added (GVA).

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour productivity: Oct to Dec 2016", Office for National Statistics, April.

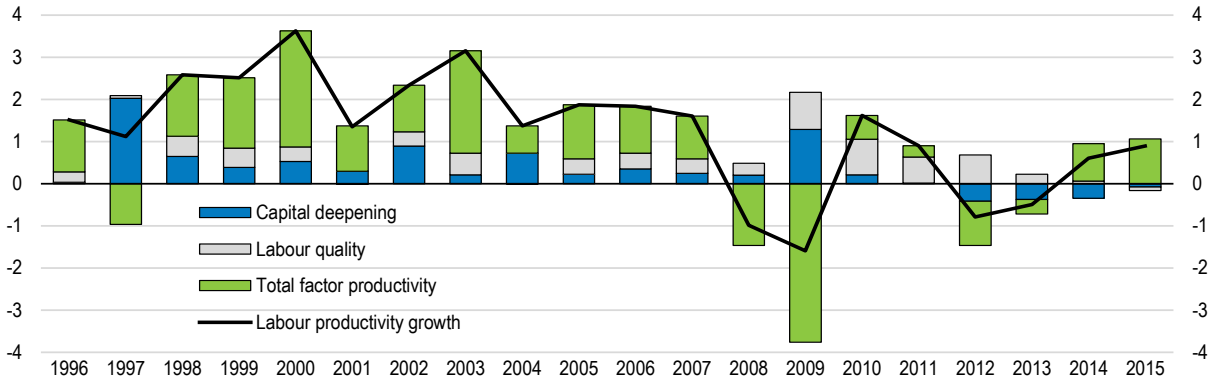
The UK productivity puzzle results from a combination of shocks

5. **Different shocks have hit labour productivity since the global downturn.** They have led to a weaker growth of total factor productivity (TFP), labour quality and capital deepening (Figure 3). However, the development of the digital economy could lead to a mismeasurement of labour productivity.

6. **TFP has been constrained by a more difficult reallocation of resources.** Poor reallocation of resources across businesses (in terms of both firm entry and exit, and the movement of labour) has contributed to a less efficient combination of capital and labour to produce output, possibly explaining a third of the productivity shortfall with the rest of the productivity weakness occurring within firms (Barnett et al., 2014a). Churn in the labour market tumbled in the wake of the crisis and it has been slow to recover (Figure 4, Panel A). The movement of capital across and within sectors has been particularly low despite a significant increase in the dispersion of the rates of returns, which should have increased incentives to reallocate (Barnett et al., 2014b). Corporate sector restructuring has been weak, as reflected by limited company liquidations given the magnitude of the output shock relative to the recession in the early 1990s (Figure 4, Panel B), although comparability is reduced by methodological changes when measuring company liquidations over time. At the same time, the growth of start-ups has been slow in the United Kingdom (Calvino, F., C. Criscuolo and C. Menon, 2016),

Figure 3. All drivers of productivity growth have weakened since the financial crisis

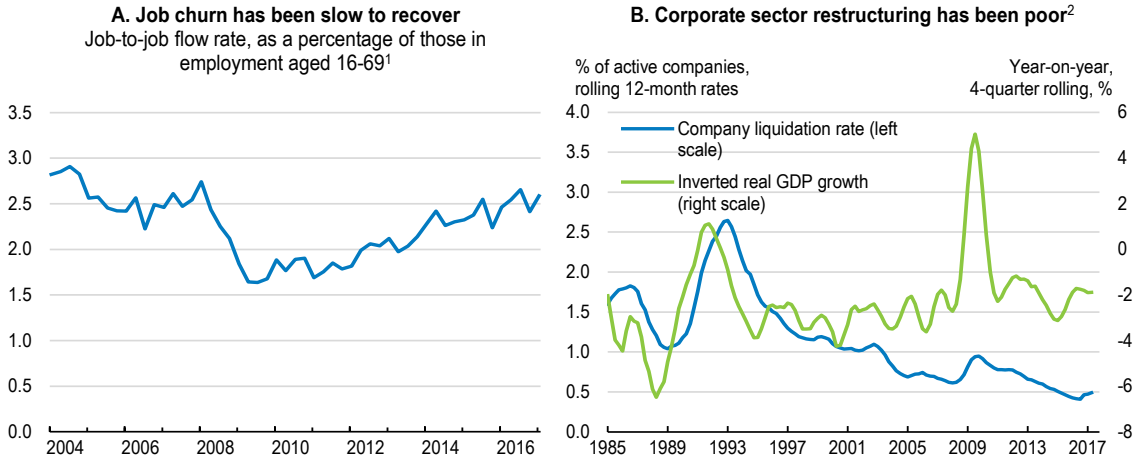
Labour productivity growth with contributions, percentage points[1]



1. Labour productivity is defined as output (i.e. real gross value added) per hour worked. Contributions to labour productivity growth are calculated using a factor augmenting production function with a weight of 0.67 for hours worked and labour quality while total factor productivity is calculated as a residual. Capital deepening refers to net capital stock per hour worked. Net capital stocks account for the depreciation in assets, thus show the market value of fixed assets. Labour quality is measured as the difference between the quality adjusted labour input (QALI) and hours worked. QALI is a method of measuring changes in the volume of labour input into production which accounts for changes in the composition (or 'quality') of the workforce as well as changes in jobs. QALI weights hours worked by different types of workers by their relative contribution to economic production. This is calculated by categorising workers by identifiable characteristics (based on age, gender, industry of employment and education level), and weighting changes in hours worked of each worker type by their share of total labour income.

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April; ONS (2016), "Capital stocks, consumption of fixed capital: 2016", Office for National Statistics, August; ONS (2016), "Quality adjusted labour input: UK estimates to 2015", Office for National Statistics, October; and ONS (2017), "Labour and Capital Income Shares, as used in the Multi-factor productivity estimates: Experimental estimates to 2015", Office for National Statistics, April.

Figure 4. Reallocation of resources has been impaired for some time



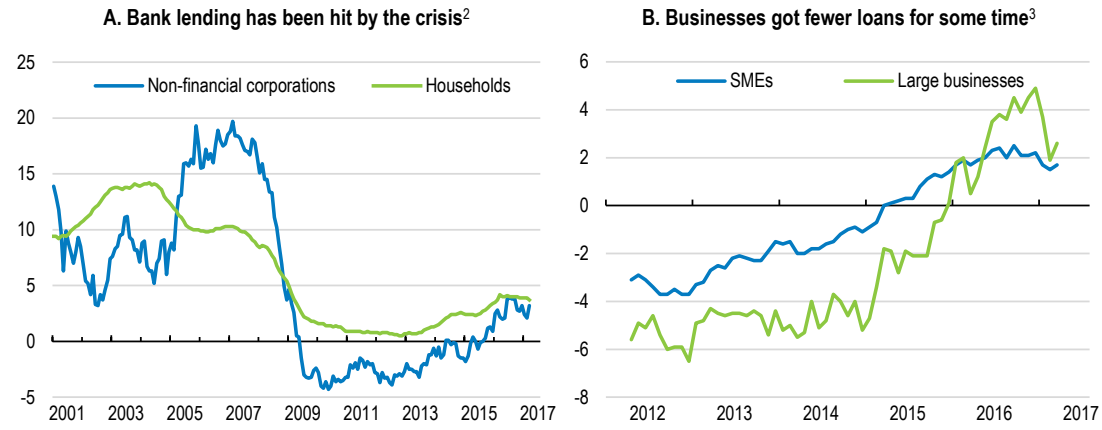
1. Seasonally adjusted. Job-to-job flows refer to the number of people who remained in employment over the quarter but are in a different job.
2. Data refer to England and Wales. Data from 2000Q1 for company liquidation rate are not consistent with earlier data because of a change to the methodology.

Source: ONS (2017), "Labour market flows: May 2017", Office for National Statistics, May; ONS (2016), "Labour Market Flows: February 2016 (Experimental Statistics)", Office for National Statistics, February; The Insolvency Service (2017), "Insolvency Statistics: April to June 2017", July; and OECD (2017), *OECD Economic Outlook: Statistics and Projections* (database), September.

7. **Lending developments may have negatively affected total factor productivity.** Bank lending to businesses was shrinking until the first half of 2015, while lending spreads have increased (Figures 5 and 6). The fall in external finance − including net lending and net issuance of other sources of finance (equity, bonds and commercial paper) − was broad based across sectors between 2010 and 2015 (Figure 1A, Annex).

Figure 5. Net business loan growth of monetary financial institutions has been negative until recently

Per cent[1]

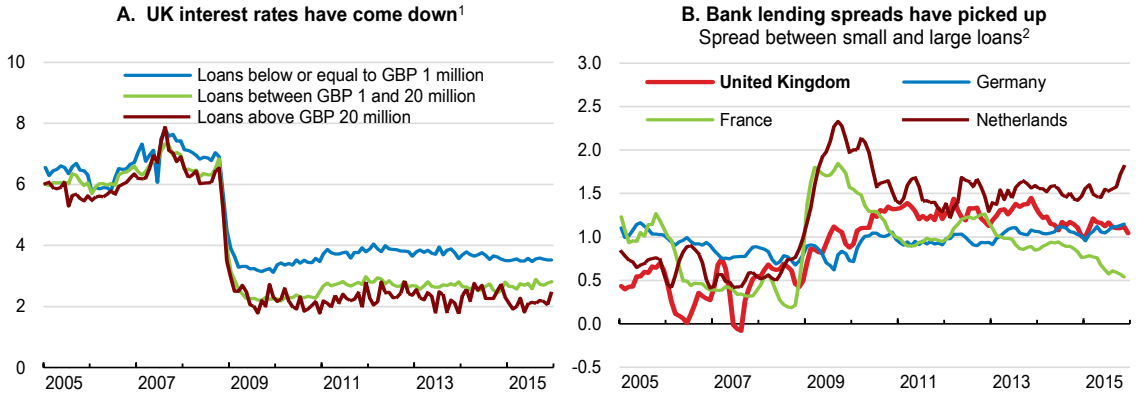


1. 12-month growth rates. Data are not seasonally adjusted.
2. Lending to private non-financial corporations and household sector refer to monetary financial institutions' sterling net lending.
3. Data refer to loans and advances in all currencies made by UK monetary financial institutions (MFIs) to non-financial businesses. Small and medium-sized enterprises (SMEs) are defined as those with an annual debit account turnover on the main business account of up to GBP 25 million. Those with an annual debit account turnover on the main business account above GBP 25 million are termed "large businesses".

Source: Bank of England (2017), "Monetary and Financial Statistics", *Statistical Interactive Database*, May.

Figure 6. Businesses face lower bank lending rates, but higher risk premiums

Percentage points



1. Monthly average of weighted average interest rates of UK resident monetary financial institutions' (excluding Central Bank) new sterling loans to private non-financial corporations. Not seasonally adjusted.

2. Three month moving average applied. In the United Kingdom, small loans are defined as loans below GBP 1 million, while in France, Germany and Netherlands small loans are defined as loans below EUR 1 million.

Source: Bank of England (2016), "Interest and Exchange Rates Data", Statistical Interactive Database, January and ECB (2016), "MFI Interest Rates", Statistical Data Warehouse, European Central Bank, January.

8. **Most of the productivity slowdown occurred within firms and sectors, irrespective of their reliance on banks, but credit allocation may have been suboptimal.** Tighter credit supply to small companies may have contributed to lower efficiency of resource allocation across businesses (Riley et al., 2014a, 2015). High productive companies that borrowed from distressed banks were more likely to exit the market, but borrowing from distressed banks by surviving firms did not impact on their productivity (Riley et al., 2014b). Bank lending may have been sustained mainly to ineffective firms, with banks being reluctant to call in impaired loans and to recognize losses (Bryson and Forth, 2015). Bank forbearance, low interest rates and some tax reliefs may have helped less viable firms to stay in business (Arrowsmith et al., 2013; Barnett et al., 2014c).

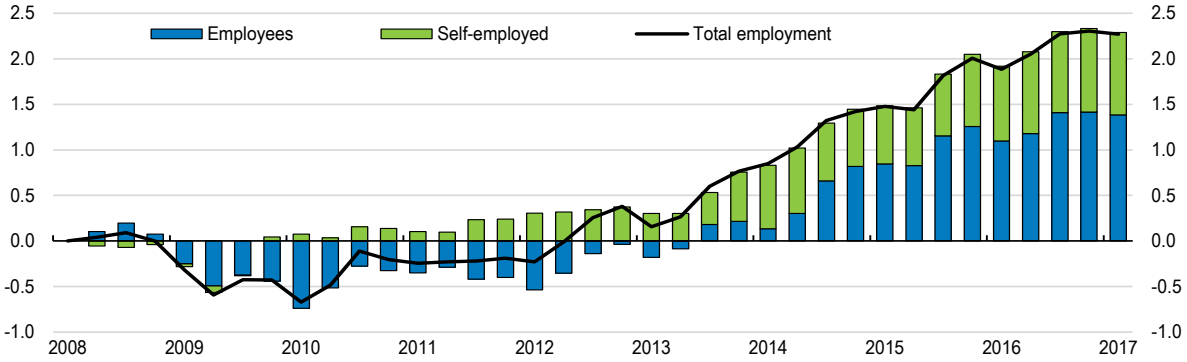
9. **The expansion of self-employment may have been another drag on TFP growth.** Employment growth has been partly accounted for by an increase in self-employment (Figure 7). A large proportion of self-employed are own-account workers, and the incidence of self-employment can be expected to rise as population ages (BoE, 2014; Tatomir, 2015; Figure 8). Relative to employees, self-employed can be less productive as they may not benefit from organisational economies of scale and scope, for instance to find new clients or to comply with regulations. Put differently, the working time of the self-employed, in particular of those with no employees, can be partly diverted from production activities towards other duties, even if their intrinsic ability to deliver output is unaltered. Low entrepreneurship skills could perhaps be another cause of weaker productivity of self-employed workers.

10. **TFP may have been reduced through lower-quality matches and labour quality has eased.** People returning to employment from unemployment or inactivity may have depreciated skills. The incidence of youth with inadequate qualifications then required by their job and/or working in occupations that do not correspond to their field of study is large and may have also played a role (Figure 9). One-quarter of all workers report a mismatch between their existing skills and those required for their job, with about 15% being over-skilled and around 10% being under-skilled (Adalet McGowan and Andrews, 2015a and 2015b). Reducing the skill mismatch to the best practice level in each industry in the OECD would boost UK productivity by 5% (OECD, 2015a). In parallel, labour quality − as measured by education level

and age as a proxy for on the job experience − made a positive contribution to labour productivity growth until 2013, but no longer in 2014 and 2015 (Figure 3).

Figure 7. Self-employment is on the rise

Contributions to the change in total employment since Q1 2010, million[1]



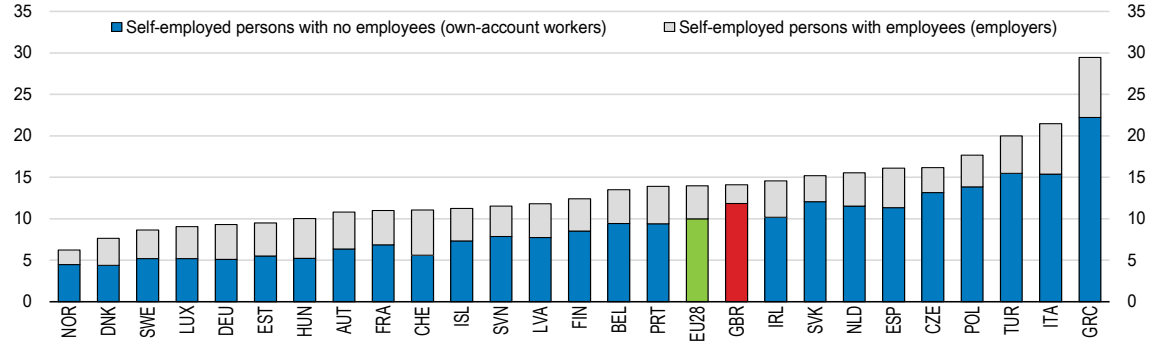
1. Data refer to those aged 16 and above. Data are not seasonally adjusted. Total employment also comprises unpaid family workers and those on government-supported training and employment programmes.

Source: ONS (2017), "UK Labour Market: May 2017", Office for National Statistics.

Figure 8. Self-employment is significant and can rise further with demographic ageing

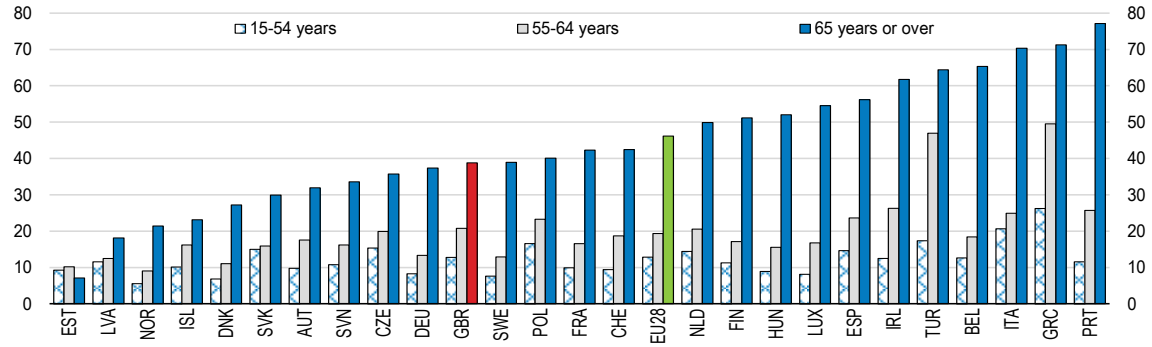
A. The share of own-account workers is high

As a percentage of total employment (15-64), 2016[1]



B. The incidence of self-employment is rising with age

Share of self-employed to total employment by age group, per cent, 2016

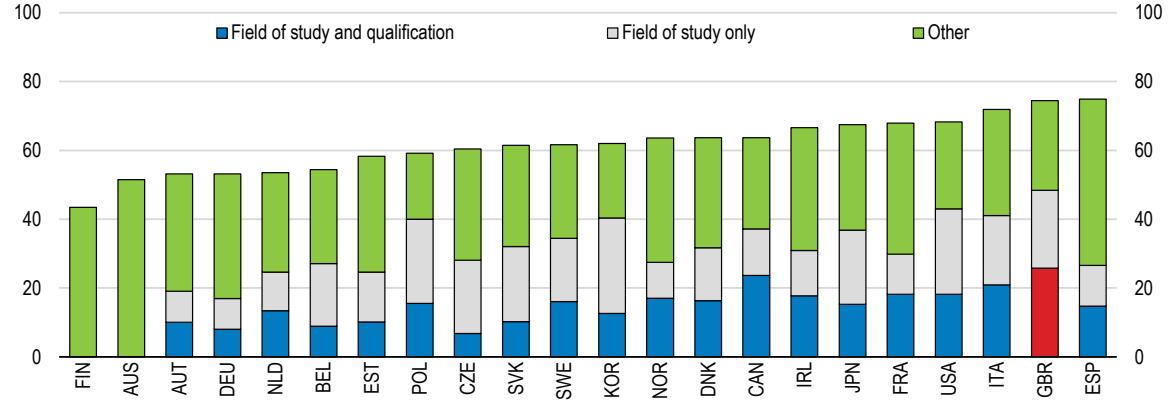


1. Data refer to population aged between 15 and 64.

Source: Eurostat (2017), "Employment and Unemployment (Labour Force Survey)", *Eurostat Database*, May.

Figure 9. Youth job mismatch is high

Total mismatch among youth (16-29) by type of mismatch, per cent of all youth in employment, 2012[1]



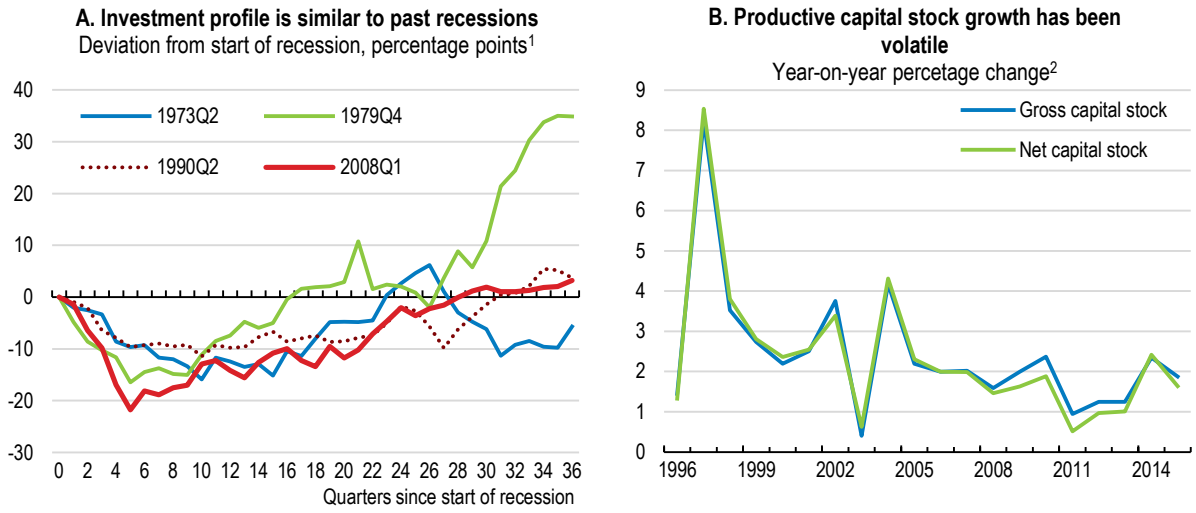
1. Data for Belgium and the United Kingdom refer to Flanders and England and Northern Ireland respectively. Workers are classified as mismatched by qualification if they have higher or lower qualifications than required by their job and by field of study if they are working in an occupation that is not related to their field of study. The category of other includes mismatches by qualification only and by the combination of literacy, qualification and field of study. Occupation is only available at the 2-digit level in the ISCO-08 classification for Australia and Finland. Hence, it is not possible to assess the extent of field of study mismatch in these two countries using the same definition used for the other countries.

Source: OECD (2014), *OECD Employment Outlook 2014*.

11. **Gross fixed capital formation has recovered since the crisis, but the investment ratio is structurally low.** The initial fall in total investment was larger compared to previous recessions in the first year or so, but the following recovery was similar to previous episodes (Figure 10, Panel A). The growth in net and gross productive capital stock has been volatile, but it remained positive (Figure 10, Panel B). However, investment needs remain sizeable (OECD, 2015b, 2017). Total investment as a percentage of GDP was the lowest in the OECD in the decade leading up to the global downturn (Figure 11, Panel A). This raises the question about the determinants of productivity growth in a low capital-intensive economy, despite stronger intangible investment (Figure 11, Panel B), and the scope for these determinants to resume one day.

12. **Mismeasurement of the growing share of the digital economy in total output might distort productivity measures.** Although the information and communication sector constitutes only a relatively small share (around 10%) of non-financial services gross value added, this share has been increasing in overall production. The mismeasurement hypothesis assumes that an overestimation of the digital product prices may understate real output. Recent empirical research suggests that such mismeasurement problems could affect UK statistics (Bean, 2016), potentially leading to changes in the composition of GDP rather than of its overall value (Heys, 2018).

Figure 10. Capital accumulation has been undermined by the financial crisis



1. In real terms. Investment refers to gross fixed capital formation.

2. In real terms. Capital excludes investment in housing. Net capital stocks account for the depreciation in assets, thus show the market value of fixed assets.

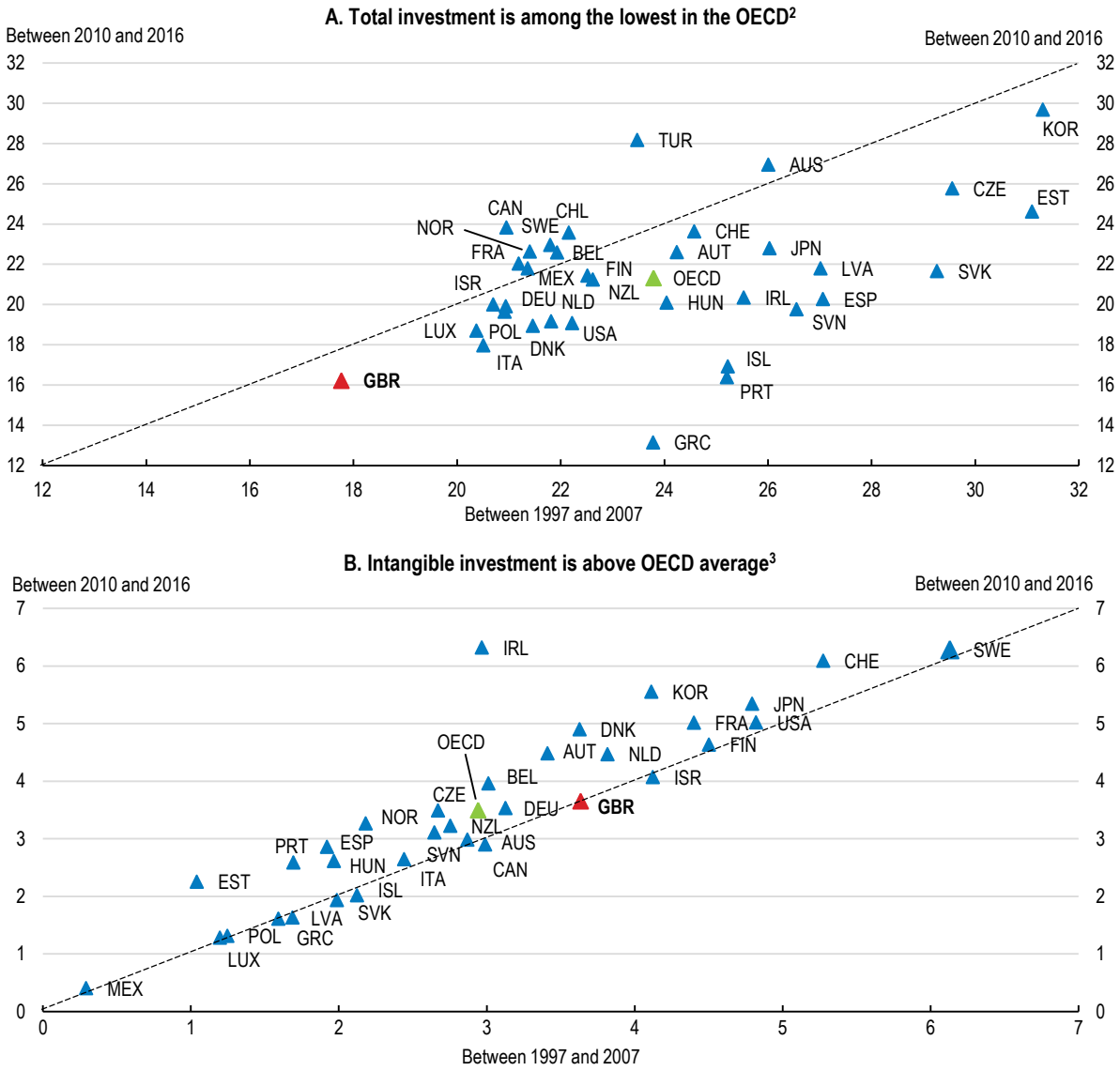
Source: OECD (2017), *OECD Economic Outlook: Statistics and Projections* (database), May; and ONS (2016), "Capital stocks, consumption of fixed capital: 2016", Office for National Statistics, August.

Productivity has also been weak in other OECD countries

13. **The productivity puzzle is not UK-specific.** Productivity growth was weakening in many OECD countries before the crisis, which compounded the phenomenon (OECD, 2015a). The level of productivity is significantly lower than had productivity maintained its pre-crisis trend growth in most countries, with the average shortfall in the OECD at slightly above 10% (Figure 12, Panel A). Output has been weaker than total hours worked relative to their respective extrapolated pre-crisis trend growth, either by falling more or by recovering less (Figure 12, Panel B).

Figure 11. Low overall investment ratio contrasts with a relatively strong investment in intangibles

Average annual investment ratio, as a percentage of GDP[1]



1. In nominal terms.

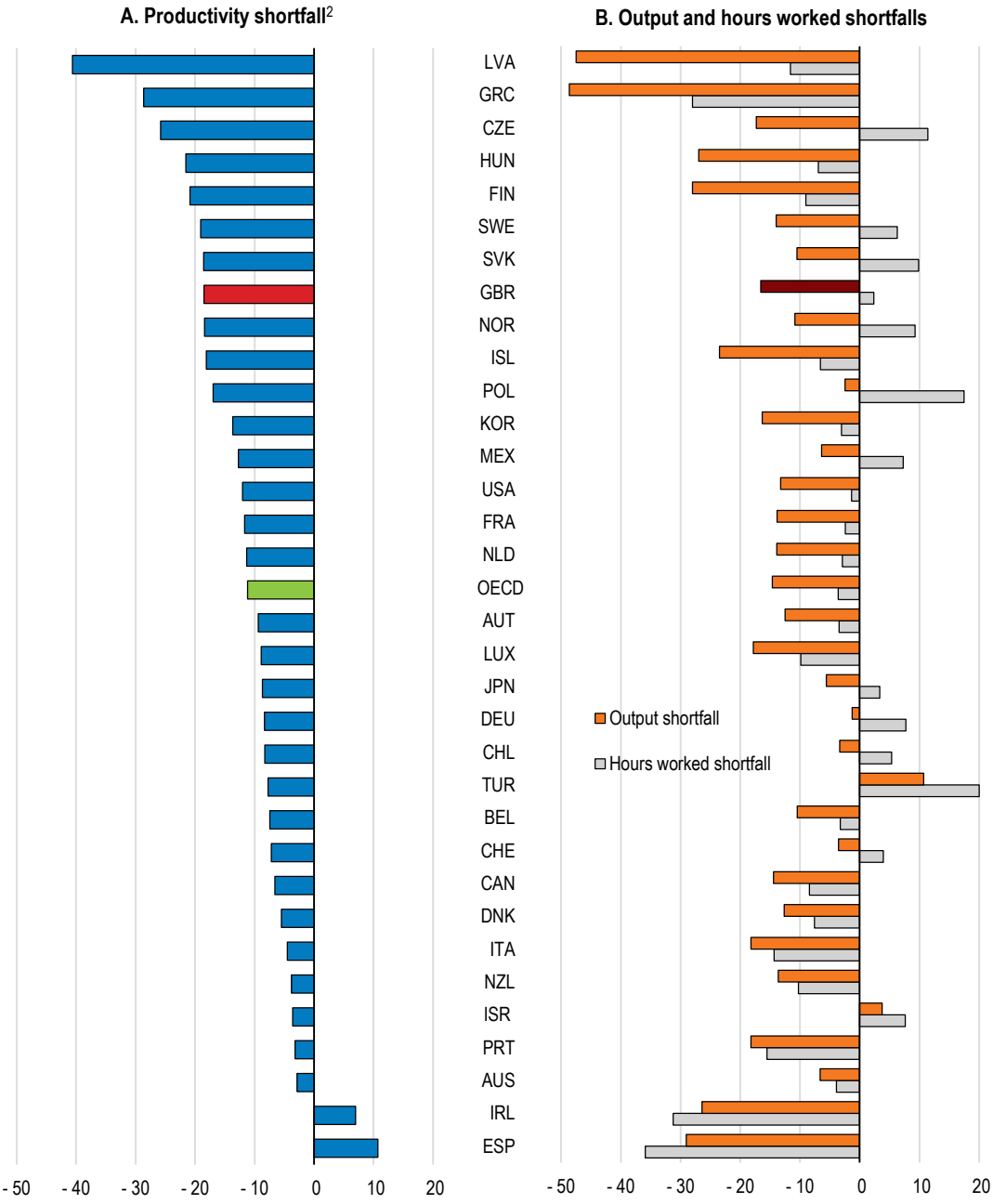
2. Total investment refers to total gross fixed capital formation as defined by ESA 2010 standard, which also includes research and development spending. The OECD aggregate is calculated as an unweighted average of the data shown.

3. Intangible investment refers to intellectual property products that include computer software and databases as well as research and development. 2010-2015 instead of 2010-2016 for Australia, Belgium, Hungary, Ireland, Israel, Japan, Korea, Mexico, New Zealand, Switzerland, and the United States. The OECD aggregate is calculated as an unweighted average of the data shown.

Source: OECD (2017), *OECD Economic Outlook: Statistics and Projections* (database), May; and OECD (2017), *OECD National Accounts Statistics* (database), May.

Figure 12. Great Recession has taken a toll on the level of productivity in OECD countries

Deviation from pre-crisis trend growth, percentage points, 2016[1]



1. 2015 for Australia, Belgium, Chile, Iceland, Israel, Japan, Korea, Mexico, New Zealand, the Slovak Republic, Switzerland, Turkey, the United States and the OECD aggregate. Pre-crisis trend growth is calculated between 1997 and 2007, and is projected from 2008 onwards. The OECD aggregate is calculated as an unweighted average of the data shown.

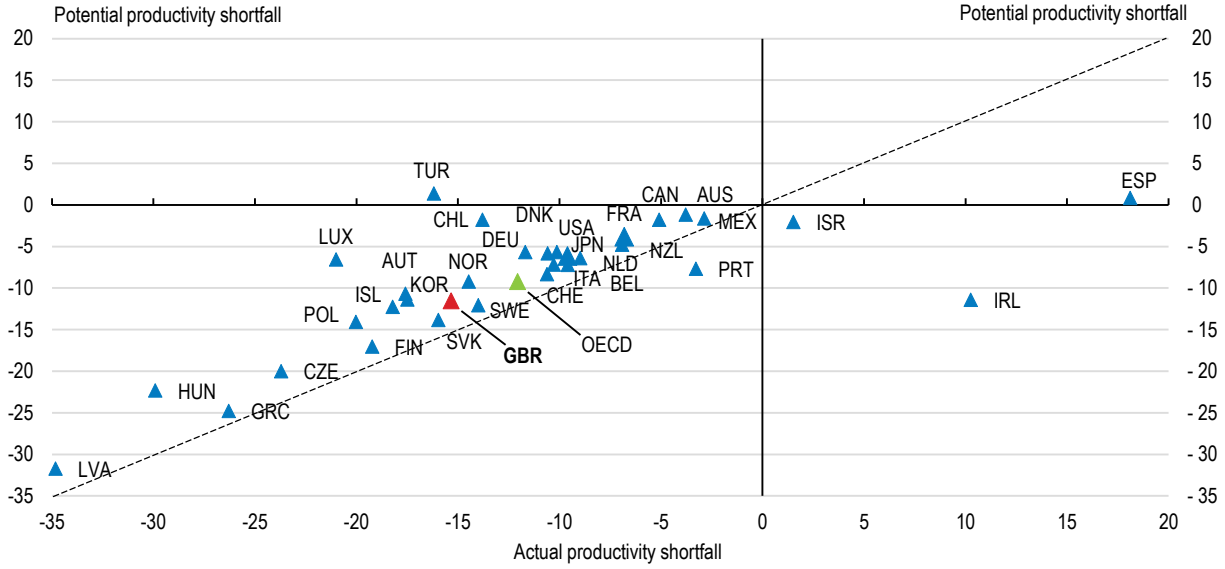
2. Labour productivity is defined as real gross domestic product (GDP) divided by total hours worked.

Source: OECD calculations based on OECD (2017), *OECD Productivity Statistics* (database), May; and OECD (2017), *OECD National Accounts Statistics* (database), May.

14. **The productivity shortfall is mainly structural in the United Kingdom, but also in many other OECD countries.** Relying on actual productivity may bias the productivity shortfall. Actual productivity could be affected by positive and negative cyclical developments, leading to an upward bias in a boom (the pre-crisis trend growth is overestimated) and a downward bias in a slump (actual productivity is below its underlying level). Using potential productivity as estimated by the OECD may provide a more reasonable counterfactual, although estimates of potential productivity could be subject to important revisions (Ollivaud and Turner, 2014). With few exceptions, productivity shortfalls (defined as output per worker) tend to be smaller when considering potential productivity against its pre-crisis trend growth (Figure 13). For instance, the potential productivity shortfall is close to zero for Turkey and Chile, while the actual productivity shortfall is negative. Yet, the two measures are more comparable for the UK. This would imply that actual productivity was not significantly distorted by the cyclical upswing before the crisis and is no longer depressed because the UK economy is operating below capacity. Put differently, the actual UK productivity shortfall is predominantly structural. This also applies to the OECD average.

Figure 13. Productivity shortfall is mainly structural in the United Kingdom

Deviation from pre-crisis trend growth, percentage points, Q4 2016[1]



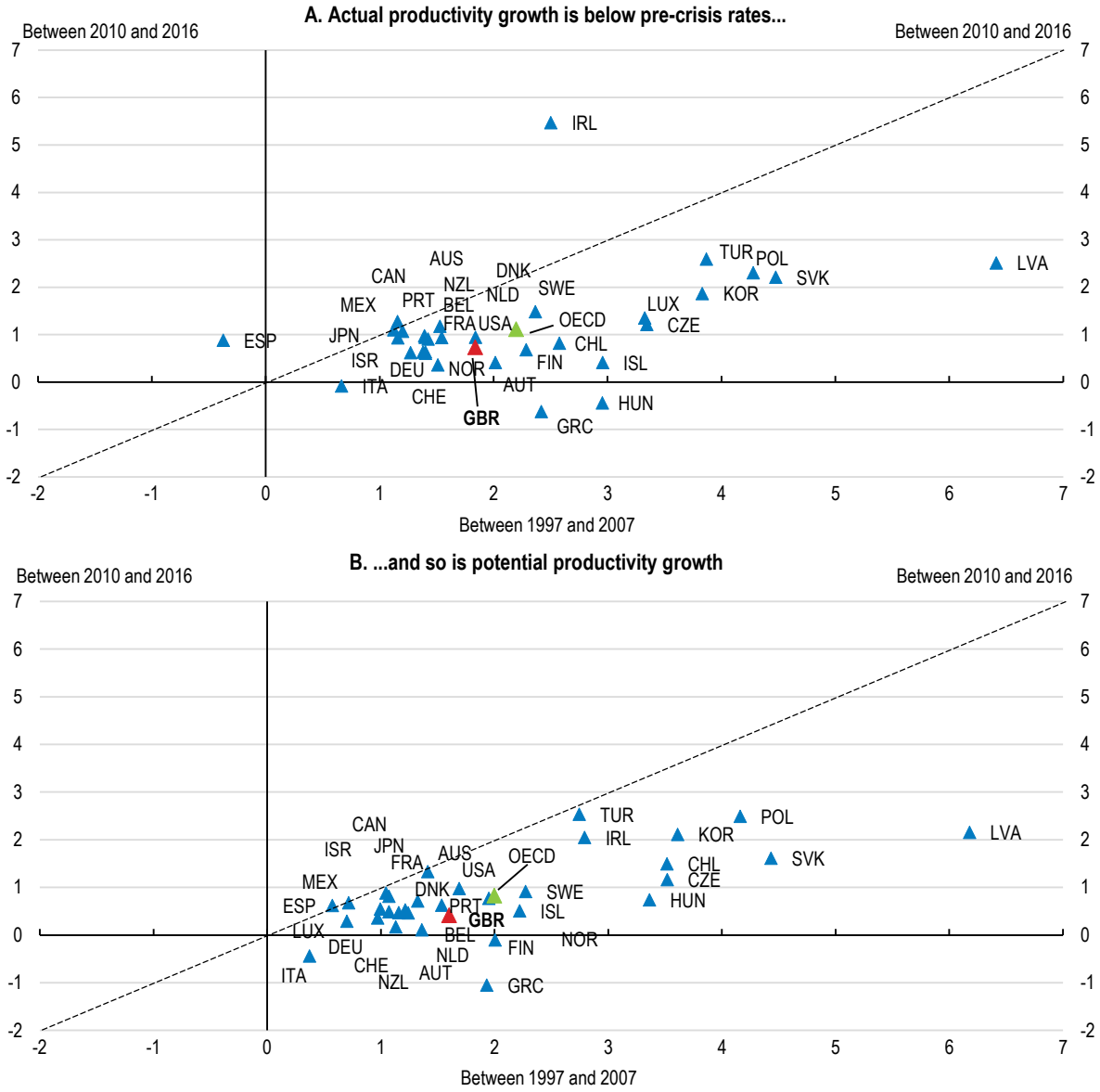
1. Pre-crisis trend growth (potential growth) is calculated between 1997 and 2007, and is projected from 2008 onwards. Labour productivity is defined as real gross domestic product (GDP) divided by total employment. The OECD aggregate is calculated as an unweighted average of the data shown.

Source: OECD calculations based on OECD (2017), *OECD Economic Outlook: Statistics and Projections* (database), May.

15. **The global financial crisis has had a permanent impact on the level of productivity, but the growth rate of productivity has not recovered.** Empirical evidence suggests that earlier banking crises were associated with permanent declines in the level of productivity relative to trend, but did not have any lasting effects on productivity growth (Gelauff et al., 2014). Average actual productivity growth (defined as output per worker) has been significantly lower since 2010 than before the crisis in most OECD countries (Figure 14, Panel A). It has been halved to around 1.0% in the OECD and the United Kingdom in comparison with the average growth rate between 1997 and 2007. As discussed before, actual productivity growth could diverge from sustainable productivity growth owing to cyclical upswings/downswings and using potential productivity growth could be more appropriate to capture medium-term productivity developments. However, it is notable that potential productivity growth is below pre-crisis rates in many OECD countries, including in the United Kingdom (Figure 14, Panel B).

Figure 14. Actual and potential productivity growth rates have not recovered since 2010

Average annual percentage change[1]



1. Labour productivity is defined as real gross domestic product (GDP) divided by total employment. The OECD aggregate is calculated as an unweighted average of the data shown.

2. 1998-2007 for Czech Republic.

Source: OECD (2017), *OECD Economic Outlook: Statistics and Projections* (database), May.

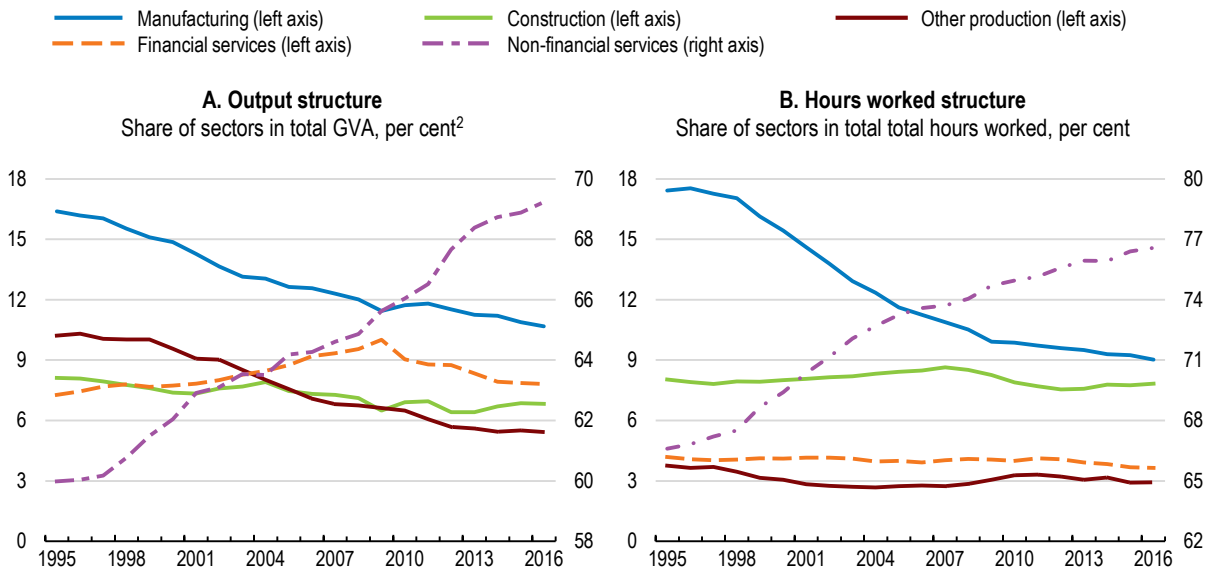
Reviewing aggregate productivity developments with a sectoral perspective

Sectors driving productivity growth

16. **The structure of the UK economy has been changing over time with a rising share of non-financial services in total output.** The relative size of the manufacturing sector has been falling and that of the non-financial services sector has been expanding (Figure 15). In financial services, the relative size

of output was rising before the recent crisis to peak in 2009, and has been gradually falling since then, but the relative size of hours worked has been broadly unchanged.

Figure 15. Importance of services has been rising in the United Kingdom[1]



1. Other production refers to agriculture, forestry and fishing (section A), mining and quarrying (section B), electricity, gas, steam and air conditioning supply (section D) and water supply, sewerage, waste management and remediation activities (section E). Imputed rental, which is part of real estate activities, is excluded from real gross value added (GVA).

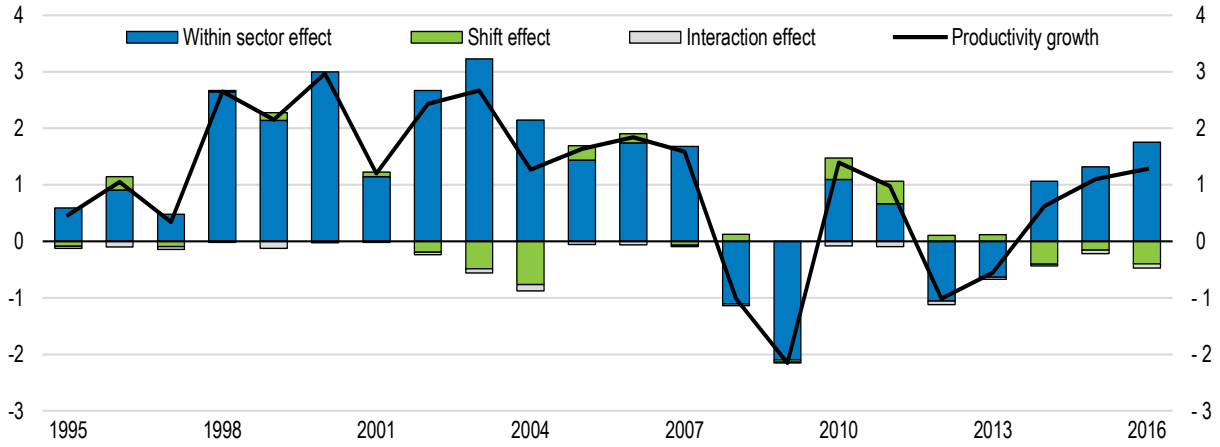
2. In real terms.

Source: ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April.

17. **Productivity within each sector has been the main determinant of aggregate productivity growth.** Decomposing productivity growth for 17 sectors of the UK economy provides further insights about the productivity puzzle (Figure 16 and Box 1). Within sector effects have had the largest contribution to productivity growth. Although the reallocation of labour among sectors with different levels (i.e. *shift effect*) or growth rates (i.e. *interaction effect*) of productivity has had a much smaller impact on labour productivity growth, since 2014 there has been a shift in labour towards sectors with lower productivity levels. In the last two decades, the shift and interaction effects have been negative on average, meaning that workers tended to shift to less productive sectors or sectors with lower productivity growth. Indeed, the relative size of sectors with medium and high productivity levels has been falling (mining and quarrying, electricity, gas, steam, and air conditioning supply, manufacturing), partly offset by the expansion of other efficient sectors (real estate activities, finance and insurance, information and communication), while sectors with lower productivity levels have been rising (professional scientific and technical activities, administrative support activities) or falling (government services, construction) (Figure 2A, Annex). More granular sectoral data are not available, but firm-level data for some sectors (non-financial corporations excluding agriculture, mining and utilities sectors) suggest that even if labour reallocation from less productive to more productive firms may have significantly contributed to productivity growth between 2004 and 2009, this contribution vanished in 2010-12 (Barnett et al., 2014c).

Figure 16. Productivity within each sector has been a major driver of aggregate productivity growth

Contribution to aggregate productivity growth, percentage points[1]



1. Based on the decomposition formula developed by the Centre of the study of living standards (CSLS) productivity growth is decomposed into three different components: "within sector effect" representing the intra-industry productivity growth, "shift effect" capturing the shift in labour between sectors with different productivity levels and "interaction effect" representing the effect of labour reallocation across sectors with different productivity growth rates. Imputed rental is excluded from the gross value added of real estate activities.

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April.

Box 1. Calculating the contributions of sectors to the aggregate productivity shortfall

Aggregate productivity shortfall is calculated as the percentage change between actual productivity and the level implied by its pre-crisis trend growth rate. The contribution of any given sector to the aggregate productivity shortfall is then calculated using a Shift-share analysis based on a decomposition formula developed by the Centre of the study of living standards (CSLS).

Labour productivity (P) is defined as output (Y) divided by labour (L) $P = \frac{Y}{L}$ and sectoral productivity $P_{ti} = \frac{Y_{ti}}{L_i}$ where subscript i= $1,2 \ldots, N$ denotes the sector and the subscript t= $1,2 \ldots, T$ denotes the time period.

The productivity shortfall (S) can be computed by looking at productivity change between the actual productivity level (P) and the counterfactual productivity level implied by its pre-crisis trend growth rate (P^*)

$$S = \frac{P - P^*}{P^*}$$

The CSLS formula decomposes productivity growth into three different components shown in the equation below, with labour productivity (P). "Within sector effect" (first component) represents the intra-industry productivity growth. "Shift effect" (second component) captures the shift in labour between sectors with different productivity levels. "Interaction effect" (third component) represents the effect of labour reallocation across sectors with different productivity growth rates:

$$S = \sum_i \frac{\Delta P_t^i \, l_{ti}^*}{P_t^*} + \sum_i \frac{(P_{ti}^* - P_t^*)\Delta l_{ti}}{P_t^*} + \sum_i \frac{(\Delta P_{ti} - \Delta P_t^*)\Delta l_{ti}}{P_t^*}$$

l_{ti} represents labour shares of a particular sector in the overall labour input ($l_{ti} = \frac{L_{ti}}{L_t}$) and counterfactual labour shares are denoted by l_{ti}^*.

Sectoral gross value added (GVA) is used for output. Aggregate GVA is the sum of individual sectors (i), which can differ from officially published aggregate GVA due to chain-linking methodology. Productivity hours, as published by the Office for National Statistics, are used for labour. Results of the shift-share analysis are based

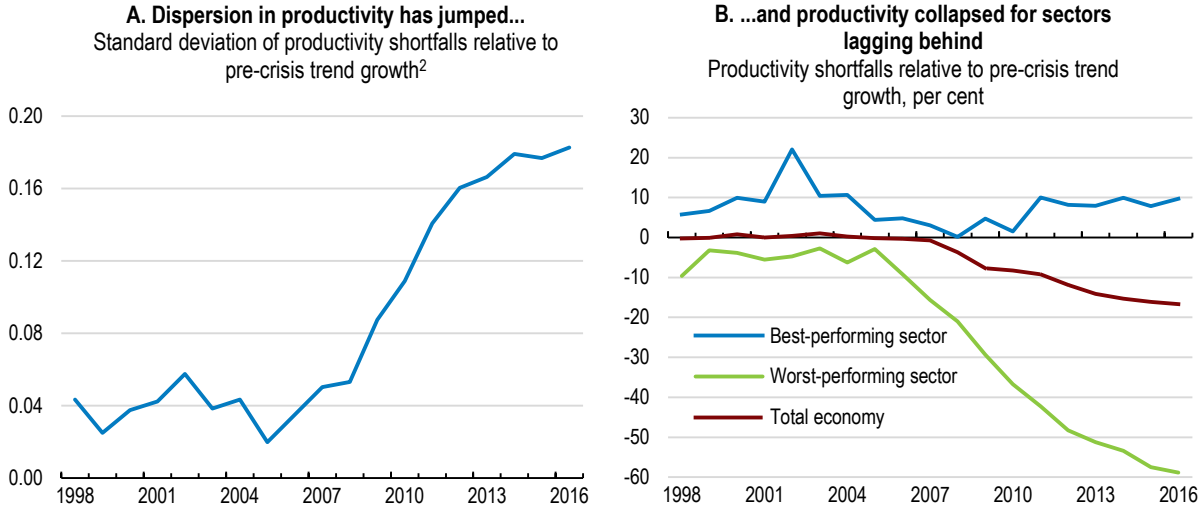
on 1-digit sectors of Standard Industrial Classification (SIC). Avillez (2012) provides further details on CSLS decomposition.

Source: Avillez R. (2012), "Sectoral Contributions to Labour Productivity Growth in Canada: Does the Choice of Decomposition Formula Matter?", Centre for Study of Living Standards, CSLS Research Department, December.

Aggregate productivity shortfall masks important heterogeneity across sectors

18. **Since the crisis, there has been a marked increase in the dispersion of productivity performance across UK sectors.** Measured by the difference between actual productivity and its level implied by the pre-crisis trend growth rate, dispersion in productivity has jumped (Figure 17, Panel A). High cross-sector heterogeneity in productivity may indicate problems of relocation of resources to more efficient uses. It is mainly the productivity of the worst-performing sectors (at a given point in time) which has tumbled, but productivity has been above its counterfactual for some sectors since 2011 (Figure 17, Panel B).

Figure 17. Cross-sector differences in productivity have soared since the financial crisis[1]



1. Imputed rental is excluded from the gross value added of real estate activities. The best/worst sector is time varying.

2. Across 1-digit Standard industrial Classification (SIC).

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April.

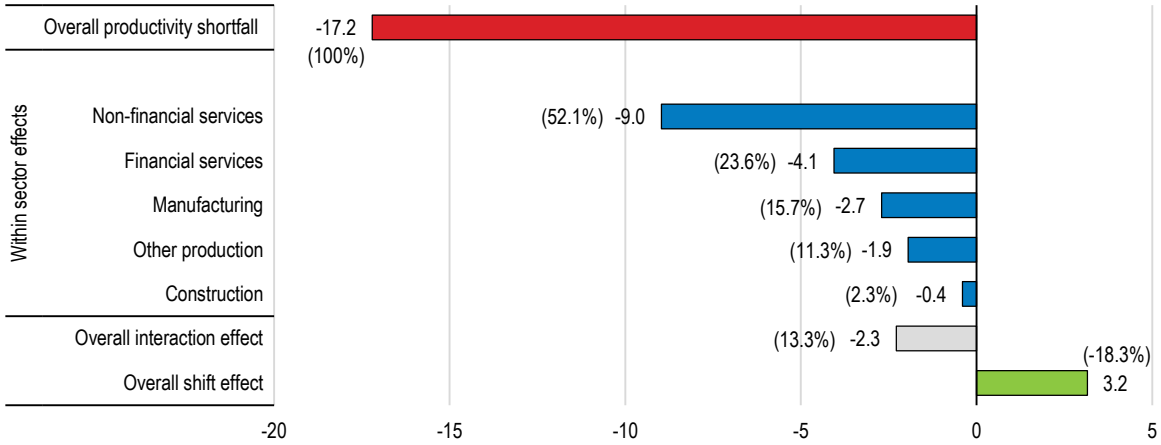
19. **There are important sectoral differences in explaining the productivity shortfall.** In the fourth quarter of 2016, over half of the total productivity shortfall was accounted for by non-financial services, nearly a fourth by financial services, around 15% by manufacturing and more than 10% by other production and construction (Figure 18; Table 1A, Annex). All but non-financial services and construction contribute disproportionately to the productivity shortfall compared to their shares in total output and employment (Figure 15). The overall shortfall derived from sectoral data is slightly smaller than when using aggregate data because imputed rents are excluded from the gross value added of real estate activities and the chain-linking methodology used by the Office for National Statistics implies that sectoral estimates do not add up to published aggregates.

20. **The decline in intra-industry productivity growth relative to its pre-crisis trend growth is the main driver behind the productivity shortfall across all sectors.** This is illustrated by a large negative contribution of the *within sector effect* (Figure 18). Labour shifted from sectors with higher

productivity growth to sectors with lower productivity growth (i.e. *interaction effect*), which added to the productivity shortfall. At the same time, labour reallocated to sectors with higher productivity levels (i.e. *shift effect*), reducing the productivity shortfall. In other words, workers were moving to more productive sectors compared to what the counterfactual would imply. The two different effects of labour reallocation, the shift effect and interaction effect, tend to cancel each other out to a large extent.

Figure 18. Services sectors account for a large share of the productivity shortfall

Contributions of sectors to the productivity shortfall relative to 1997-2007 trend growth, percentage points and percentages in brackets, Q4 2016[1]



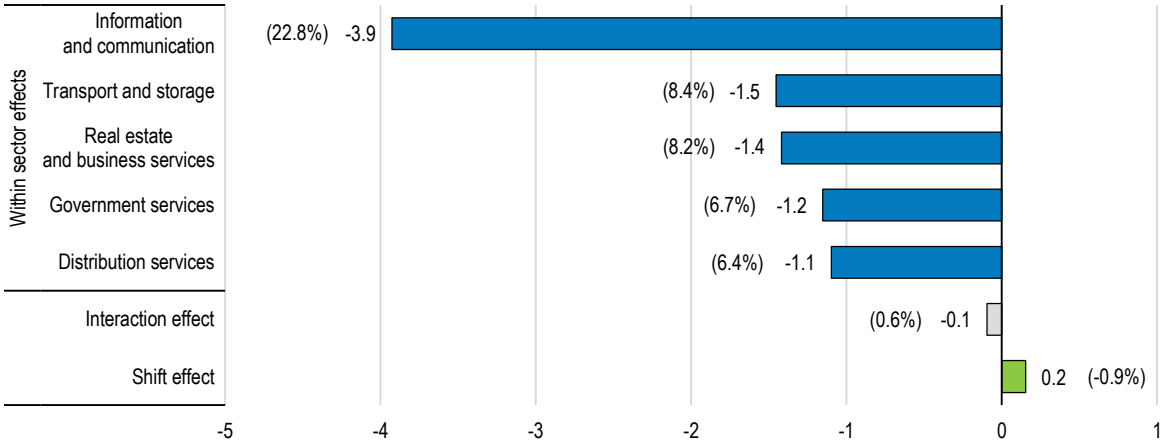
1. Based on the decomposition formula developed by the Centre of the study of living standards (CSLS) productivity growth is decomposed into three different components: “within sector effect” representing the intra-industry productivity growth, “shift effect” capturing the shift in labour between sectors with different productivity levels and ”interaction effect” representing the effect of labour reallocation across sectors with different productivity growth rates. Other production refers to agriculture, forestry and fishing (section A), mining and quarrying (section B), electricity, gas, steam and air conditioning supply (section D) and water supply, sewerage, waste management and remediation activities (section E). Imputed rental is excluded from the gross value added of real estate activities.

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April.

21. **Information and communication (ICT) is the major contributor within non-financial services to the overall productivity shortfall.** The ICT sector explains over a fifth of the productivity gap (Figure 19). Transport and storage, and real estate and business services, account each for about 8-8.5% of the overall shortfall, followed by government services and distribution services, with each contributing to the shortfall by around 6.5-7%. Other services such as arts, entertainment and recreation activities, and activities of households as employees do not add to the overall productivity gap. Similarly to other sectors, the decline in intra-industry productivity growth (i.e. *within sector effect*) relative to its pre-crisis trend growth is the main driver of the productivity shortfall in non-financial services (Figure 19).

Figure 19. Within non-financial services ICT contributes the most to the productivity shortfall

Contributions of sectors of non-financial services to the productivity shortfall relative to 1997-2007 trend growth, percentage points and percentages in brackets, Q4 2016[1]



1. Based on the decomposition formula developed by the Centre of the study of living standards (CSLS) productivity growth is decomposed into three different components: "within sector effect" representing the intra-industry productivity growth, "shift effect" capturing the shift in labour between sectors with different productivity levels and "interaction effect" representing the effect of labour reallocation across sectors with different productivity growth rates. Distribution services refer to wholesale and retail trade; repair of motor vehicles and motorcycles (section G) and accommodation and food service activities (section I). Real estate and business services refer to real estate activities (section L), professional, scientific and technical activities (section M) and administrative and support service activities (section N). Government services refer to public administration and defence (section O), education (section P) and health and social activities (section Q). Imputed rental is excluded from the gross value added of real estate activities. ICT: information and communication.

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April.

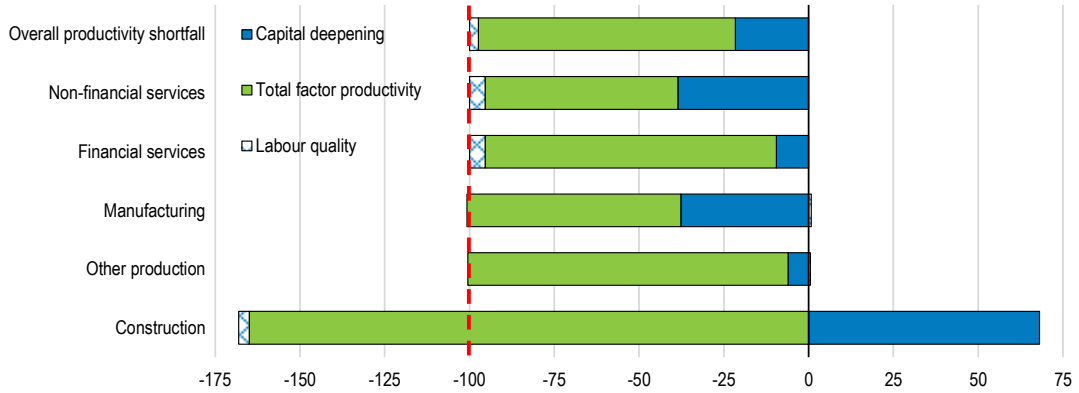
22. **Subdued TFP is the key driver of the aggregate productivity shortfall in all sectors.** TFP has negatively contributed to productivity developments across all sections of the UK economy (Figure 20). In particular, TFP has significantly held back productivity in financial services and other production sectors. Capital deepening has also had a large impact on the productivity shortfall, especially in non-financial services and manufacturing where its impact has been nearly as high as that of TFP. Labour quality had a small negative contribution to the aggregate productivity shortfall, mainly in non-financial and financial services.

23. **In non-financial services, TFP has been the most important driver of the productivity shortfall.** TFP has remained the most important determinant of the productivity shortfall across several key sectors of non-financial services (Figure 21). Capital per hour has also had a substantial negative effect in all sectors, in particular in distribution services, with the lowest impact on government services. Labour quality has had a small negative contribution in real estate and business services, and in distribution services, but has made a marginal positive contribution in the case of government services.

24. **Wages have continued to broadly reflect productivity at the aggregate level since the crisis.** The wage share has been constant for the whole economy between 2007 and 2015, with cross-sectoral differences (Table 2A, Annex). The wage share has fallen in manufacturing, information and communication, finance and insurance, transport and storage, and real estate and business services. By contrast, wage growth has outpaced productivity and resulted in increases in the wage share in other production, construction, government services, and in arts, entertainment and recreation and other services.

Figure 20. Weak total factor productivity is the main driver of the productivity shortfall

Decomposition of shortfall relative to 1997-2007 trend growth (shortfall for each sector = -100%), per cent, 2015[1]

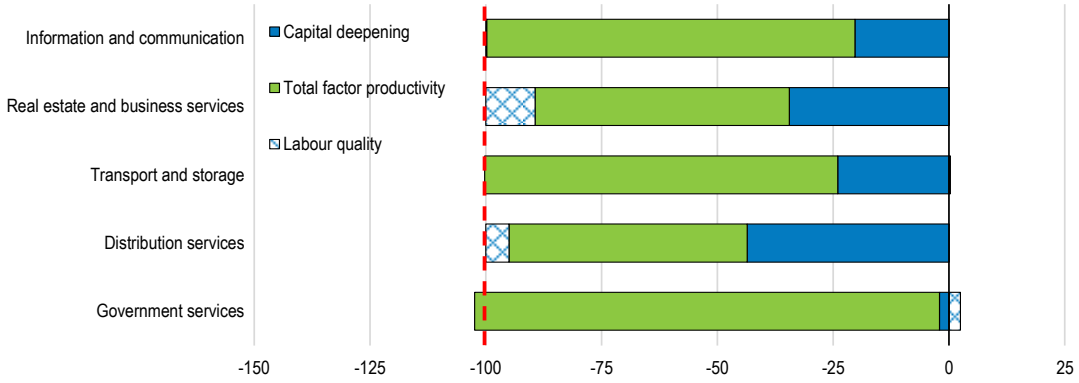


1. Capital deepening refers to net capital stock per hour worked. Net capital stocks account for the depreciation in assets, thus show the market value of fixed assets, and exclude dwellings. Other production refers to agriculture, forestry and fishing (section A), mining and quarrying (section B), electricity, gas, steam and air conditioning supply (section D) and water supply, sewerage, waste management and remediation activities (section E). Imputed rental is excluded from the gross value added of real estate activities.

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April; ONS (2016), "Capital stocks, consumption of fixed capital: 2016", Office for National Statistics, August; ONS (2016), "Quality adjusted labour input: UK estimates to 2015", Office for National Statistics, October; and ONS (2017), "Labour and Capital Income Shares, as used in the Multi-factor productivity estimates: Experimental estimates to 2015", Office for National Statistics, April.

Figure 21. Sluggish TFP and capital deepening explain the productivity gap in non-financial services

Decomposition of shortfall relative to 1997-2007 trend growth (shortfall for each sector = -100%), per cent, 2015[1]



1. Capital deepening refers to net capital stock per hour worked. Net capital stocks account for the depreciation in assets, thus show the market value of fixed assets, and exclude dwellings. Distribution services refer to wholesale and retail trade; repair of motor vehicles and motorcycles (section G) and accommodation and food service activities (section I). Real estate and business services refer to real estate activities (section L), professional, scientific and technical activities (section M) and administrative and support service activities (section N). Government services refer to public administration and defence (section O), education (section P) and health and social activities (section Q). Imputed rental is excluded from the gross value added of real estate activities. TFP: total factor productivity.

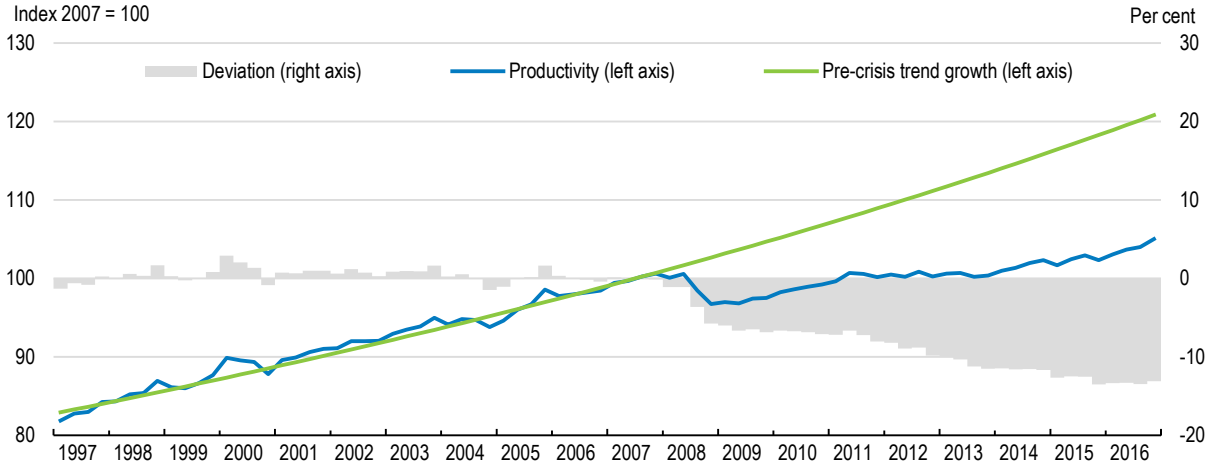
Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April; ONS (2016), "Capital stocks, consumption of fixed capital: 2016", Office for National Statistics, August; ONS (2016), "Quality adjusted labour input: UK estimates to 2015", Office for National Statistics, October; and ONS (2017), "Labour and Capital Income Shares, as used in the Multi-factor productivity estimates: Experimental estimates to 2015", Office for National Statistics, April.

Assessing the drivers of the productivity puzzle at the sectoral level

Non-financial services: self-employment, skill mismatches and lower capital-output ratio

25. **After the crisis, productivity of non-financial services has been growing but it has failed to catch up with its pre-crisis trend growth.** Although since mid-2009 there has been a constant but slow-paced rise in productivity, its level is permanently lower than the counterfactual level (Figure 22). A similar pattern can be observed at the more disaggregated sectoral level (Figure 23). The productivity gap is particularly large in ICT, and transport and storage sectors (Figure 23, Panels A and B). Although the deviation of actual productivity from its pre-crisis trend growth in the real estate and business sectors is smaller (Figure 23, Panel C), these sectors have a sizable negative effect on the overall productivity shortfall due to their large share (25%) in total gross value added of non-financial services. Encouragingly, however, the productivity gap has started to narrow for distribution services more recently (Figure 23, Panel D).

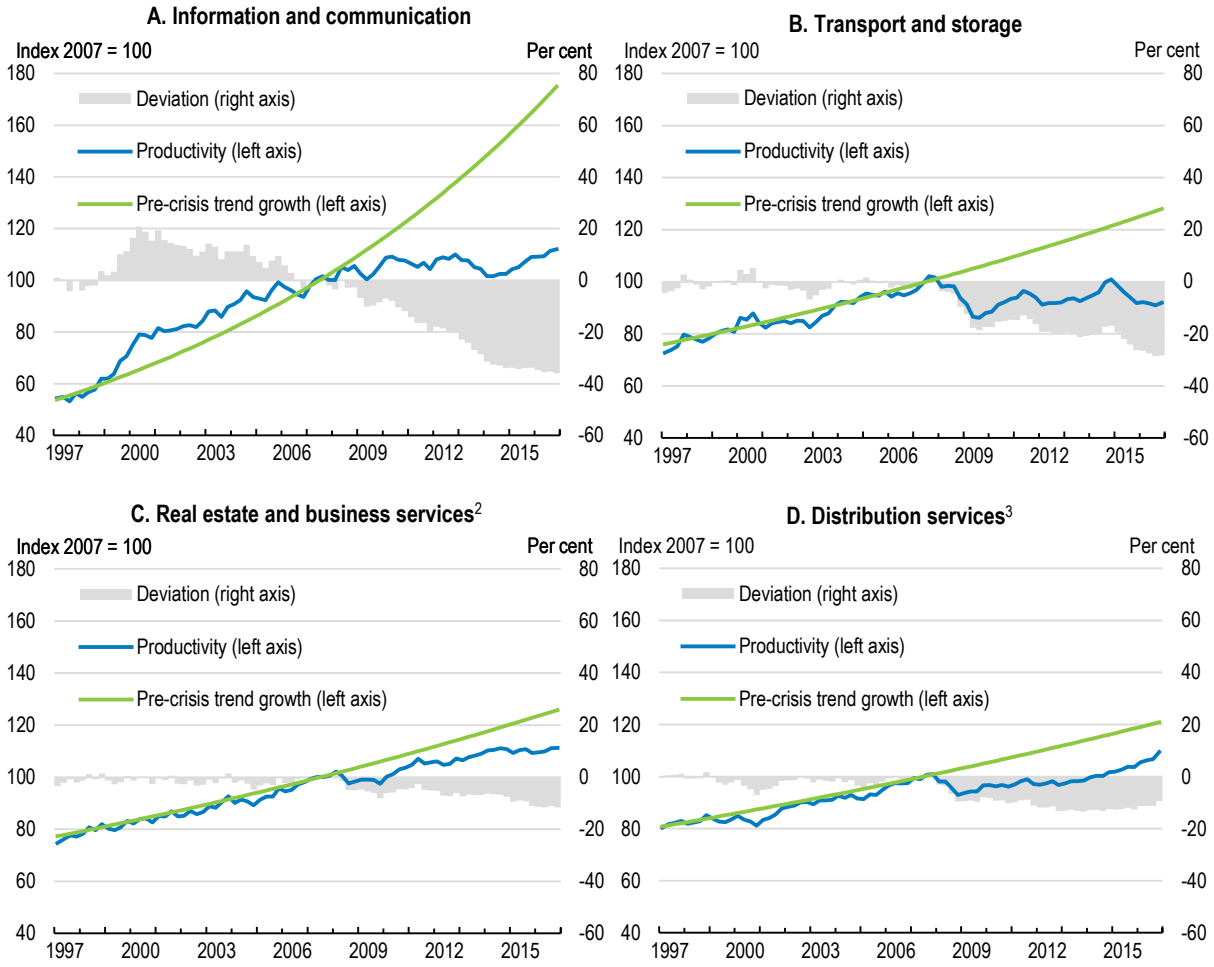
Figure 22. Productivity of non-financial services has not converged to pre-crisis trend growth[1]



1. Labour productivity refers to real gross value added (GVA) per hour. Pre-crisis trend growth is calculated between 1997 and 2007, and is projected from 2008 onwards. Imputed rental is excluded from the gross value added of real estate activities.

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April.

Figure 23. Labour productivity has been sluggish in all main sectors of non-financial services[1]



1. Labour productivity refers to real gross value added (GVA) per hour. Pre-crisis trend growth is calculated between 1997 and 2007, and is projected from 2008 onwards.

2. Real estate and business services refer to real estate activities (section L), professional, scientific and technical activities (section M) and administrative and support service activities (section N). Imputed rental is excluded from the gross value added of real estate activities.

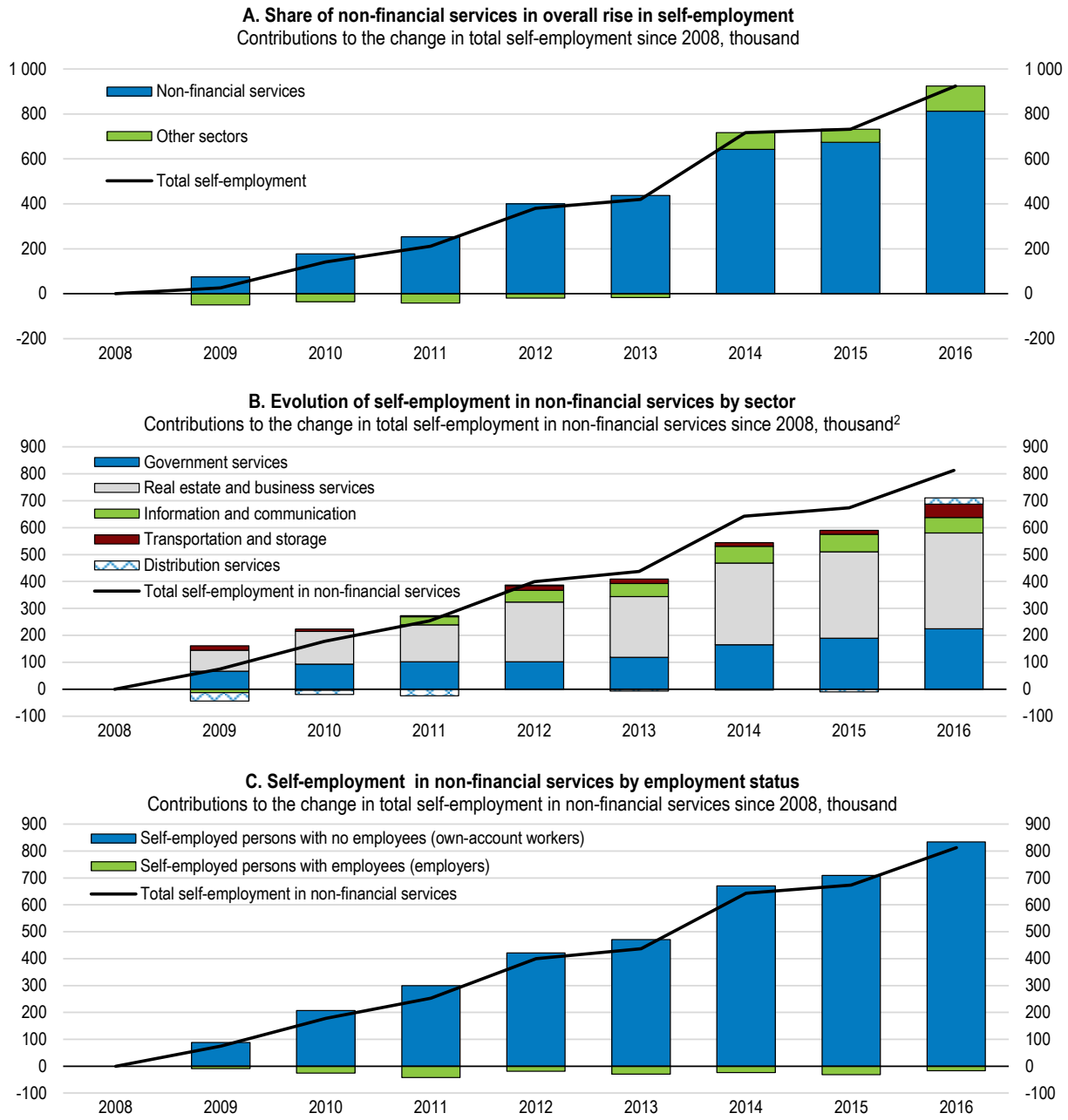
3. Distribution services refer to wholesale and retail trade; repair of motor vehicles and motorcycles (section G) and accommodation and food service activities (section I).

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April.

26. **Rising self-employment may have been one the factors weighing down on TFP.** The lion's share of overall rises in self-employment in the economy has happened in non-financial services (Figure 24, Panel A). The number of self-employed has expanded across a number of non-financial services sectors since the crisis (Figure 24, Panel B). Moreover, all created self-employed positions have been for self-employed with no employees (own-account workers), which could have a lower productivity than employees and self-employed with employees, the number of which has been falling (Figure 24, Panel C). Overall, a higher incidence of self-employment could explain why weak TFP has been the major driver of the productivity shortfall across all sectors of non-financial services (Figure 21). It remains to be

seen whether changes in the composition of employment with a greater proportion of self-employed, partly driven by population ageing (Figure 8, Panel B), are consistent with rapid gains in labour productivity.

Figure 24. Non-financial services have been a high recipient of self-employed workers[1]



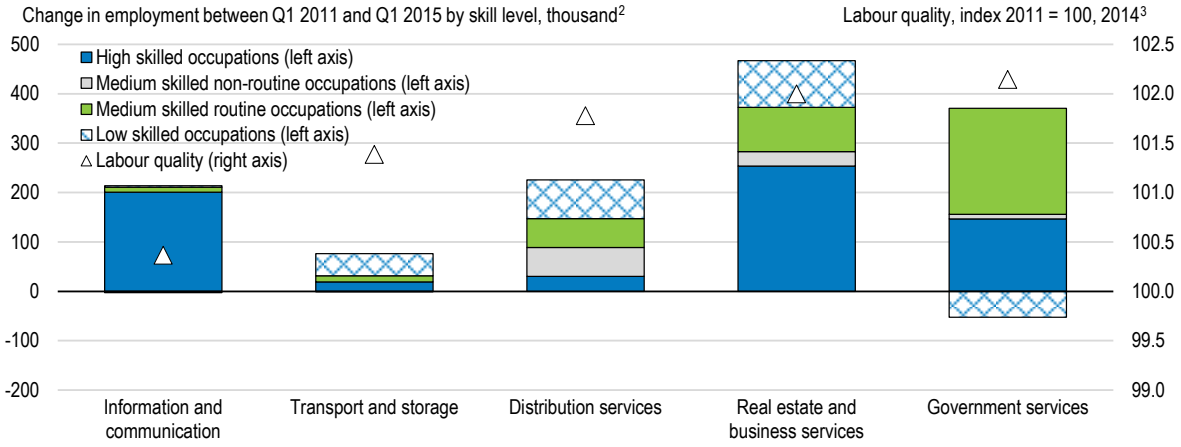
1. Data refer to population aged 15 and over.

2. Distribution services refer to wholesale and retail trade; repair of motor vehicles and motorcycles (section G) and accommodation and food service activities (section I). Real estate and business services refer to real estate activities (section L), professional, scientific and technical activities (section M) and administrative and support service activities (section N). Government services refer to public administration and defence (section O), education (section P) and health and social activities (section Q).

Source: Eurostat (2017), "Employment and Unemployment (Labour Force Survey)", *Eurostat Database*, May.

27. **Greater mismatches between changing skills and created jobs may have also held back TFP.** Such mismatches are reflected by the difference between the growth in labour quality and the growth of new occupations (Figure 25). In other words, there is an increasing mismatch between the supply of skills (measured by labour quality) and the demand for different skills types. The ICT sector, which explains slightly more than a fifth of the overall productivity shortfall (Figure 19), has witnessed job creation essentially in high-skilled occupations but the improvement in labour quality has been comparatively the weakest among non-financial services sectors. In parallel, the increase in labour quality has been the strongest for government services, where mainly medium-skilled routine occupations have been created.

Figure 25. Some evidence of skill mismatches in non-financial services[1]



1. Distribution services refer to wholesale and retail trade; repair of motor vehicles and motorcycles (section G) and accommodation and food service activities (section I). Real estate and business services refer to real estate activities (section L), professional, scientific and technical activities (section M) and administrative and support service activities (section N). Government services refer to public administration and defence (section O), education (section P) and health and social activities (section Q).

2. High skilled occupations include managers, professionals, technicians and associate professionals. Medium skilled non-routine occupations include service and sales workers and craft and related trades workers. Medium skilled routine occupations include clerical support workers, skilled agricultural, forestry and fishery workers and plant and machine operators and assemblers. Low skilled occupations refer to elementary occupations.

3. Labour quality is measured as the difference between the quality adjusted labour input (QALI) and hours worked. QALI is a method of measuring changes in the volume of labour input into production which accounts for changes in the composition (or 'quality') of the workforce as well as changes in jobs. QALI weights hours worked by different types of workers by their relative contribution to economic production. This is calculated by categorising workers by identifiable characteristics (based on age, gender, industry of employment and education level), and weighting changes in hours worked of each worker type by their share of total labour income.

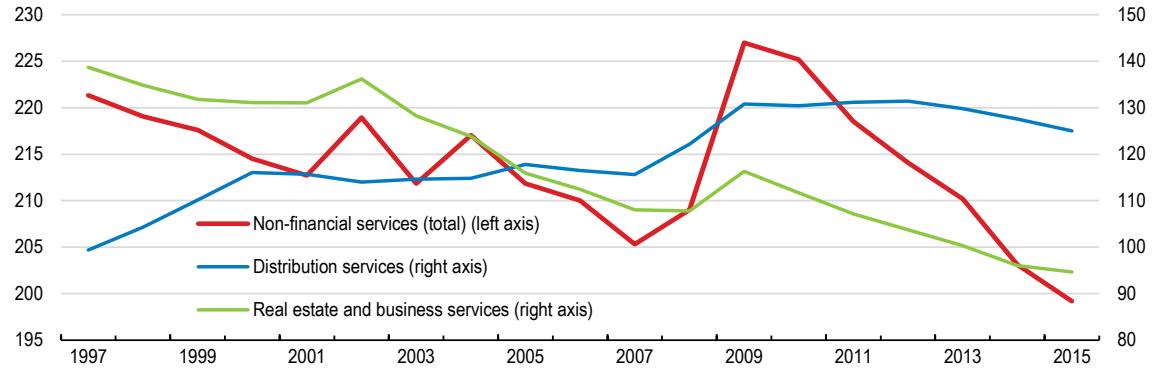
Source: ONS (2015), "Labour Market Statistics", Office for National Statistics; and ONS (2016), "Quality adjusted labour input: UK estimates to 2015", Office for National Statistics, October.

28. **Weak capital deepening has been weighing negatively on the productivity of some non-financial services sectors.** Capital per hour plays an important role in explaining the productivity shortfall of non-financial services, in particular in real estate and business services and distribution services (Figure 21). The production of real estate and business services has become less capital intensive over time, as the ratio of net capital stock to gross value added (GVA) has been in a long-standing downward trend (Figure 26). Although more volatile, a similar profile appears for the total non-financial services sector. These developments contrast with distribution services where the capital-output ratio has tended to

grow over time, which could help to explain a greater resilience of productivity in this sector (Figure 23, Panel D).

Figure 26. Capital-output ratio has been falling in non-financial services

Ratio of net capital stock to GVA by sector, per cent[1]



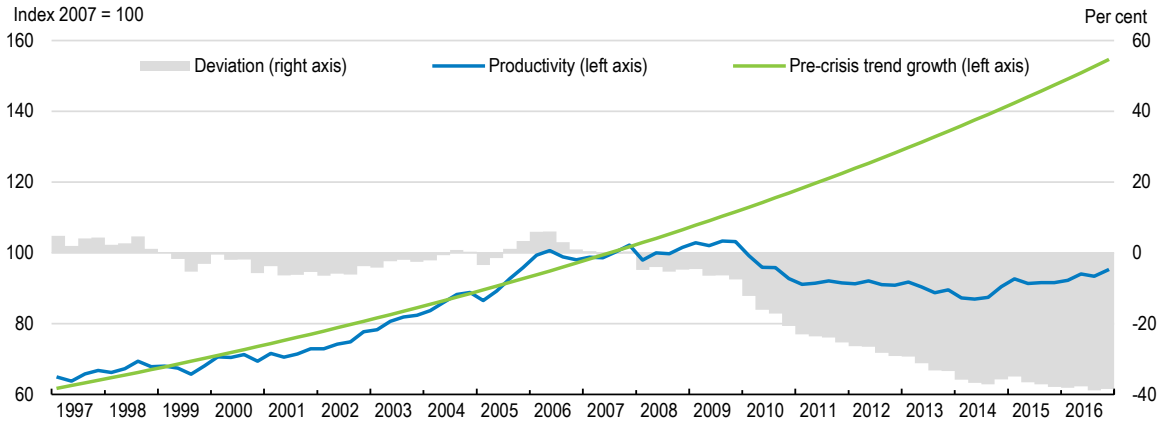
1. In real terms. Net capital stocks account for the depreciation in assets, thus show the market value of fixed assets, and exclude dwellings. Distribution services refer to wholesale and retail trade; repair of motor vehicles and motorcycles (section G) and accommodation and food service activities (section I). Real estate and business services refer to real estate activities (section L), professional, scientific and technical activities (section M) and administrative and support service activities (section N). Imputed rental, which is part of real estate activities, is excluded from real gross value added (GVA).

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2016), "Capital stocks, consumption of fixed capital: 2016", Office for National Statistics, August.

Financial services: collapse in risk-taking and leverage

29. **The financial crisis has halted the expansion of the financial sector.** Productivity was trending downwards between 2010 and 2014 and has been creeping up since then (Figure 27). As a result, a large productivity shortfall has emerged and its contribution to the aggregate productivity gap, driven by intra-industry productivity growth, reached close to 4 percentage points in the last quarter of 2016 (Figure 18).

Figure 27. Productivity has been depressed in financial services[1]

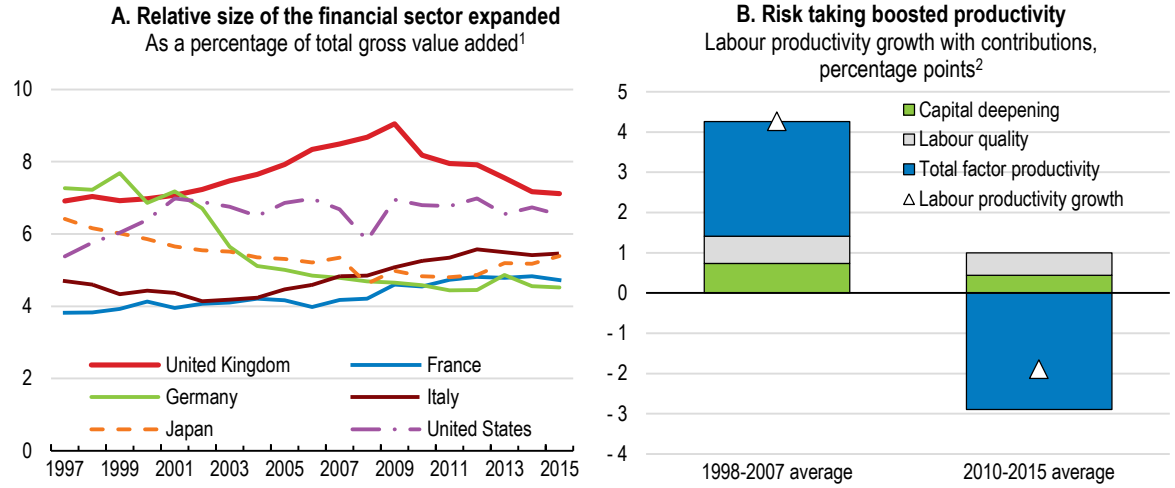


1. Labour productivity refers to real gross value added (GVA) per hour. Pre-crisis trend growth is calculated between 1997 and 2007, and is projected from 2008 onwards.

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April.

30. **Excessive expansion of the financial sector was driving productivity before the global downturn.** Although the measurement of output of the financial sector is difficult (Burgess, 2011), its share in total gross value added was rising sharply in the run-up to the crisis, with the size of the sector becoming significantly larger than in the rest of the G7 at the peak in 2009 (Figure 28, Panel A). TFP was a key engine of productivity growth before 2007, but has been depressed since then (Figure 28, Panel B). High contribution of TFP to overall productivity could reflect the importance of risk-taking and leverage for the development of the sector. The weakness of output and productivity could persist if the crisis and its consequences have put a lid on these drivers. Looking ahead, the key issue is the extent to which the financial sector can add to productivity growth of the UK economy without undermining financial stability.

Figure 28. Productivity growth in the financial sector was high in the run-up to the financial crisis



1. In real terms.

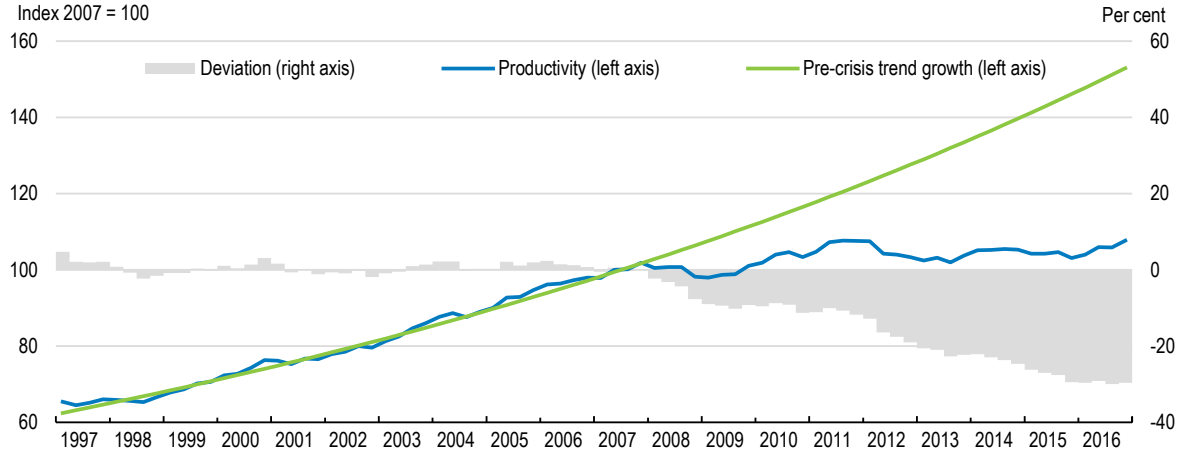
2. Labour productivity is defined as output (i.e. real gross value added) per hour worked. Contributions to labour productivity growth are calculated using a factor augmenting production function with a weight of 0.59 for hours worked and labour quality while total factor productivity is calculated as a residual. Capital deepening refers to net capital stock per hour worked. Net capital stocks account for the depreciation in assets, thus show the market value of fixed assets, and exclude dwellings. Labour quality is measured as the difference between the quality adjusted labour input (QALI) and hours worked. QALI is a method of measuring changes in the volume of labour input into production which accounts for changes in the composition (or 'quality') of the workforce as well as changes in jobs. QALI weights hours worked by different types of workers by their relative contribution to economic production. This is calculated by categorising workers by identifiable characteristics (based on age, gender, industry of employment and education level), and weighting changes in hours worked of each worker type by their share of total labour income.

Source: OECD (2017), OECD National Accounts Statistics (database), June; and OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April; ONS (2016), "Capital stocks, consumption of fixed capital: 2016", Office for National Statistics, August; ONS (2016), "Quality adjusted labour input: UK estimates to 2015", Office for National Statistics, October; and ONS (2017), "Labour and Capital Income Shares, as used in the Multi-factor productivity estimates: Experimental estimates to 2015", Office for National Statistics, April.

Manufacturing: low corporate restructuring

31. **As much as other sectors, the manufacturing sector has been significantly affected by the global downturn and in its aftermath.** Labour productivity has been flat since the crisis, resulting in an ever increasing productivity gap *vis-à-vis* its pre-crisis trend growth (Figure 29). The contribution of the manufacturing sector to the overall productivity shortfall was nearly 3 percentage points at the end of 2016 (Figure 18).

Figure 29. Productivity has been flat in the manufacturing sector[1]

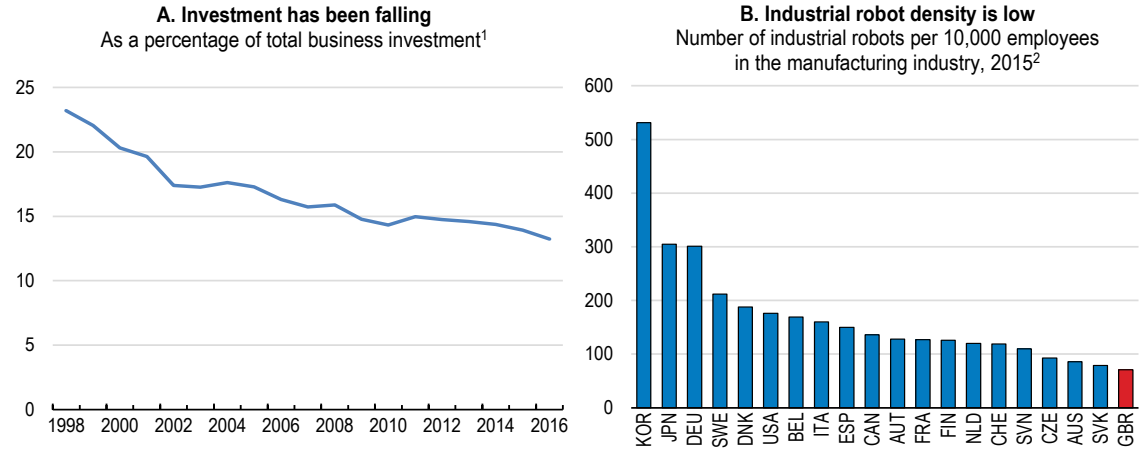


1. Labour productivity refers to real gross value added (GVA) per hour. Pre-crisis trend growth is calculated between 1997 and 2007, and is projected from 2008 onwards.

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April.

32. **Greater substitution of labour for capital has been a drag on productivity of the sector.** Weak productivity is partly due to low accumulation of the capital stock as measured by the share of investment in manufacturing in total business investment of the private sector (Figure 30, Panel A). This could reflect the substitution of labour for capital as the cost of labour may have fallen relative to the cost of capital in the context of persistent uncertainties and credit constraints. Such substitution is corroborated by a low density of industrial robots in the OECD (Figure 30, Panel B) and may have actually started before the crisis. Although differences in production structure can partly account for this, France has nearly 80% more robots than the United Kingdom, despite manufacturing production representing around 10% of gross value added in both countries.

Figure 30. Low capital stock accumulation and robot density in the manufacturing sector



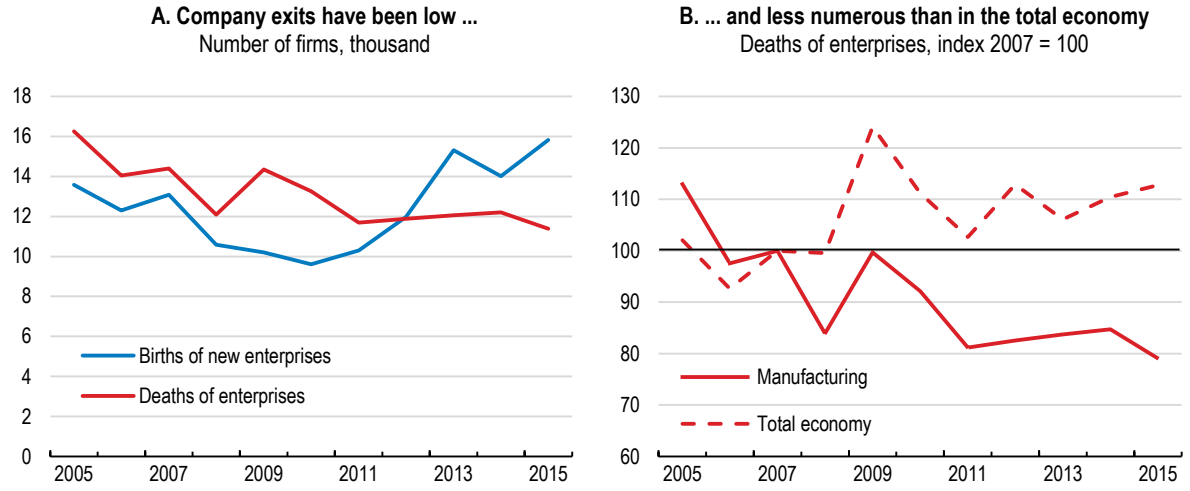
1. In real terms. Data refer to private sector investment.

2. Data refer to all types of multipurpose industrial robots.

Source: ONS (2017), "Business investment in the UK: Oct to Dec 2016 revised results", Office for National Statistics, March; and International Federation of Robotics (IFR).

33. **Weak corporate restructuring has been another driver of the productivity shortfall.** Weak TFP, which is the main driver of the productivity shortfall (Figure 20), could be explained by poor corporate restructuring and creative destruction as reflected by low company exits (Figure 31, Panel A). After edging up in 2009, company deaths have resumed their pre-crisis fall, being significantly less numerous than in the economy overall (Figure 31, Panel B). Moreover, in low-tech manufacturing the percentage of capital and labour that is held up by zombie firms (defined as firms which persistently fail to cover their interest payments from current profits) is estimated to be respectively at around 18% and 13% (OECD, 2017). Weak TFP may also indicate weak innovation of the sector, as reflected by its falling capital intensity and lower industrial robot density (Figure 30), and smaller gains from offshoring (leading up to reductions in prices of imported inputs from China and other emerging markets) since the financial crisis (Tenreyro, 2018).

Figure 31. Restructuring of the manufacturing sector has stalled



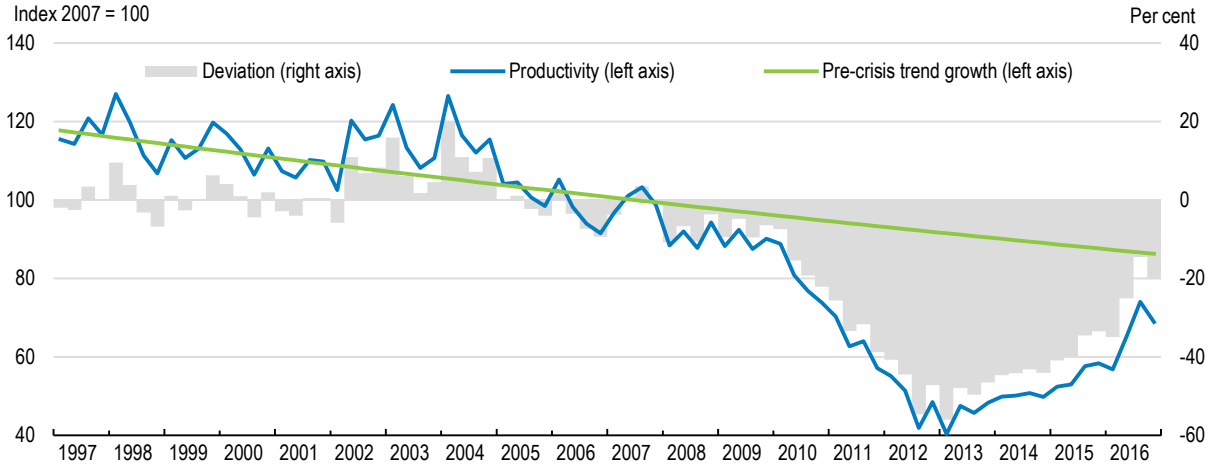
Source: ONS (2016), "Business demography, UK: 2015", Office for National Statistics, November.

Mining and quarrying: secular decline of a maturing sector

34. **Productivity in the mining and quarrying sector has been volatile since the crisis.** The mining and quarrying sector, which is part of other production, accounts for a very small share of the overall productivity shortfall (Table 1A, Annex). The crisis squeezed the sector as labour productivity dropped significantly below its counterfactual between 2009 and 2012 (Figure 32), which could reflect raising maintenance costs and growing difficulties in oil and gas extraction (McCafferty, 2014). However, productivity has been on the rise again since 2013, reflecting attempts to sustain production.

35. **The sector is on a secular decline.** Oil and gas extraction represent around 70% of the mining and quarrying sector, which used to be an important sector of the UK economy as mirrored by its high share in total gross value added (Figure 33, Panel A). However, the relative size of the sector peaked in the second half of 1990s and has been contracting since, as oil production has been gradually shrinking (Figure 33, Panel B).

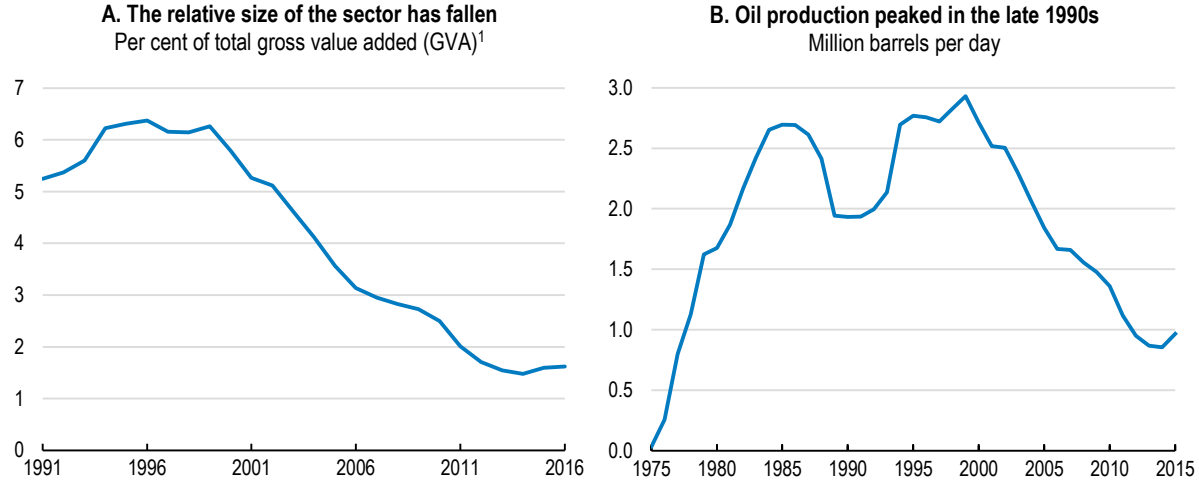
Figure 32. Productivity in mining and quarrying has been U-shaped since the financial crisis[1]



1. Labour productivity refers to real gross value added (GVA) per hour. Pre-crisis trend growth is calculated between 1997 and 2007, and is projected from 2008 onwards.

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April.

Figure 33. Oil and gas extraction has been on a secular decline



1. In real terms. Data refer to oil and gas sector (i.e. extraction of crude petroleum and natural gas). Imputed rental, which is part of real estate activities, is excluded from real gross value added (GVA).

Source: ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and Thomson Reuters Datastream.

Conclusion

36. **The productivity puzzle has started with the Great Recession, which has hit labour productivity across the OECD.** Most of the UK productivity underperformance is structural rather than cyclical and is mainly determined by poor within-sector TFP. Large rises in labour supply in the form of self-employed workers, lower matching of skills to jobs and a weaker capital-output ratio (especially in real estate and business services) may have slowed down productivity growth in non-financial services. Edging down productivity in the financial sector is mainly linked to reduced risk-taking and leverage, as

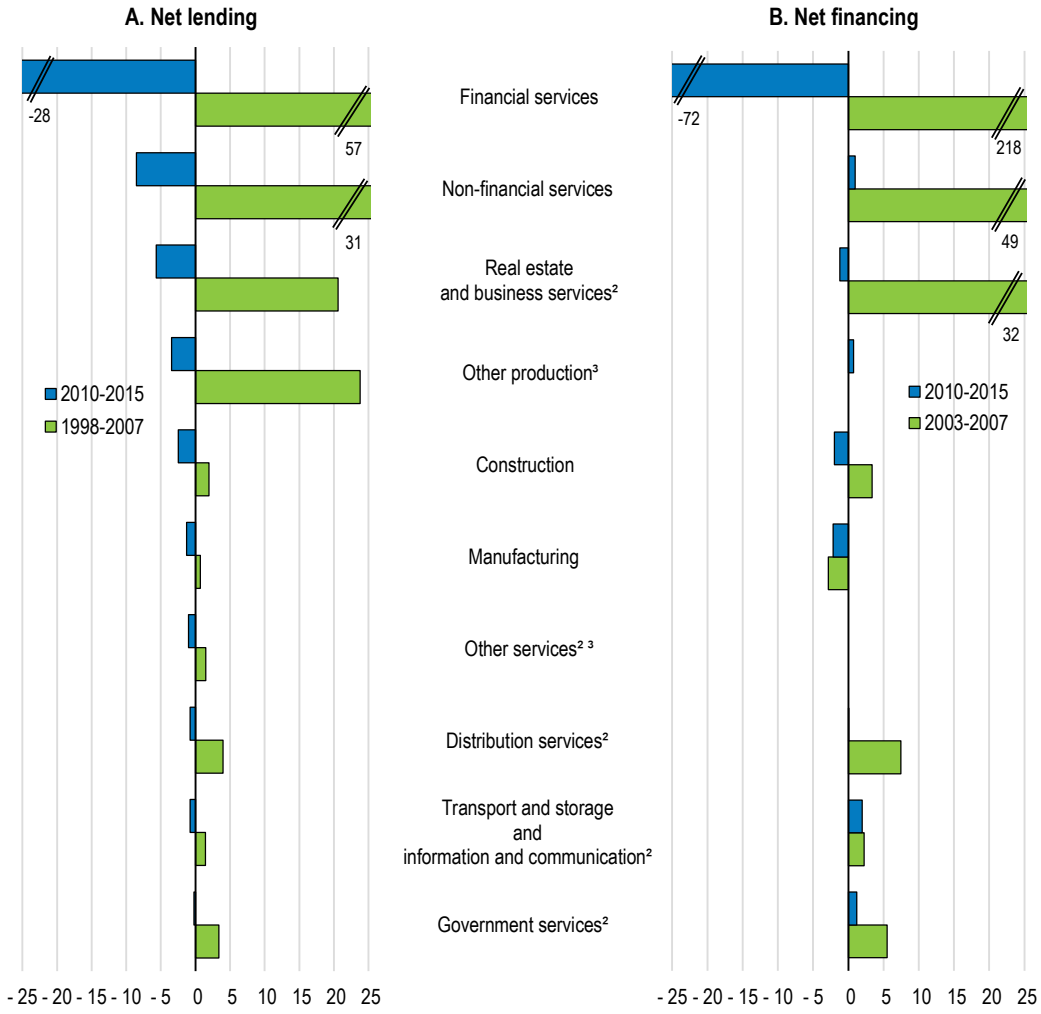
reflected by subdued TFP. Weak corporate restructuring and greater substitution of labour for capital may have held back productivity gains in the manufacturing sector.

37. **The origins of the UK productivity puzzle are also in part explained by pre-crisis developments.** These include: *i*) the rate of tangible investment was low as compared to other OECD countries; *ii*) the financial sector was expanding too rapidly despite the comparative advantage of the City; *iii*) productivity gains in the manufacturing sector were insufficiently "offensive" (driven by innovation); and *iv*) there was a secular decline of the oil and gas sectors with the steady dwindling of resources in the North Sea.

ANNEX

Figure 1A. External finance developments by sector

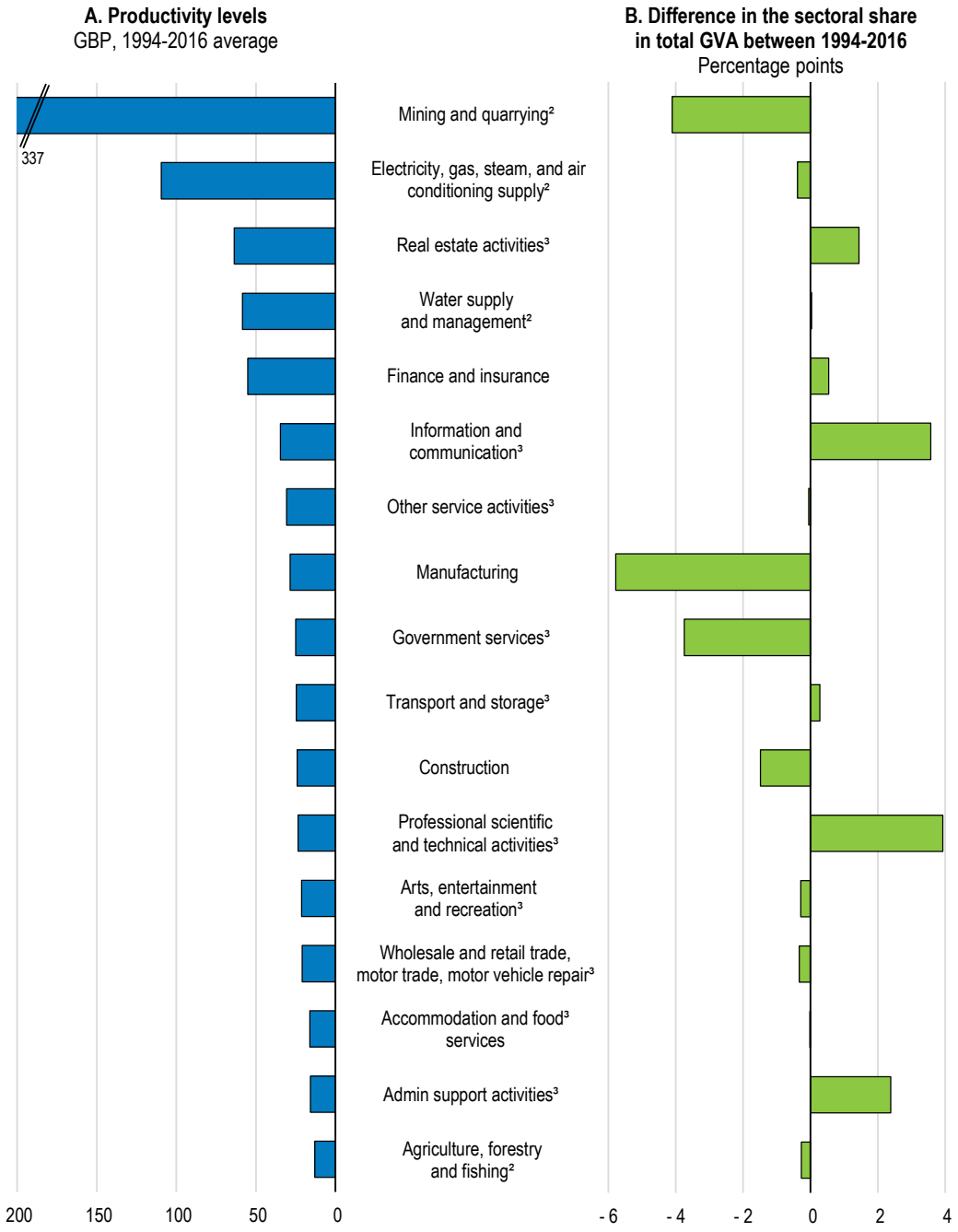
Annual average net finance raised by UK businesses by sector, GBP billion[1]



1. Net financing includes net lending and net capital issuance (i.e. equity, bonds and commercial papers). Other production refers to agriculture, forestry and fishing (section A), mining and quarrying (section B), electricity, gas, steam and air conditioning supply (section D) and water supply, sewerage, waste management and remediation activities (section E). Distribution services refer to wholesale and retail trade; repair of motor vehicles and motorcycles (section G) and accommodation and food service activities (section I). Real estate and business services refer to real estate activities (section L), professional, scientific and technical activities (section M) and administrative and support service activities (section N). Government services refer to public administration and defence (section O), education (section P) and health and social activities (section Q).
2. Part of non-financial services.
3. Net financing is not calculated as there is no data available for net capital issuance.

Source: Bank of England (2017), "Further analyses of deposits and lending, Table C1.2" and "Capital issuance, Table E3.1", May.

Figure 2A. Sectoral productivity levels and change in GVA share[1]



1. Labour productivity is defined as output (i.e. real gross value added (GVA)) per hour worked. GVA shares are calculated in real terms. Imputed rental, which is part of real estate activities, is excluded from GVA.

2. Part of other production.

3. Part of non-financial services. Government services refer to public administration and defence (section O), education (section P) and health and social activities (section Q).

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April.

Table 1A. Sectoral contributions to the productivity shortfall

Shortfall relative to 1997-2007 growth trend, Q4 2016[1]

	Contribution to productivity gap (% pts)	Contribution to productivity gap (%)	Within sector effects (% pts)	Shift effect per sector (% pts)	Interaction effect (% pts)
Whole economy	**-17.2**	**100.0**	**-18.1**	**3.2**	**-2.3**
Finance and insurance	-4.2	24.4	-4.1	-0.3	0.1
Information and communication	-3.9	22.5	-3.9	0.2	-0.1
Manufacturing	-2.3	13.3	-2.7	1.0	-0.6
Professional scientific and technical activities	-1.9	10.9	-1.9	0.0	0.0
Transport and storage	-1.5	8.5	-1.5	0.0	0.0
Government services	-0.9	5.1	-1.2	0.5	-0.3
Wholesale and retail trade; repair of motor vehicles and motorcycles	-0.6	3.5	-0.6	-0.1	0.0
Accommodation and food services	-0.6	3.4	-0.5	-0.1	0.0
Electricity, gas, steam, and air conditioning supply	-0.6	3.3	-0.9	1.2	-0.8
Agriculture, forestry and fishing	-0.5	2.9	-0.2	-0.2	0.0
Construction	-0.3	1.6	-0.4	0.3	-0.1
Water supply; sewerage, waste management and remediation activities	-0.3	1.5	-0.4	0.3	-0.1
Real estate activities	-0.2	1.3	0.3	-0.3	-0.1
Mining and quarrying	-0.1	0.7	-0.4	0.3	-0.1
Arts, entertainment and recreation	-0.1	0.4	-0.2	0.1	0.0
Other service activities	0.3	-1.5	0.3	0.0	0.0
Admin support activities	0.3	-2.0	0.2	0.2	-0.1

1. Government services refer to public administration and defence (section O), education (section P) and health and social activities (section Q). Imputed rental is excluded from the gross value added of real estate activities. Based on the decomposition formula developed by the Centre of the study of living standards (CSLS) productivity growth is decomposed into three different components: “within sector effect” representing the intra-industry productivity growth, “shift effect” capturing the shift in labour between sectors with different productivity levels and ”interaction effect” representing the effect of labour reallocation across sectors with different productivity growth rates.

Source: OECD calculations based on ONS (2017), "Quarterly National Accounts: Oct to Dec 2016", Office for National Statistics, March; and ONS (2017), "Labour Productivity: Oct to Dec 2016", Office for National Statistics, April.

Table 2A. Wage shares have been broadly stable overall, with some differences across sectors

	2007	2015	Difference between 2015 and 2007
Whole economy	0.64	0.64	0.00
Manufacturing	0.76	0.70	-0.06
Other production[1]	0.30	0.37	0.08
Construction	0.62	0.70	0.08
Distribution services[2]	0.71	0.73	0.02
Transport and storage	0.83	0.74	-0.08
Information and communication	0.63	0.60	-0.03
Finance and insurance	0.58	0.55	-0.04
Real estate and business services[3]	0.64	0.57	-0.07
Government services[4]	0.64	0.78	0.14
Arts, entertainment and recreation and other services	0.53	0.61	0.08

1. Other production refers to agriculture, forestry and fishing (section A), mining and quarrying (section B), electricity, gas, steam and air conditioning supply (section D) and water supply, sewerage, waste management and remediation activities (section E).
2. Distribution services refer to wholesale and retail trade; repair of motor vehicles and motorcycles (section G) and accommodation and food service activities (section I).
3. Real estate and business services refer to real estate activities (section L), professional, scientific and technical activities (section M) and administrative and support service activities (section N).
4. Government services refer to education (section P) and health and social activities (section Q).

Source: ONS (2017), "Labour and Capital Income Shares, as used in the Multi-factor productivity estimates: Experimental estimates to 2015", Office for National Statistics, April.

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