# OECD Compendium of Productivity Indicators 2019

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# OECD Compendium of Productivity Indicators 2019

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# *Foreword*

The *OECD Compendium of Productivity Indicators* presents a broad overview of recent and longer term trends in productivity levels and growth across OECD countries and key partner economies. It highlights the key measurement issues faced when compiling cross-country comparable productivity indicators and describes the caveats needed in analyses.

It examines the role of productivity as the main driver of economic growth and convergence, and the contributions of labour, capital and multifactor productivity to economic growth. It looks at the contribution of individual industries or sectors as well as the role of firm size in productivity performance. It explores the link between productivity, trade and international competitiveness, and analyses trends as compared with cyclical patterns in labour and multifactor productivity growth.

The 2019 *OECD Compendium of Productivity Indicators* was prepared in the OECD Statistics and Data Directorate by Frédéric Parrot and María Belén Zinni, and edited by Nadim Ahmad and Mariarosa Lunati. The contributions of Gueram Sargsyan and Ashley Ward are gratefully acknowledged. The publication has benefited from comments from Paul Schreyer, Deputy Director of the OECD Statistics and Data Directorate.

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# *Reader's guide*

Productivity is commonly defined as a ratio between the volume of output and the volume of inputs. In other words, it measures how efficiently production inputs, such as labour and capital, are being used in an economy to produce a given level of output. Productivity is considered a key source of economic growth and competitiveness and, as such, internationally comparable indicators of productivity are central for assessing economic performance.

This *OECD Compendium of Productivity Indicators* presents a broad overview of recent and longer term trends in productivity in OECD countries, providing insights on:

- international comparisons of income per capita and the role of labour productivity;
- the role played by labour and capital inputs and multifactor productivity in driving economic growth;
- the contribution of individual industries or sectors to aggregate labour productivity growth;
- differences in productivity small and medium-sized enterprises (SMEs) and large firms;
- the links between productivity and international competitiveness;
- the relationship between wages and productivity;
- long-term trends in productivity growth in major advanced economies.

## Measures of productivity

There are many different productivity measures. The key distinguishing factor reflects the policy focus, albeit data availability can also play an important role.

***Labour productivity***, measured as Gross Domestic Product (GDP) per hour worked, is one of the most widely used measures of productivity at country level. Productivity based on hours worked better captures the use of the labour input than productivity based on numbers of persons employed (head counts). Generally, the source for total hours worked is the *OECD National Accounts Statistics* (database), although other sources are necessarily used where data are lacking. Work continues at the national level to develop the necessary source data but despite the progress and ongoing efforts, for some countries, the measurement of hours worked still suffers from a number of statistical problems that can hinder international comparability (Chapter 8. ).

To take account of the role of the ***capital input*** in the production process, the preferred measure is the flow of productive services that can be drawn from the cumulative stock of past investments, such as machinery and equipment. These services, provided by capital goods to the production process, are known as capital services. Capital services provided by each type of capital good are estimated by the rate of change of the productive capital stock, taking into account wear and tear, retirements and other sources of reduction in the productive capacity of fixed capital goods. The overall volume measure of capital services (i.e. capital input) is computed by aggregating the volume change of capital services of all individual assets using asset specific user cost shares as weights. No conceptual distinction is made between user costs of capital and rental prices of capital. In principle, the rental price is that price that could be directly observed if markets existed for all capital services. In practice,

however, rental prices have to be imputed for most assets, using the implicit rent that capital goods' owners "pay" to themselves: the user costs of capital. In other words, the user cost of capital reflects the amount that the owner of a capital good would charge if he rented out the capital good under competitive conditions.

After computing the contributions of labour and capital inputs to output growth, the so-called ***multifactor productivity*** can be derived. It represents the efficiency of the combined use of labour and capital in the production process and is measured as the residual growth that cannot be explained by changes in labour and capital inputs. Multifactor productivity is often perceived as a pure measure of technical change, but, in practice, it should be interpreted in a broader sense that partly reflects the way capital and labour inputs are measured. Changes in multifactor productivity reflect also the effects of changes in management practices, brand names, organisational change, general knowledge, network effects, spillovers from one production factor to another, adjustment costs, economies of scale, the effects of imperfect competition and measurement errors.

Gains in productivity also influence the development of ***unit labour costs***, one of the most commonly used indicators to assess a country's international competitiveness. However, the ability of unit labour costs to inform policies targeting international competitiveness may be limited. This relates to the increasing need to take into account the growing international fragmentation of production, the effects of which on competitiveness may not be captured sufficiently by unit labour costs.

## The OECD Productivity Statistics (database)

The indicators presented in this publication are drawn from the *OECD Productivity Statistics* (database), which provides a consistent set of annual estimates of labour, capital and multifactor productivity growth, unit labour costs and many other related indicators as a tool to analyse the drivers of economic growth in OECD member countries and emerging economies. The database includes the following indicators:

- GDP per capita and labour productivity levels
- Growth in labour productivity
- Measures of labour input, such as total hours worked and total persons employed
- Measures of capital input, as an aggregate and by type of capital good
- Share of labour costs in the total cost of production
- Multifactor productivity growth
- Unit labour costs and labour compensation

Chapter 8. presents the definition of each indicator and the computation method.

## Country, time and industry coverage

Most countries covered in this publication produce their national accounts on the basis of the System of National Accounts 2008 (2008 SNA), which recognised, among other changes, that expenditures on research and development should be treated as investment (Chapter 8. ). However, at the time of publication the indicators computed for Colombia reflect the 1993 SNA standards, meaning that some care is needed in comparing across countries. For the Russian Federation, the indicators reflect a mix between the two systems, 1993 SNA (until 2010) and 2008 SNA (from 2011 onwards).

The *OECD Compendium of Productivity Indicators* includes data for the following countries depending on data availability. The figures in this publication use ISO codes for country names as listed below.

| | | | |
|---|---|---|---|
| AUS | Australia | IRL | Ireland |
| AUT | Austria | ISL | Iceland |
| BEL | Belgium | ISR | Israel |
| BRA | Brazil | ITA | Italy |
| CAN | Canada | JPN | Japan |
| CHE | Switzerland | KOR | Korea |
| CHL | Chile | LTU | Lithuania |
| CHN | China (People's Republic of) | LUX | Luxembourg |
| COL | Colombia | LVA | Latvia |
| CRI | Costa Rica | MEX | Mexico |
| CZE | Czech Republic | NLD | Netherlands |
| DEU | Germany | NOR | Norway |
| DNK | Denmark | NZL | New Zealand |
| ESP | Spain | POL | Poland |
| EST | Estonia | PRT | Portugal |
| FIN | Finland | RUS | Russian Federation |
| FRA | France | SVK | Slovak Republic |
| GBR | United Kingdom | SVN | Slovenia |
| GRC | Greece | SWE | Sweden |
| HUN | Hungary | TUR | Turkey |
| IDN | Indonesia | USA | United States |
| IND | India | ZAF | South Africa |

This publication looks at longer term trends in productivity growth but also at productivity patterns before and after the global crisis. To this end, indicators are typically presented for distinctive time periods: 1995-2017; 2001-2017; 2001-2007; and 2010-2017. For each country, the average value in the different periods only takes into account the years for which data are available for the respective indicator and its components.

Throughout this publication, the sectoral breakdown follows the International Standard Industry Classification of all Economic Activities (ISIC). Indicators by industry are presented according to its latest version, ISIC Rev.4, or the European equivalent, NACE Rev.2 (Nomenclature statistique des activités économiques dans la Communauté européenne).

Data are provided for the total economy and for selected sectors in the "non-agricultural business sector, excluding real estate" (ISIC Rev.4-codes B-N excluding L). These include: B - Mining and quarrying; C - Manufacturing; D - Electricity, gas, steam and air conditioning supply; E - Water supply; sewerage, waste management and remediation activities; F - Construction; as well as G-N excluding L - Business sector services, excluding real estate.

Business sector services (ISIC Rev.4 codes G-N, excluding L) include: G - Wholesale and retail trade; repair of motor vehicles and motorcycles; H - Transportation and storage; I - Accommodation and food service activities; J - Information and communication; K - Financial and insurance activities; M - Professional, scientific and technical activities; N - Administrative and support service activities. Real estate activities (ISIC Rev.4, code L) are excluded, as their value added includes the imputation made for the dwelling services provided and consumed by home-owners.

The business sector also excludes activities that are often provided by non-market producers. This reflects the fact that non-market activities are often measured on a sum-of-costs approach in current prices, with an implicit imputation made for labour productivity growth (usually zero) for volume estimates, together with an assumption of zero net operating surplus. These activities comprise: O - Public administration and defence; compulsory social security; P – Education; Q - Human health and social work activities; R - Arts, entertainment and recreation; S - Other service activities; T - Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; U - Activities of extraterritorial organisations and bodies.

This year edition presents indicators for more detailed economic activities according to ISIC Rev. 4.

# *Executive summary*

## Short-term trends

Labour productivity growth in the OECD area remains weak. Since 2010, annual growth in labour productivity has slowed to 0.9%, about half the rate recorded in the pre-crisis period. Labour productivity growth has also slowed in OECD countries with relatively low labour productivity levels, undermining the pace of convergence. A similar picture surfaces for emerging economies, in particular in Brazil, the Russian Federation and South Africa, who have fallen further behind the productivity frontier with subdued performance in recent years.

On the back of weak multifactor productivity growth and with post-crisis investment rates still below pre-crisis levels in many economies, GDP per capita growth has been largely sustained by increases in labour utilisation, as employment rates have climbed to historic highs in most countries.

In many countries, recent employment growth has been in activities with relatively low labour productivity, dragging down overall labour productivity. Some countries, such as Belgium, Finland, Italy and Spain, have even seen net job destruction in industries with above average labour productivity levels and in many OECD economies, the top three sectors generating the largest net employment gains since 2010 had below average labour productivity, with accommodation and food services, and health and residential care activities featuring highly in many economies.

More jobs in lower labour productivity activities has also meant more jobs with below average wages in most economies, weighing down on average salaries in the economy as a whole, compounding the effects of slower productivity growth and its ability to drive wage growth. Although growth in real wages (compensation per hour worked), adjusted for inflation has begun to strengthen in most economies in recent years it remains below pre-crisis rates in many. However, in many countries, there are signs that the post-crisis decoupling of wage and productivity growth is beginning to unwind, in particular in those economies where employment rates are high.

The recovery of investment remains modest. In some countries, such as Canada, the United Kingdom and the United States, the slack in labour markets and downward pressure on wages may have allowed firms to defer investment decisions and instead increase employment, especially with labour costs lagging investment costs, undermining, in turn, the potential for investment driven productivity growth.

With labour costs beginning to rise in many countries, firms may begin to reconsider investment decisions, but political uncertainties, trade tensions and the erosion of business and consumer confidence may continue to undermine the recovery of investment.

## Long-term trends

Productivity growth in most countries remains well below historic averages. The slowdown in labour and multifactor productivity growth has been a common feature across countries, and underlying long-term trends suggest that it was underway prior to the crisis.

The post-crisis period has been characterised by a significant increase in the contribution of labour utilisation to GDP per capita growth, notably in the United Kingdom and the United States. This differs from the pre-crisis period where growth in labour utilisation played only a marginal role in most countries.

The post-crisis slowdown in labour productivity growth in manufacturing has been widespread, spanning nearly all sub-sectors of manufacturing from higher-tech, higher skilled activities such as computers and electronics, to those traditionally viewed as lower-tech and lower-skilled, such as textiles.

Productivity growth in manufacturing, however, continues to outpace productivity growth in services. Within the business services sector, for most countries, labour productivity growth over the past fifteen years was mainly driven by distribution, accommodation and food, and transport services, reflecting their large share on overall economic activity and employment. In the pre-crisis period strong productivity growth in finance and insurance activities also played a strong role but their contribution has been weaker since then. Although productivity growth has also slowed considerably in information and communication (ICT) activities it remains above that for the whole economy in many countries.

In most countries, gaps in labour productivity levels between large firms and small and medium-sized enterprises (SMEs) are significant. This is particularly true for micro firms in both manufacturing and business services sectors, even if there are countries and industries where some smaller enterprises are able to outperform larger firms, mostly in business services. In information and communication activities, productivity gaps between SMEs, in particular micro firms, and large firms remain high but the evidence suggests that those gaps are closing, in particular in the Baltic States, and Portugal, pointing to potential uptake of digital tools.

Investment in intellectual property products has been increasing over the last fifteen years, often at a faster pace than investment in traditional physical capital, with shares of investment in intellectual property products climbing to 30% in Switzerland and 43% in Ireland in 2017.

Over the past fifteen years, many countries have improved their relative competitiveness by keeping unit labour costs (ULCs) in check in both manufacturing and business sector services; as was the case in Belgium, Germany, Ireland, Israel, Poland and Portugal, reflecting relatively strong labour productivity growth and/or moderate wage increases. In the Czech Republic, Hungary, Korea, Lithuania, Poland, the Slovak Republic and Slovenia, large productivity gains have helped to keep ULCs in check despite significant wage increases.

Labour income shares have declined in most countries over the last fifteen years, particularly in the manufacturing sector, with the largest declines in Greece (58% in 2001 to 45% in 2017), Poland (from 66% in 2001 to 53% in 2017) and the United States (61% in 2001 to 48% in 2016). In business services, the largest declines occurred in Australia (70% in 2001 to 61% in 2017), Belgium (85% in 2001 to 75% in 2017) and Ireland (56% in 2001 to 43% in 2017).

# Chapter 1. **Recent trends in productivity, employment and wages**

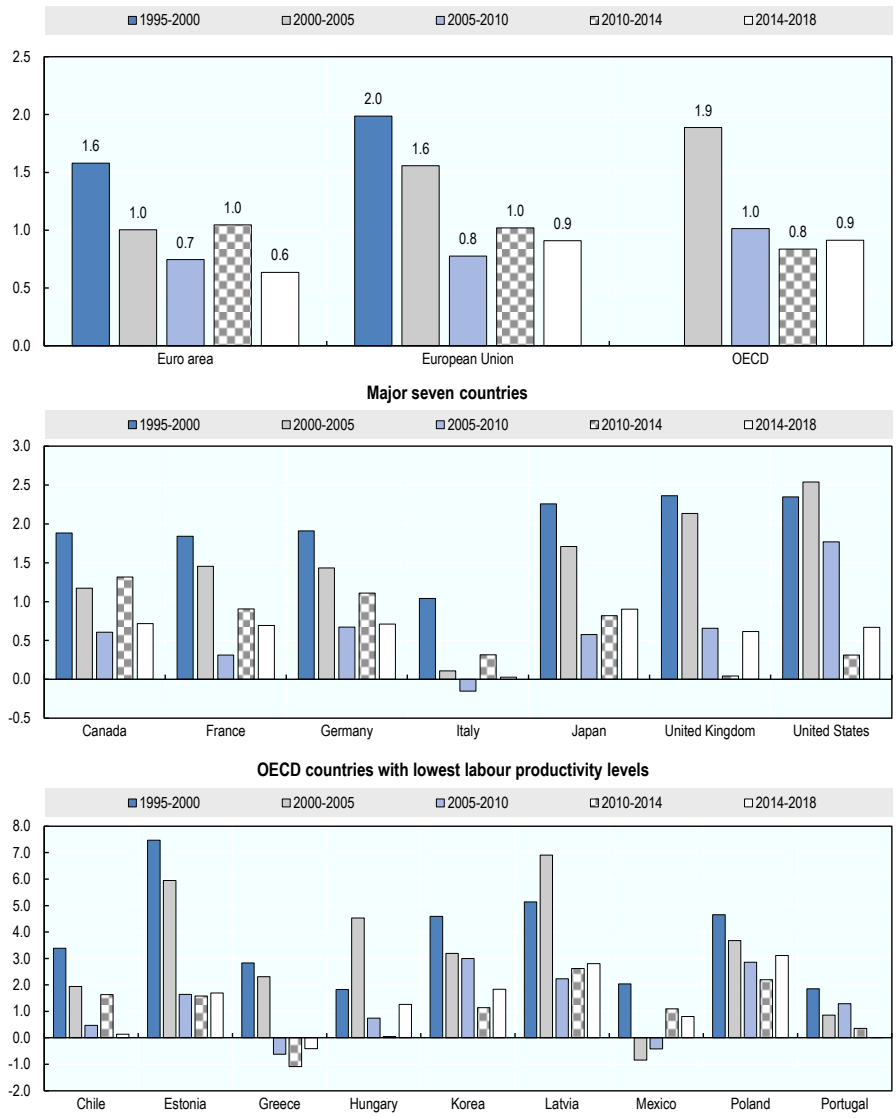
The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## Labour productivity growth remains weak

Labour productivity growth in the OECD area remains weak and well below pre-crisis rates. Since 2010, annual growth in labour productivity has slowed to 0.9%, about half the rate recorded in the 2000-2005 pre-crisis period (Figure 1.1). Post-crisis labour productivity growth has also slowed in countries with relatively low labour productivity levels (Figure 2.7), undermining the pace of convergence towards higher labour productivity levels. A similar picture emerges for emerging economies, in particular in Brazil, the Russian Federation and South Africa (Figure 1.2), who have fallen further behind the productivity frontier as productivity has contracted in recent years.

**Figure 1.1. Labour productivity growth in the OECD**

GDP per hour worked, percentage rate at annual rate

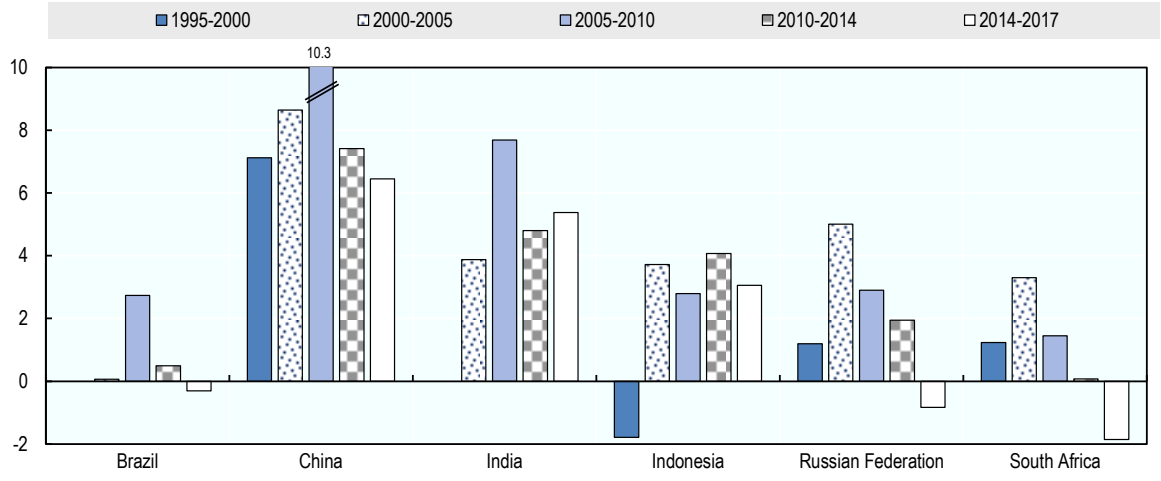



*Note*: Data for all other countries are presented in the Annex 1.A.
*Source*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, March 2019.

StatLink http://dx.doi.org/10.1787/888933967908

**Figure 1.2. Labour productivity growth in BRIICS**

GDP per person employed, percentage change at annual rate



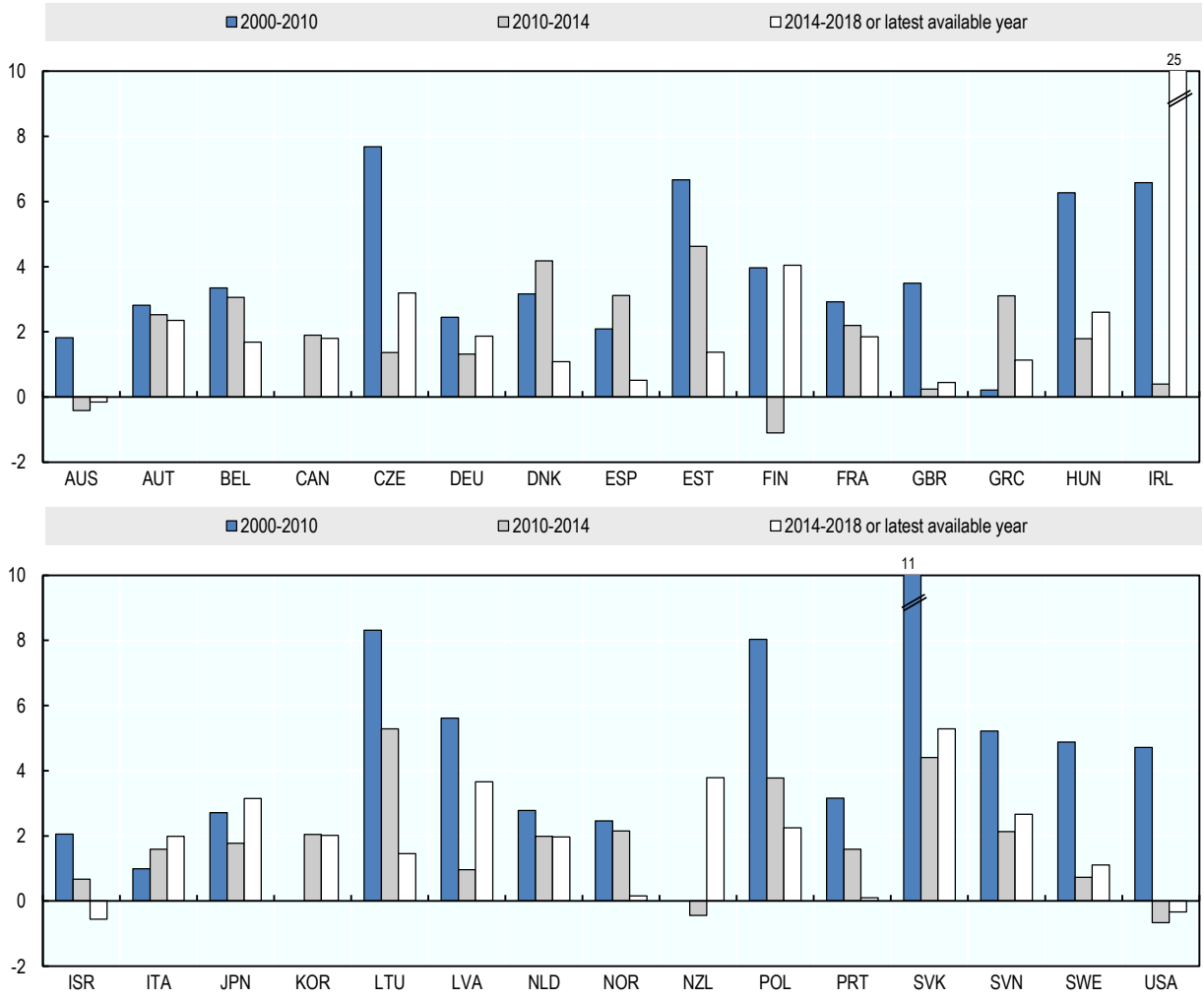

*Source*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, March 2019.

StatLink http://dx.doi.org/10.1787/888933967927

The post-crisis slowdown in productivity growth affects all major sectors, but particularly manufacturing where productivity growth rates remain well below last-decade's rates in most countries (Figure 1.3). Indeed, in Australia, Israel, the United Kingdom and the United States, productivity gains in manufacturing have been negligible since 2010. In Ireland, the relocation of firms with significant intellectual property assets and aircraft leasing companies, led to a significant increase in labour productivity in 2015.

**Figure 1.3. . Labour productivity in manufacturing**

GDP per hour worked, percentage change at annual rate



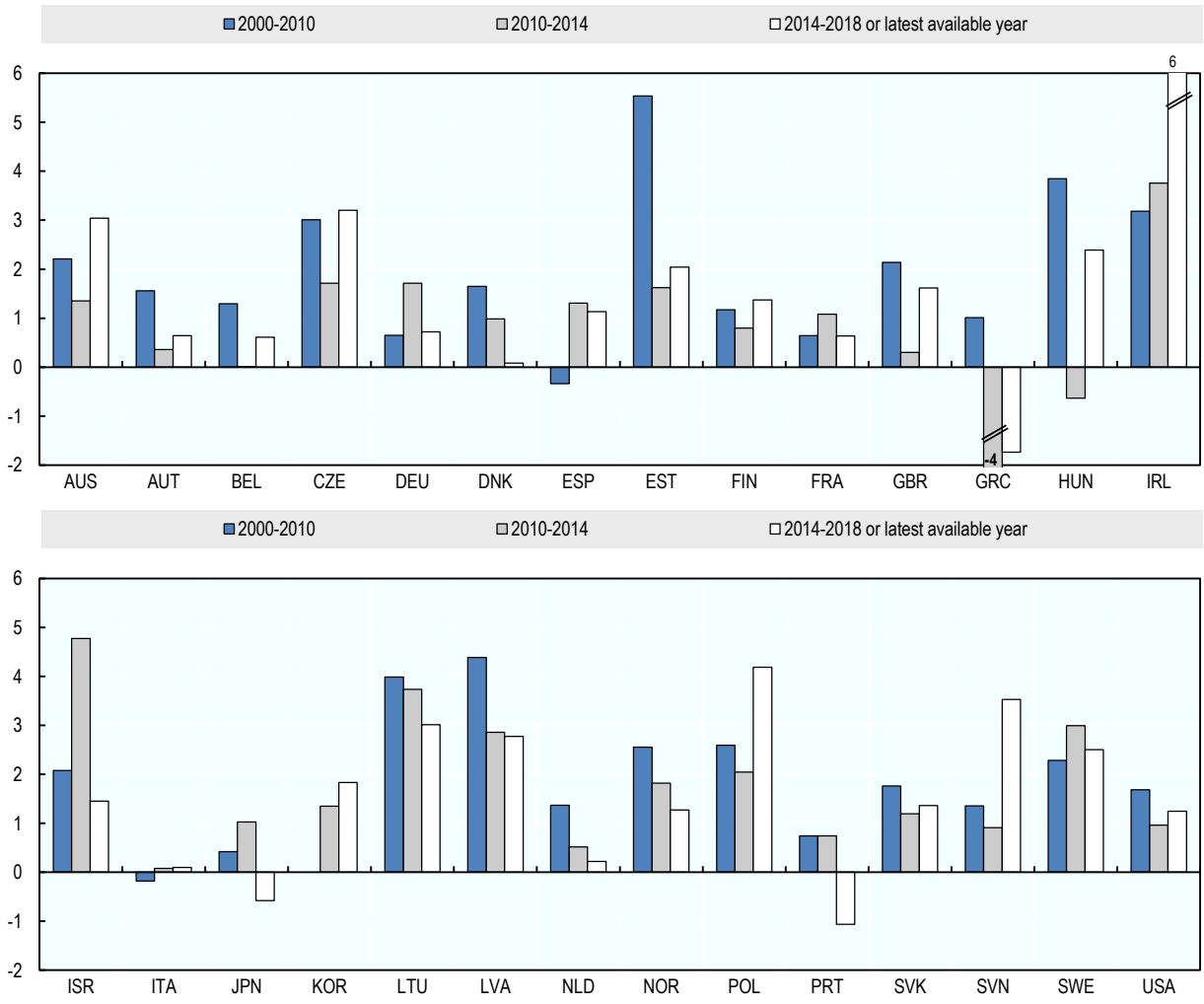

*Note*: For Japan, Korea and the United States, labour productivity is measured as gross value added per person employed, as national accounts estimates of hours worked by main economic activity are not currently available.
*Source*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, March 2019.

StatLink http://dx.doi.org/10.1787/888933967946

In the services sector, the picture has been more varied (Figure 1.4). In Central and Eastern European OECD economies, for example, the catch-up process has helped sustain relatively robust growth, picking up strongly in Poland and Slovenia in the most recent years. However, productivity growth remains weak in most other economies, indeed sclerotic in some, such as Italy and Greece. Even in countries where it has improved in recent years, such as the United States, it remains weak.

**Figure 1.4. . Labour productivity in business services excluding real estate**

GDP per hour worked, percentage change at annual rate




*Notes*: Business services exclude real estate activities. For Japan, Korea and the United States, labour productivity is measured as gross value added per person employed, as national accounts estimates of hours worked by main economic activity are not currently available.
*Source*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, March 2019.

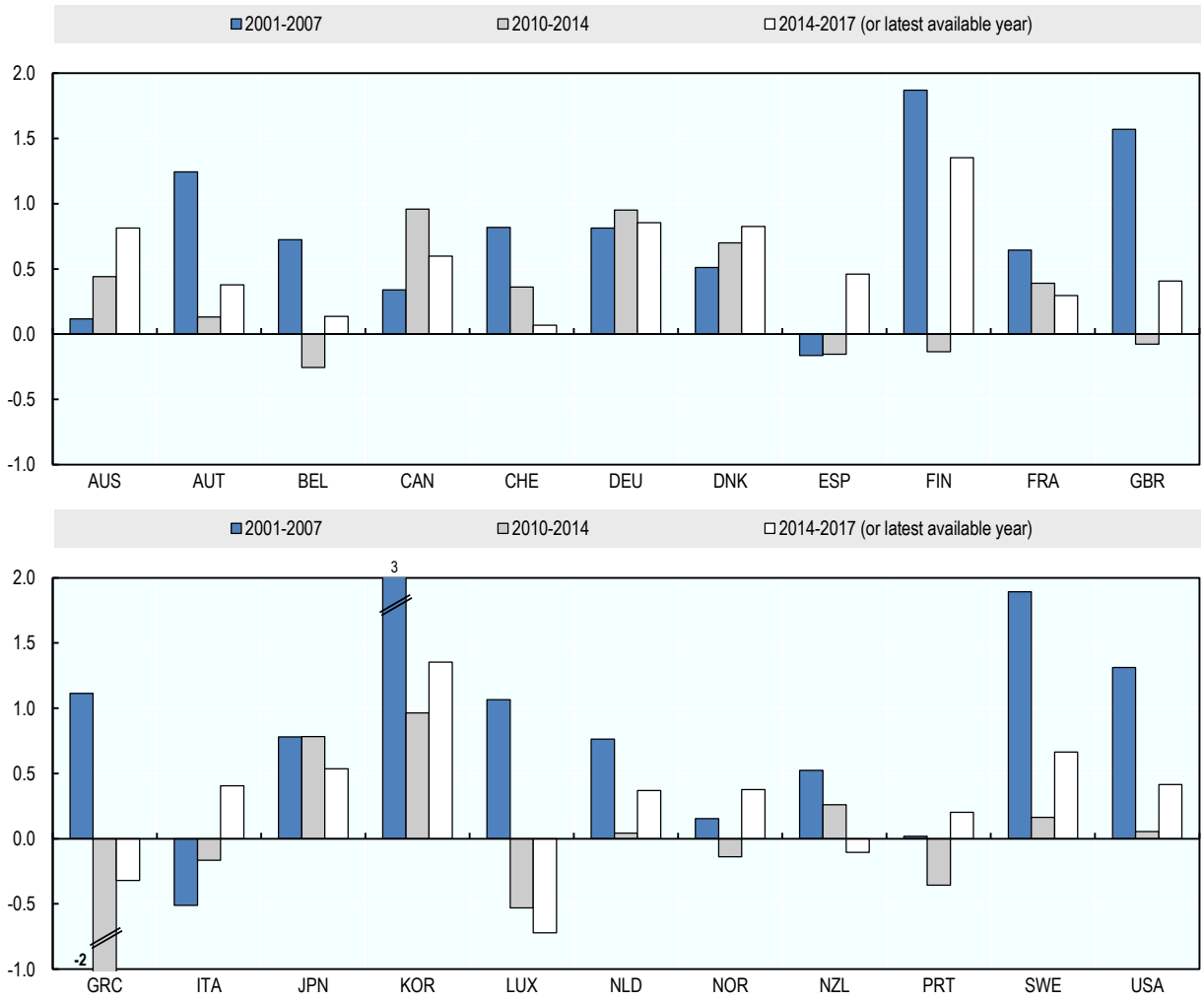
StatLink http://dx.doi.org/10.1787/888933967965

### *Multifactor productivity growth remains below pre-crisis rates*

Like labour productivity growth, multifactor productivity growth also remains weak across most OECD economies, and although some countries, including the United Kingdom and the United States, have seen a pick-up in recent years, growth remains well below pre-crisis rates (Figure 1.5). Multifactor productivity growth has also improved in Italy, Portugal and Spain, outpacing pre-crisis rates, but it remains weak.

**Figure 1.5. Growth in multifactor productivity**

Percentage change at annual rate




*Source*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, March 2019.

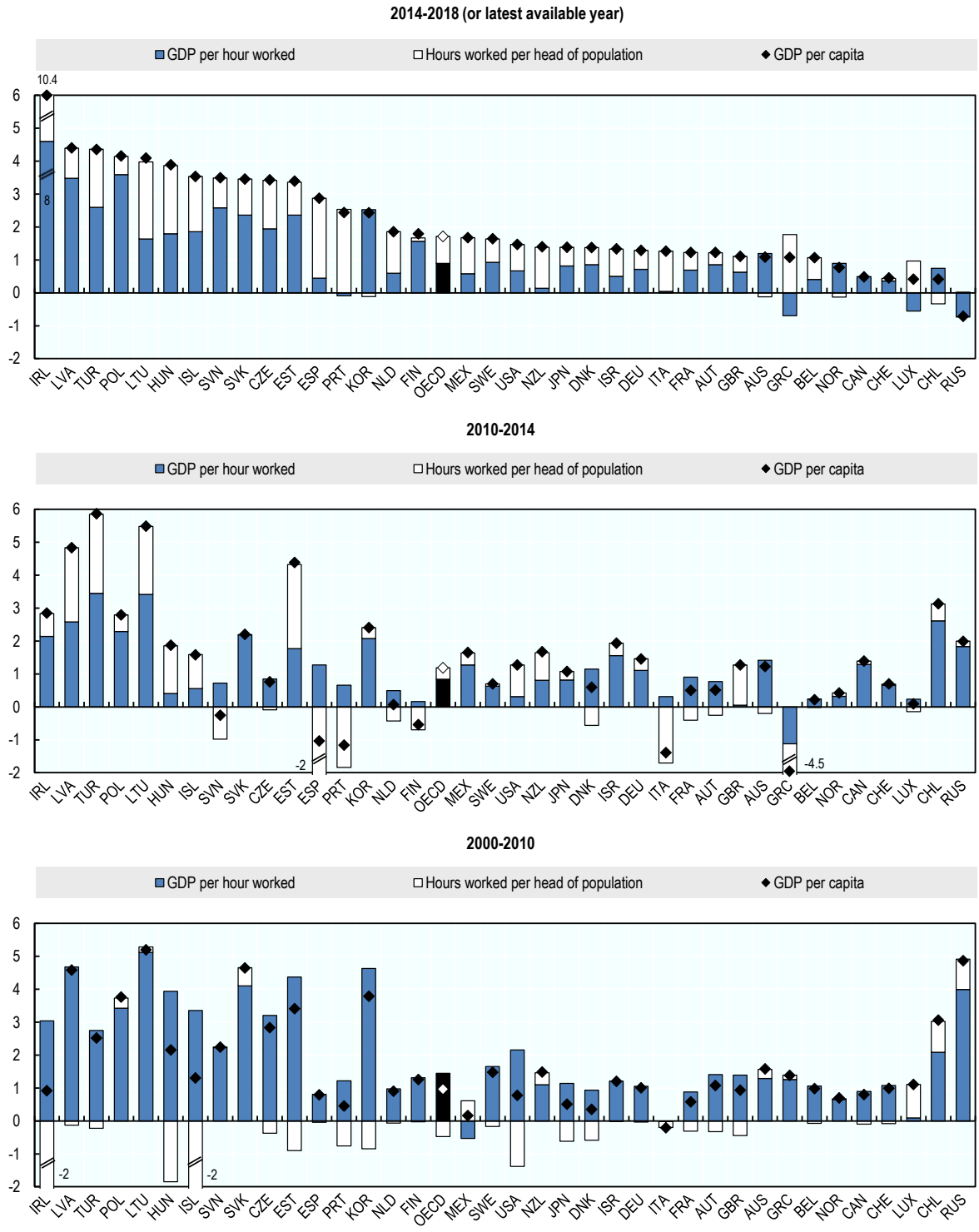
StatLink http://dx.doi.org/10.1787/888933967984

## Employment rates have climbed to historic highs

Weak productivity growth restricts the potential for economic growth and improvements in living standards. Unlike in the pre-crisis period, where productivity was the main driver of economic growth, since 2010, contributions from labour utilisation, i.e. hours worked per head of population, have been the main driver of growth in GDP per capita in many countries (Figure 1.6), with the contributions increasing significantly in nearly all countries. In Italy, New Zealand and Portugal, and to a lesser extent the Netherlands and Spain, GDP per capita growth was almost entirely driven by labour utilisation.

**Figure 1.6. Growth in GDP per capita, labour productivity and labour utilisation**

Total economy, percentage rate at annual rate



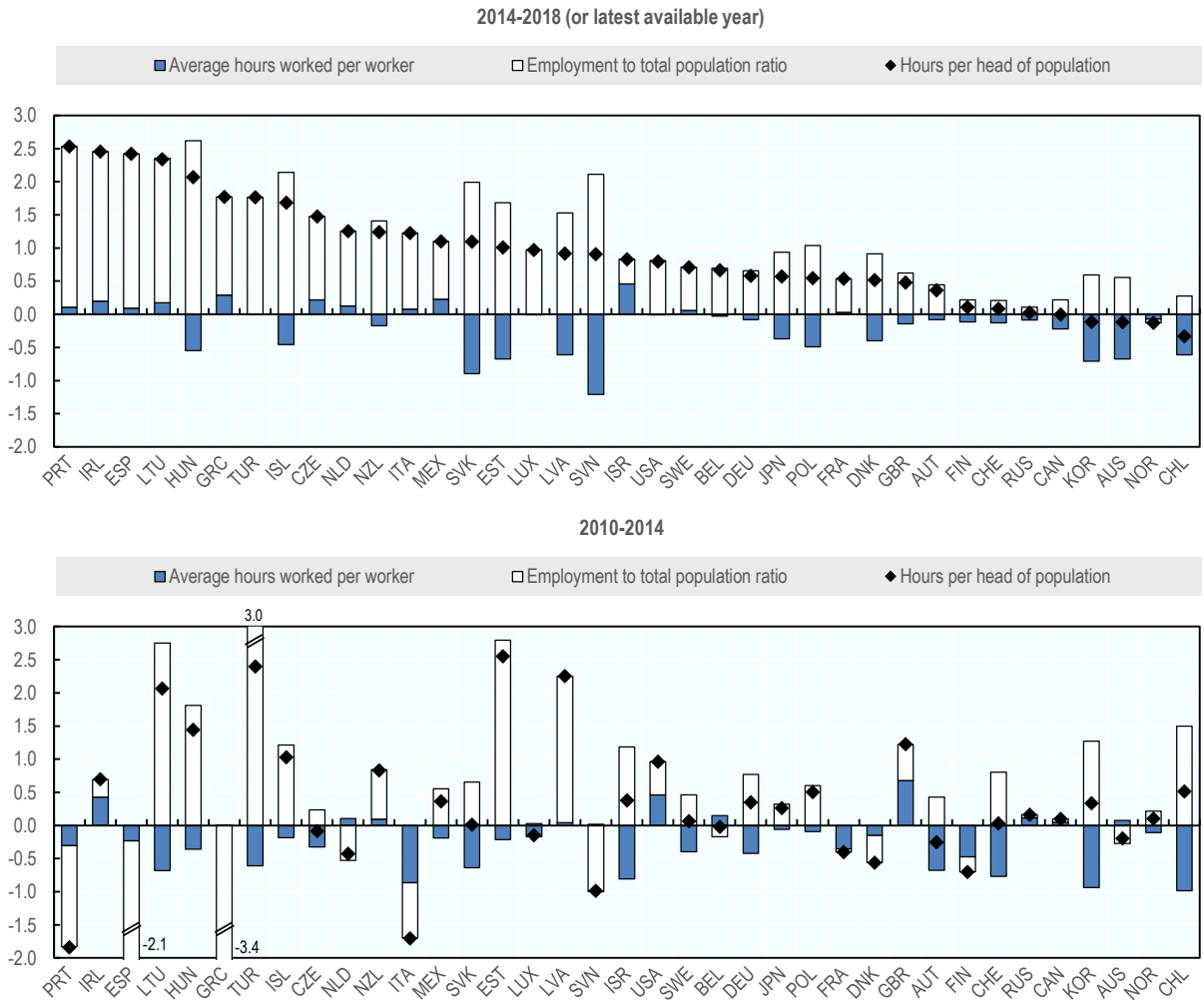

*Source*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, March 2019.

StatLink http://dx.doi.org/10.1787/888933968003

Post-crisis increases in labour utilisation have been largely driven by increasing employment almost across the board (Figure 1.7), with employment rates climbing to historic highs in most countries (Figure 1.8) (OECD, 2018b). However, demographic changes, in particular population ageing, limit the potential for labour utilisation to act as a sustainable source of economic growth (OECD, 2017).

**Figure 1.7. Sources of growth in labour utilisation after the crisis**

Total economy, percentage rate at annual rate

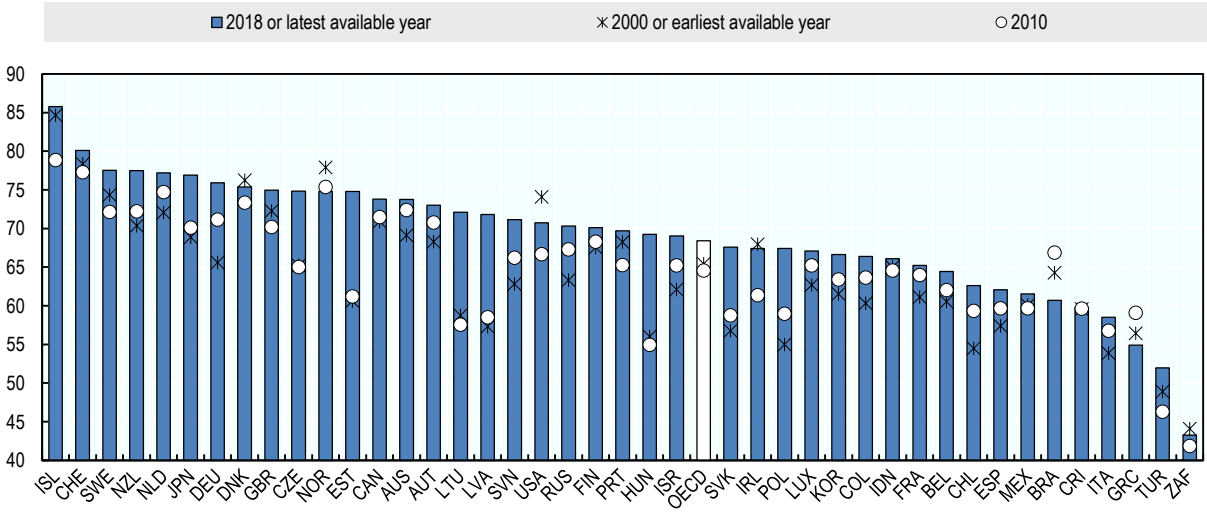



*Sources*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, February 2019.

StatLink http://dx.doi.org/10.1787/888933968022

**Figure 1.8. Employment rates**

Employment to 15-64 aged population ratio, all persons, percentage



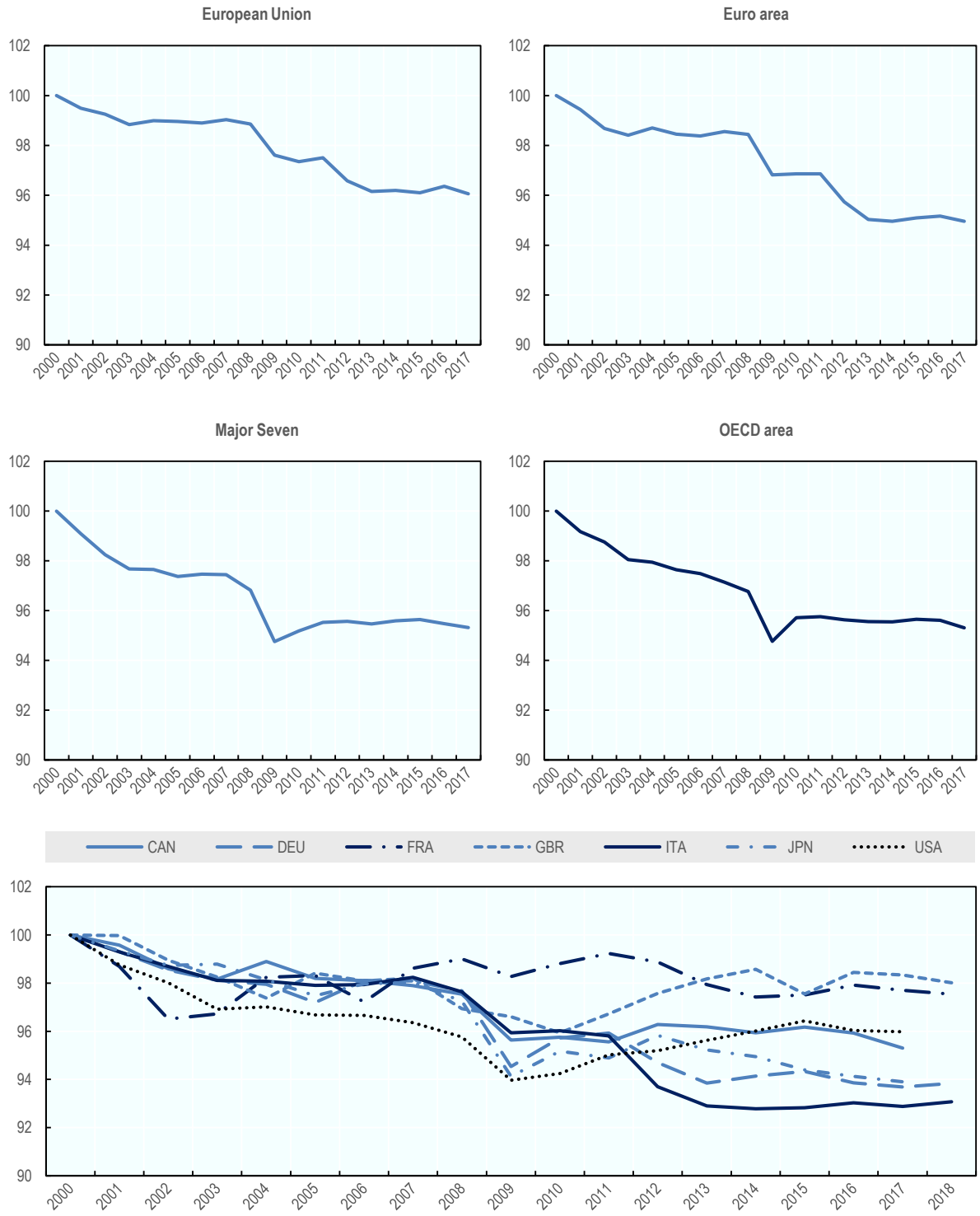

*Sources*: *OECD Employment and Labour Market Statistics* (database), https://doi.org/10.1787/lfs-data-en, and *OECD Main Economic Indicators* (database), https://doi.org/10.1787/data-00052-en, April 2019.

StatLink http://dx.doi.org/10.1787/888933968041

Changes in average hours worked per person have contributed less to the pick-up in labour utilisation in recent years but of note is the fact that the long-term decline in average hours worked has begun to stabilise in many countries and reverse in some, such as the United Kingdom and the United States (Figure 1.9).

**Figure 1.9. Average hours worked per worker**

Indices, 2000=100




*Source*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, March 2019.

StatLink http://dx.doi.org/10.1787/888933968060

**Box 1.1. Challenges in measuring working time and international labour productivity gaps**

Historically, comparisons of productivity across countries have shown substantial gaps, even between similar-sized economies at a similar stage of development. However, a new OECD study (Ward et al., 2018) reveals smaller gaps when differences in how countries measure labour input, and in particular, average hours worked are accounted for.

In the national accounts framework, for productivity measures, labour input is most appropriately defined by the total number of hours actually worked by all persons engaged in production, i.e. employees and self-employed (OECD, 2001). Hours worked include all hours effectively used in production, whether paid or not, but they exclude hours not used in production (e.g. annual and sickness leave), even if some compensation is received for them. In practice, countries adopt one of two methods to estimate average hours worked for productivity estimates:

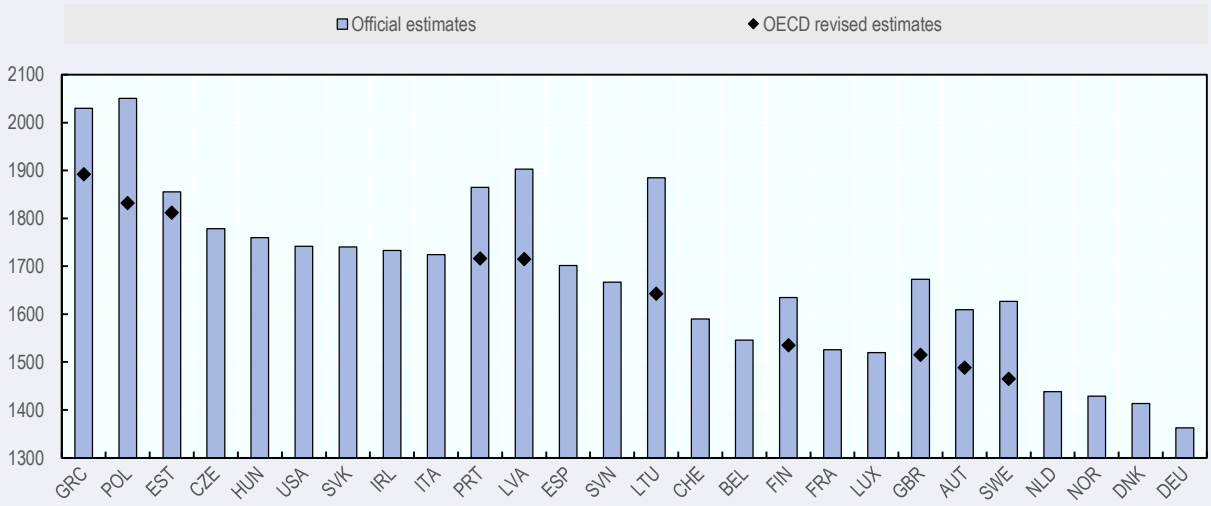
- the direct method, which takes actual hours worked self-reported by respondents in surveys, generally labour force surveys (LFS); and
- the component method, which starts from contractual, paid or usual hours per week from establishment surveys, administrative sources or, indeed, the LFS, with adjustments for absences (e.g. public holidays, annual, sickness and maternity leave) and paid and unpaid overtime and indeed other adjustments that are necessary to align with concepts of output in the national accounts, for example concerning cross-border workers.

While the "direct" approach appeals due to its simplicity, it depends heavily on respondent recall, cannot account for respondents' self-reporting bias, and, moreover, assumes a perfect alignment of workers and measures of output. The component approach is more complex, but it systematically attempts to address these issues. To give some sense of the potential impact of these different approaches on the international comparability of hours worked, the OECD has used the LFS and complementary sources to estimate national hours worked using both a direct approach and a simplified component method.

The results provide strong evidence that response bias and a lack of exhaustive adjustments to align with the underlying conceptual production boundary, lead to systematic upward biases in estimates based on the direct method, which are, in turn, always higher than those compiled using the simplified component approach. Figure 1.10 compares official estimates of hours worked in countries' national accounts with the OECD simplified component method estimates for those countries that currently use a direct method and make minimal or no additional adjustments.

The corollary of an over-estimation of hours worked is an under-estimation of labour productivity levels. Figure 1.11 below presents the impact of the adjustments shown in Figure 1.10 above on labour productivity levels, referenced to the United States. Overall, the results point to a reduction in relative productivity gaps of around 10 percentage points compared with current official estimates in many countries.

**Figure 1.10. Average annual hours worked per worker, selected OECD countries, 2016**

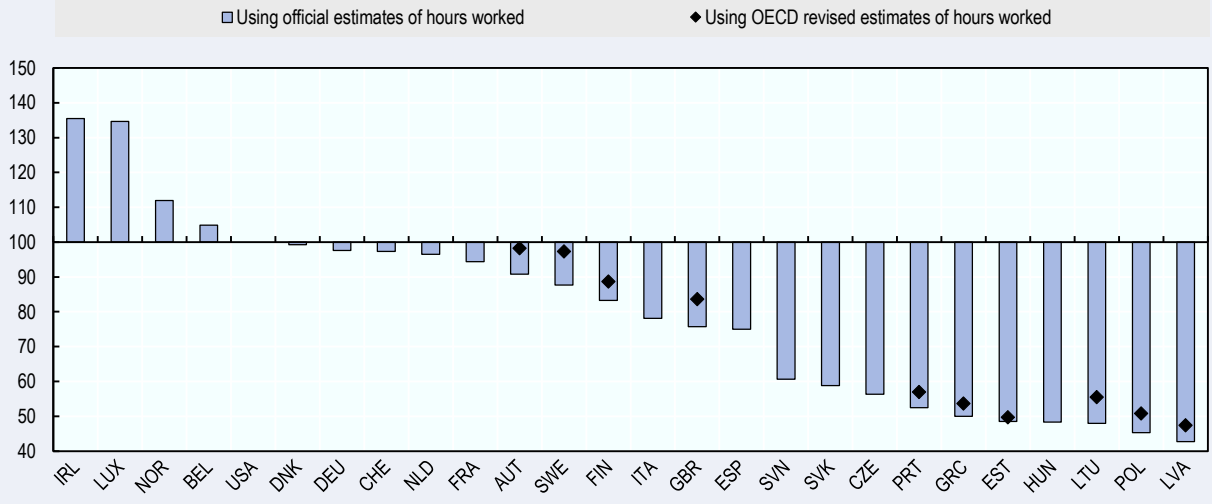



*Source:* Ward, A., M. Zinni and P. Marianna (2018), "International productivity gaps: Are labour input measures comparable?", *OECD Statistics Working Papers, No. 2018/12*, OECD Publishing, Paris, https://doi.org/10.1787/5b43c728-en.

StatLink http://dx.doi.org/10.1787/888933968079

**Figure 1.11. International productivity gaps, 2016**

GDP per hour worked, current prices and current PPPs, total economy, United States = 100




*Source:* Ward, A., M. Zinni and P. Marianna (2018), "International productivity gaps: Are labour input measures comparable?", *OECD Statistics Working Papers, No. 2018/12*, OECD Publishing, Paris, https://doi.org/10.1787/5b43c728-en.

StatLink http://dx.doi.org/10.1787/888933968098

While the results reveal biases in international comparisons of productivity levels, it does not follow that the same holds for international comparisons of productivity growth rates; growth rate estimates would only be distorted if the impact of the adjustments had significantly and disproportionally changed over time. Indeed, implementing the simple component approach reveals no systematic bias in growth rates.

Minor differences do occur however, and, so, to avoid introducing differences with national estimates of productivity growth (and those that can be derived from the countries' national accounts data), the OECD has taken estimates of average hours actually worked (levels) using the simplified component method in 2016 as a benchmark, and projected series forwards and backwards using official (national) growth rates.

At this stage, based on the data available to the OECD, the implementation of the simplified component method has been applied to the following countries: Austria, Estonia, Finland, Greece, Latvia, Lithuania, Poland, Portugal, Sweden and the United Kingdom. These changes have been incorporated into the *OECD Productivity Statistics* (database) and the OECD Average annual hours actually worked per worker dataset as of the end of January 2019, along with corresponding metadata, and are now incorporated in the labour productivity levels available in this publication.

## Most new jobs have been created in low productivity and low paid activities

Compounding the impact of weak productivity growth on material well-being, is the fact that in most OECD economies most jobs have been created in lower labour productivity activities, weighing down, in turn, on overall labour productivity levels (Table 1.1) (OECD, 2018a). Some countries, such as Belgium, Finland, Italy and Spain, have even seen net job destruction in industries with above average labour productivity levels.

In many OECD economies the three sectors generating the largest employment gains between 2010 and 2017 had below average labour productivity, with accommodation and food, and health and residential care activities featuring highly in many economies (Table 1.2). In Belgium, Canada, Italy, Portugal and Sweden, the top three sectors, all with below average labour productivity in 2010, accounted for 40% of total employment creation in the economy between 2010 and 2017, while in the Netherlands, this share was close to 55%. Only a few countries, such as Czech Republic and Poland, had a single sector with above average labour productivity among the three activities with the largest net employment creation. On the other hand, most economies had at least one sector with above average labour productivity among the top three sectors that lost most jobs over the same period; two sectors in the case of Germany and the United Kingdom, and all three in the case of Sweden and the United States (Table 1.3).

Since labour compensation levels typically correlate highly with labour productivity levels, more jobs in low labour productivity activities has also meant more jobs with below average wages in most economies (Table 1.1), weighing down on average salaries in the economy as a whole. For example, the top three sectors with the largest employment gains between 2010 and 2017 in France, Germany and the United Kingdom accounted for one third of total employment creation and paid below average wages (Table 1.2). Similarly, in most countries, in at least one of the top three sectors showing the largest job destruction, wages were above total economy's average; all three in Sweden and the United States (Table 1.3). However, in some countries, one or more of the top three sectors with the largest employment gains had above average productivity and above average wages, as was the case for example of computer programming, related consultancy activities and other information services in Poland and Spain.

**Table 1.1. Change in employment over the period 2010-2017 (or latest available year)**

Thousands of persons; percentage of total employment in 2010 (in brackets)

| | Industries that in 2010 had labour productivity | | Industries that in 2010 had labour compensation | |
|---|---|---|---|---|
| Country | above average | below average | above average | below average |
| AUT | 59 [1.4%] | 258 [6.3%] | 152 [3.7%] | 164 [4.0%] |
| BEL | -20 [-0.5%] | 270 [6.0%] | 69 [1.5%] | 181 [4.1%] |
| CAN | 163 [0.9%] | 510 [2.9%] | 451 [2.6%] | 221 [1.3%] |
| CZE | 161 [3.2%] | 128 [2.5%] | 252 [5.0%] | 37 [0.7%] |
| DEU | 701 [1.7%] | 1 921 [4.7%] | 939 [2.3%] | 1 683 [4.1%] |
| DNK | 43 [1.5%] | 90 [3.2%] | 67 [2.4%] | 66 [2.4%] |
| ESP | -483 [-2.5%] | 354 [1.8%] | -413 [-2.1%] | 285 [1.4%] |
| EST | 26 [4.7%] | 42 [7.7%] | 38 [7.0%] | 30 [5.4%] |
| FIN | -5 [-0.2%] | 66 [2.7%] | 18 [0.7%] | 43 [1.7%] |
| FRA | 212 [0.8%] | 529 [2.0%] | 77 [0.3%] | 664 [2.5%] |
| GBR | 568 [1.9%] | 2 265 [7.7%] | 1 012 [3.5%] | 1 821 [6.2%] |
| GRC | -98 [-2.1%] | -461 [-9.8%] | -180 [-3.8%] | -379 [-8.1%] |
| HUN | 396 [10.0%] | 171 [4.3%] | 395 [9.9%] | 173 [4.4%] |
| IRL | 67 [3.6%] | 192 [10.2%] | 111 [5.9%] | 148 [7.9%] |
| ISL | 7 [4.3%] | 25 [15.4%] | 15 [9.4%] | 17 [10.4%] |
| ITA | -110 [-0.4%] | 170 [0.7%] | -55 [-0.2%] | 115 [0.5%] |
| LTU | 67 [5.4%] | 49 [3.9%] | 74 [5.9%] | 41 [3.3%] |
| LVA | 31 [3.7%] | 12 [1.4%] | 33 [3.9%] | 9 [1.1%] |
| NLD | 53 [0.6%] | 267 [3.0%] | 16 [0.2%] | 304 [3.5%] |
| NOR | 16 [0.6%] | 158 [6.1%] | 111 [4.3%] | 63 [2.4%] |
| POL | 513 [3.3%] | 195 [1.3%] | 536 [3.5%] | 173 [1.1%] |
| PRT | -54 [-1.1%] | -168 [-3.4%] | -31 [-0.6%] | -191 [-3.9%] |
| SVK | 54 [2.5%] | 148 [6.8%] | 79 [3.6%] | 123 [5.7%] |
| SVN | 12 [1.3%] | 13 [1.4%] | 30 [3.1%] | -4 [-0.5%] |
| SWE | 34 [0.8%] | 345 [7.7%] | 89 [2.0%] | 290 [6.4%] |
| USA | 3 893 [2.8%] | 8 312 [5.9%] | 2 636 [1.9%] | 9 569 [6.8%] |

*Notes*: Average labour productivity and average labour compensation per employee are measured as gross value added per person employed and compensation per employee in the total economy of the country. Data for Canada refer to the period 2010-2013 and shows thousands of jobs created over that period. Data for France, Germany, Italy, Latvia, Lithuania, Norway, Poland, Portugal, Sweden and the United States refer to 2010-2016. Information provided for the United States follows a broader industry breakdown and comparisons with other countries needs some caution. Figures in the table refer to net jobs created/lost in a given sector over the period.

*Sources: OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, and *OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en, March 2019.

StatLink http://dx.doi.org/10.1787/888933968117

**Table 1.2. Net employment creation between 2010 and 2017 (or latest available year)**

Three sectors with largest net employment creation, largest 15 OECD economies (where data exist)

| Country | Sectors with largest net job creation between 2010 and 2017 | Jobs created (net), in number of persons | Net job creation in the sector, % of total net job creation between 2010 and 2017 | Labour productivity of the sector in 2010, % of total economy labour productivity | Compensation per employee in the sector in 2010, % of compensation per employee in the economy |
|---|---|---|---|---|---|
| AUT | I_55_56 (Accommodation and food service activities) | 38 600 | 10% | 75% | 66% |
| | P85 (Education) | 36 200 | 9% | 84% | 117% |
| | Q_87_88 (Residential care activities; social work activities without accommodation) | 33 400 | 9% | 42% | 69% |
| BEL | M_69_70 (Legal and account activities; activities of head offices; management consultancy activities) | 55 300 | 16% | 102% | 178% |
| | N_80_82 (Security and investigation; services to buildings and landscape; office administrative and support) | 51 200 | 15% | 50% | 79% |
| | Q_87_88 (Residential care activities; social work activities without accommodation) | 48 400 | 14% | 48% | 86% |
| CAN | G47 (Retail trade, except of motor vehicles and motorcycles) | 141 450 | 18% | 43% | 52% |
| | F_41_42_43 (Construction) | 132 350 | 17% | 97% | 114% |
| | I_55_56 (Accommodation and food service activities) | 56 200 | 7% | 32% | 42% |
| CZE | C29 (Manufacture of motor vehicles, trailers and semi-trailers) | 53 900 | 12% | 147% | 115% |
| | P85 (Education) | 37 400 | 8% | 76% | 105% |
| | C25 (Manufacture of fabricated metal products, except machinery and equipment) | 33 900 | 8% | 72% | 89% |
| DEU | Q86 (Human health activities) | 434 000 | 14% | 77% | 94% |
| | Q_87_88 (Residential care activities; social work activities without accommodation) | 426 000 | 14% | 37% | 59% |
| | N_80_82 (Security and investigation; services to buildings and landscape; office administrative and support) | 257 000 | 8% | 39% | 50% |
| ESP | I_55_56 (Accommodation and food service activities) | 185 600 | 19% | 93% | 87% |
| | J_62_63 (Computer programming, consultancy and related activities; information service activities) | 93 200 | 10% | 114% | 137% |
| | S96 (Other personal service activities) | 74 700 | 8% | 44% | 53% |
| FRA | Q86 (Human health activities) | 141 000 | 11% | 86% | 95% |
| | N78 (Employment activities) | 137 000 | 11% | 52% | 79% |
| | Q_87_88 (Residential care activities; social work activities without accommodation) | 135 000 | 11% | 46% | 66% |
| GBR | I_55_56 (Accommodation and food service activities) | 379 800 | 12% | 40% | 47% |
| | N_80_82 (Security and investigation; services to buildings and landscape; office administrative and support) | 282 400 | 9% | 43% | 49% |
| | M_69_70 (Legal and account activities; activities of head offices; management consultancy activities) | 265 800 | 8% | 94% | 93% |
| HUN | O84 (Public administration and defence; compulsory social activity) | 68 300 | 9% | 102% | 119% |
| | M_69_70 (Legal and account activities; activities of head offices; management consultancy activities) | 64 300 | 9% | 152% | 205% |
| | G46 (Wholesale trade, except of motor vehicles and motorcycles) | 62 000 | 9% | 162% | 176% |
| ITA | I_55_56 (Accommodation and food service activities) | 218 400 | 20% | 68% | 76% |
| | T_97_98 (Activities of households as employers; production activities of private households for own use) | 102 700 | 10% | 21% | 35% |
| | N78 (Employment activities) | 97 900 | 9% | 46% | 75% |
| NLD | N78 (Employment activities) | 208 000 | 35% | 41% | 61% |
| | I_55_56 (Accommodation and food service activities) | 78 000 | 13% | 39% | 44% |
| | G47 (Retail trade, except of motor vehicles and motorcycles) | 44 000 | 7% | 43% | 45% |
| POL | C29 (Manufacture of motor vehicles, trailers and semi-trailers) | 90 000 | 7% | 96% | 86% |
| | O84 (Public administration and defence; compulsory social activity) | 82 000 | 7% | 93% | 146% |
| | J_62_63 (Computer programming, consultancy and related activities; information service activities) | 78 000 | 6% | 156% | 158% |
| PRT | Q_87_88 (Residential care activities; social work activities without accommodation) | 26 300 | 14% | 51% | 70% |
| | I_55_56 (Accommodation and food service activities) | 24 550 | 13% | 85% | 79% |
| | N_80_82 (Security and investigation; services to buildings and landscape; office administrative and support) | 24 600 | 13% | 50% | 65% |
| SWE | Q_87_88 (Residential care activities; social work activities without accommodation) | 85 000 | 19% | 55% | 82% |
| | P85 (Education) | 55 000 | 12% | 54% | 75% |
| | I_55_56 (Accommodation and food service activities) | 49 000 | 11% | 44% | 63% |
| USA | Q_86_87_88 (Human health and social work activities) | 1 682 000 | 13% | 55% | 82% |
| | I_55_56 (Accommodation and food service activities) | 1 388 000 | 11% | 36% | 44% |
| | M_69_to_75 (Professional, scientific and related activities) | 1 286 000 | 10% | 146% | 196% |

*Notes*: Average labour productivity and average labour compensation per employee are measured as gross value added per person employed and compensation per employee in the total economy of the country. Data for Canada refer to 2010-2013 and show thousands of jobs created over that period. Data for France, Germany, Italy, Poland, Portugal, Sweden and the United States refer to 2010-2016. Information provided for the United States follows a broader industry breakdown and comparisons with other countries needs some caution.

*Sources*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, and *OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en, March 2019.

StatLink http://dx.doi.org/10.1787/888933968136

**Table 1.3. Net employment destruction between 2010 and 2017 (or latest available year)**

Three sectors with largest net employment destruction, largest 15 OECD economies (where data exist)

| Country | Sectors with largest net job destruction between 2010 and 2017 | Jobs destroyed (net), in number of persons | Net job destruction in the sector, % of total net job destruction between 2010 and 2017 | Labour productivity of the sector in 2010, % of total economy labour productivity | Compensation per employee in the sector in 2010, % of compensation per employee in the economy |
|---|---|---|---|---|---|
| AUT | A01 (Crop and animal production, hunting and related service activities) | -28 850 | 43% | 24% | 46% |
| | K64 (Financial service activities, except insurance and pension funding) | -9 500 | 14% | 168% | 169% |
| | C_31_32 (Manufacture of furniture, other manufacturing) | -4 600 | 7% | 78% | 84% |
| BEL | K64 (Financial service activities, except insurance and pension funding) | -8 800 | 9% | 297% | 212% |
| | C_13_15 (Manufacture of textiles, wearing apparel; leather and related products) | -7 600 | 8% | 81% | 99% |
| | C29 (Manufacture of motor vehicles, trailers and semi-trailers) | -6 800 | 7% | 113% | 142% |
| CAN | N_80_82 (Security and investigation; services to buildings and landscape; office administrative and support) | -21 750 | 19% | 51% | 73% |
| | O84 (Public administration and defence; compulsory social activity) | -12 350 | 11% | 115% | 141% |
| | C_13_15 (Manufacture of textiles, wearing apparel; leather and related products) | -7 560 | 7% | 54% | 75% |
| CZE | F_41_42_43 (Construction) | -69 150 | 46% | 74% | 86% |
| | G47 (Retail trade, except of motor vehicles and motorcycles) | -27 300 | 18% | 55% | 69% |
| | O84 (Public administration and defence; compulsory social activity) | -9 900 | 7% | 109% | 127% |
| DEU | O84 (Public administration and defence; compulsory social activity) | -173 000 | 36% | 95% | 124% |
| | J58 (Publishing activities) | -47 000 | 10% | 99% | 95% |
| | A01 (Crop and animal production, hunting and related service activities) | -41 000 | 8% | 43% | 54% |
| ESP | F_41_42_43 (Construction) | -512 300 | 46% | 107% | 104% |
| | T_97_98 (Activities of households as employers; production activities of private households for own use) | -76 400 | 7% | 28% | 44% |
| | K64 (Financial service activities, except insurance and pension funding) | -59 400 | 5% | 235% | 214% |
| FRA | F_41_42_43 (Construction) | -101 000 | 19% | 88% | 102% |
| | G45 (Wholesale and retail trade and repair of motor vehicles and motorcycles) | -44 000 | 8% | 77% | 91% |
| | T_97_98 (Activities of households as employers; production activities of private households for own use) | -42 000 | 8% | 29% | 58% |
| GBR | O84 (Public administration and defence; compulsory social activity) | -259 100 | 58% | 99% | 119% |
| | K64 (Financial service activities, except insurance and pension funding) | -61 200 | 14% | 297% | 231% |
| | C18 (Printing and reproduction of recorded media) | -31 200 | 7% | 75% | 92% |
| HUN | A01 (Crop and animal production, hunting and related service activities) | -29 250 | 19% | 49% | 63% |
| | H49 (Land transport and transport via pipelines) | -20 400 | 13% | 64% | 69% |
| | C13_15 (Manufacture of textiles, wearing apparel; leather and related products) | -17 460 | 11% | 29% | 41% |
| ITA | F_41_42_43 (Construction) | -354 400 | 35% | 73% | 91% |
| | O84 (Public administration and defence; compulsory social activity) | -131 100 | 13% | 130% | 148% |
| | C23 (Manufacture of other non-metallic mineral products) | -57 500 | 6% | 87% | 103% |
| NLD | F_41_42_43 (Construction) | -54 000 | 20% | 90% | 120% |
| | Q_87_88 (Residential care activities; social work activities without accommodation) | -38 000 | 14% | 40% | 68% |
| | O84 (Public administration and defence; compulsory social activity) | -36 000 | 13% | 128% | 137% |
| POL | A01 (Crop and animal production, hunting and related service activities) | -319 000 | 65% | 20% | 86% |
| | F_41_42_43 (Construction) | -50 000 | 10% | 107% | 89% |
| | C_13_15 (Manufacture of textiles, wearing apparel; leather and related products) | -32 000 | 7% | 40% | 48% |
| PRT | F_41_42_43 (Construction) | -159 900 | 39% | 65% | 75% |
| | A01 (Crop and animal production, hunting and related service activities) | -103 500 | 25% | 15% | 44% |
| | O84 (Public administration and defence; compulsory social activity) | -29 900 | 7% | 129% | 159% |
| SWE | C26 (Manufacture of computer, electronic and optical products) | -22 000 | 29% | 276% | 144% |
| | C28 (Manufacture of machinery and equipment n.e.c.) | -8 000 | 11% | 125% | 108% |
| | C17 (Manufacture of paper and paper products) | -5 000 | 7% | 157% | 128% |
| USA | O84 (Public administration and defence; compulsory social activity) | -296 000 | 80% | 148% | 184% |
| | C26 (Manufacture of computer, electronic and optical products) | -66 000 | 18% | 384% | 328% |
| | C19 (Manufacture of coke and refined petroleum products) | -10 000 | 3% | 670% | 144% |

*Notes*: Average labour productivity and average labour compensation per employee are measured as gross value added per person employed and compensation per employee in the total economy of the country. Data for Canada refer to the period 2010-2013 and shows thousands of jobs created over that period. Data for Belgium, France, Germany, Italy, Poland, Portugal, Sweden, the United Kingdom and the United States refer to 2010-2016. Information provided for the United States follows a broader industry breakdown and comparisons with other countries needs some caution.

*Sources*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, and *OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en, March 2019.

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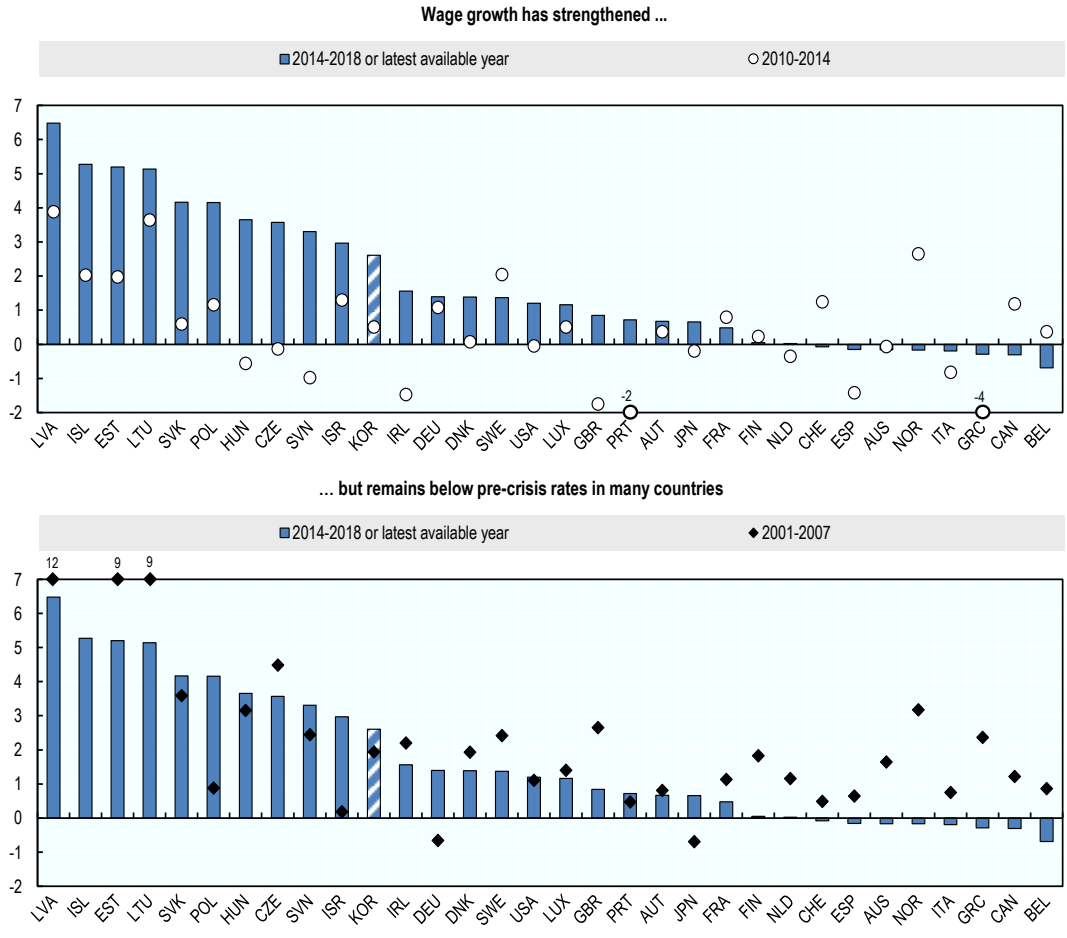
## Wage growth has recovered in many countries but remains below pre-crisis rates in most countries

The sharp increase in unemployment rates at the height of the crisis was followed by a significant slowdown in wage growth in many countries (OECD, 2018b). While unemployment rates are now below, or close to, pre-crisis levels in many countries – with record lows in some - wage growth remains sluggish. Growth in real wages, adjusted for inflation (using the consumer price index), has improved almost across the board in recent years compared with the early recovery period, but remains below pre-crisis rates in two thirds of OECD countries (Figure 1.12). In many countries, e.g. Ireland, Portugal, and the United Kingdom, recent growth in real wages has come on the back of declines in purchasing power in the years following the crisis. However, in many other countries, real wages have barely increased (e.g. Finland, the Netherlands) or even declined (e.g. Canada, Belgium) in recent years.

**Figure 1.12. Growth in real wages before and after the crisis**

Compensation per hour worked (employees), total economy, CPI all items-deflated, percentage change at annual rate




*Note*: Data for Korea refer to real average compensation per employee.
*Sources*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, *OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en, and *OECD Main Economic Indicators* (database), https://doi.org/10.1787/data-00052-en, March 2019.

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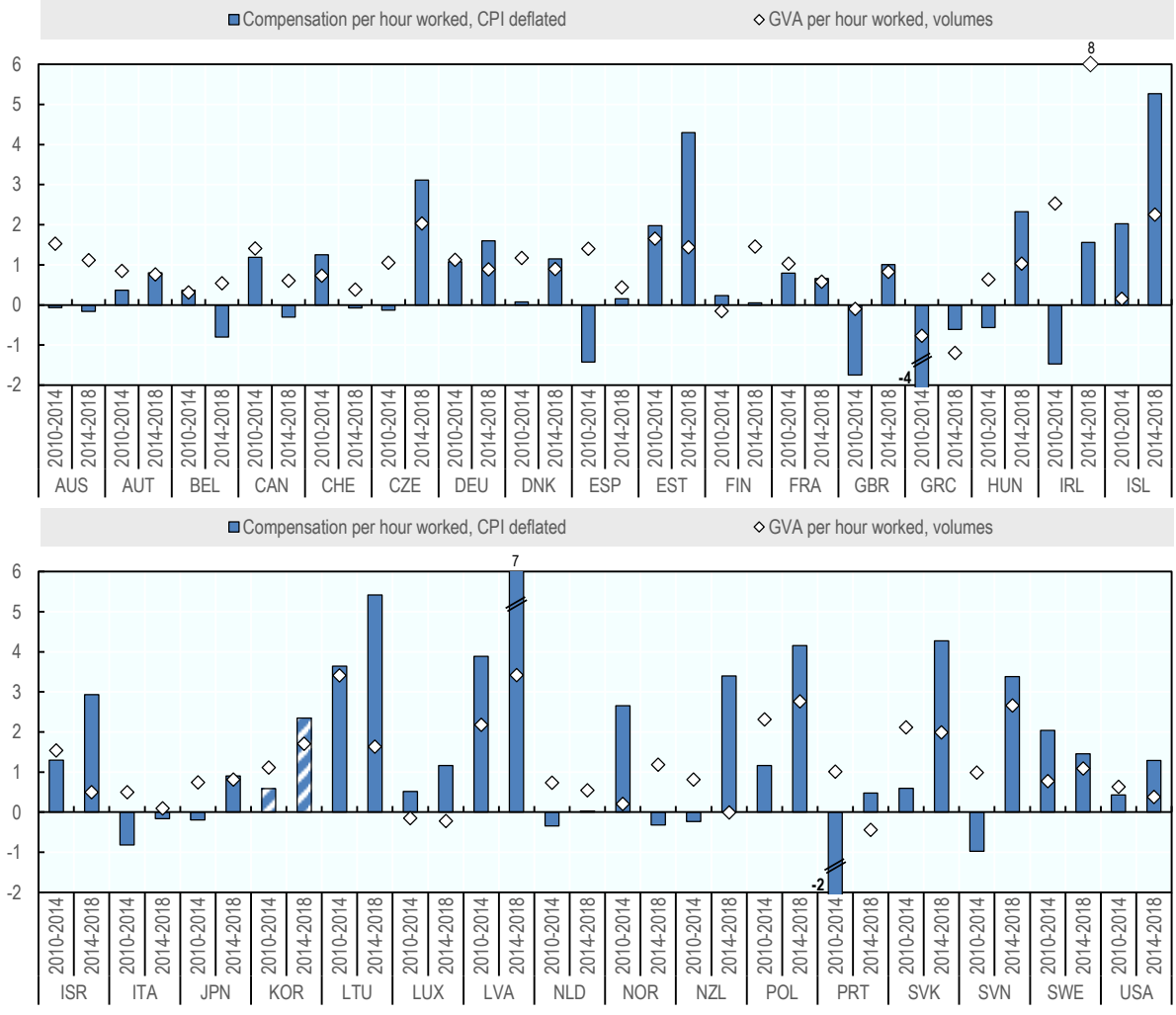
Sluggish wage growth is in part a function of slowing productivity growth (OECD, 2018b), but in many countries there are signs that the post-crisis decoupling of wage and productivity growth is beginning to unwind (Figure 1.13) (OECD, 2017; OECD, 2018a), in particular in those economies where employment rates are high.

**Figure 1.13. Growth in labour productivity and average labour compensation per hour, total economy**

Percentage change at annual rate




*Notes*: The 2014-2018 period corresponds to 2014-2018 or latest available year. For Korea, labour productivity refers to gross value added volume per person employed and labour compensation refers to average real compensation per employee.

*Sources*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, *OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en, and *OECD Main Economic Indicators* (database), https://doi.org/10.1787/data-00052-en, March 2019.

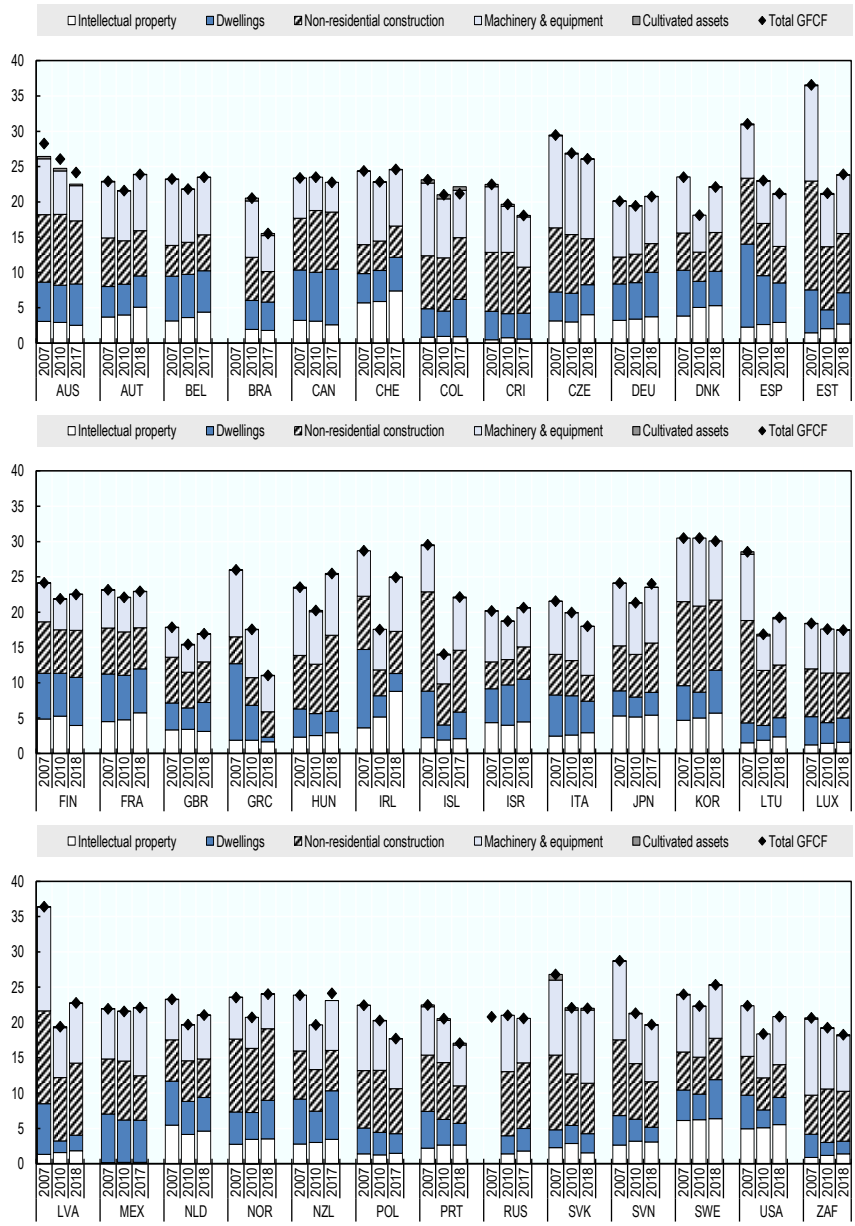
StatLink http://dx.doi.org/10.1787/888933968193

Recent increases in wages may in turn help to boost productivity growth. In some economies, such as Canada, the United Kingdom and the United States, slack in the labour market appears to have allowed firms to defer investment decisions (Figure 1.14) and instead meet increased demand through higher (including temporary) labour utilisation, especially with labour costs lagging investment costs

(Figure 1.15). With labour costs beginning to rise in many countries, however, firms may begin to reconsider investment decisions, but political uncertainties, trade tensions and the erosion of business and consumer confidence (OECD, 2019a), may continue to weigh down on the recovery in investment (Figure 1.14) and productivity growth.

**Figure 1.14. Investment rates**

Total economy, gross fixed capital formation by asset type as a percentage of GDP




*Sources*: *OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en, IBGE and ROSSTAT, March 2019.

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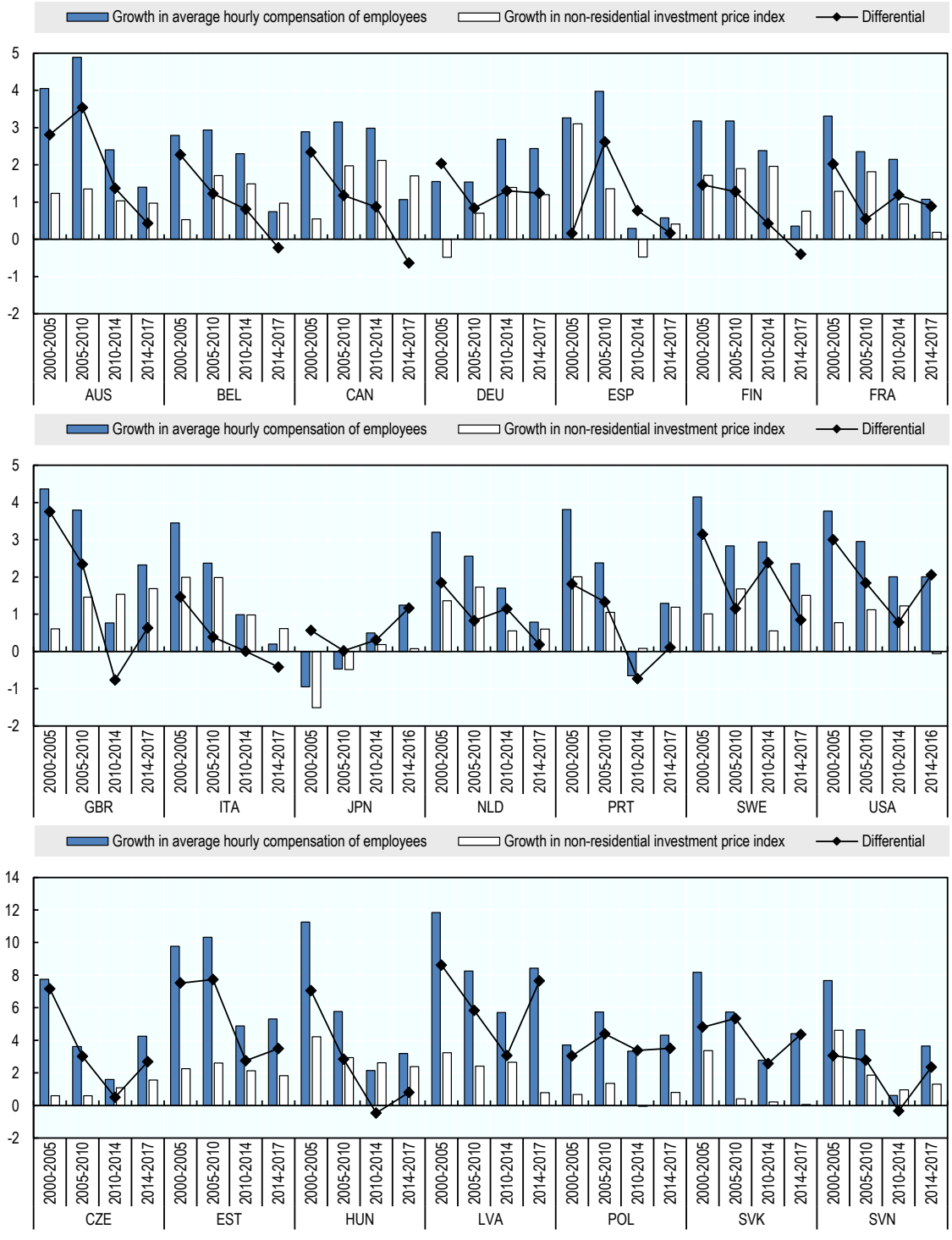
**Figure 1.15. Growth differential between labour costs and investment prices**

Selected OECD countries, total economy, percentage change at annual rate




*Sources*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, and *OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en, March 2019.

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## Conclusions

Ten years after the global financial crisis productivity growth remains weak in most economies. Economic growth over this period has been sustained by job creation, but with employment rates climbing to historic highs in many economies the contribution from higher employment will inevitably begin to wane. Higher employment rates appear, at least in part, to be a post-crisis effect. The slack in labour markets and downward pressure on wages may have allowed firms to defer investment decisions and instead increase employment, undermining, in turn, the potential for investment driven productivity growth. The fact that most of these new jobs have been in activities with relatively low productivity and low wages has compounded the impact of lower investment. With labour costs beginning to rise in many countries, firms may begin to reconsider investment decisions, but political uncertainties, trade tensions and the erosion of business and consumer confidence may continue to weigh down on investment. As higher employment cannot be an indefinite source of growth, policies to kick-start the investment engine, to capitalise on mega-trends such as efficiencies and economies of scale provided by the digital transformation, or to stimulate growth in higher productivity activities, are essential (OECD, 2019a; OECD, 2019c).

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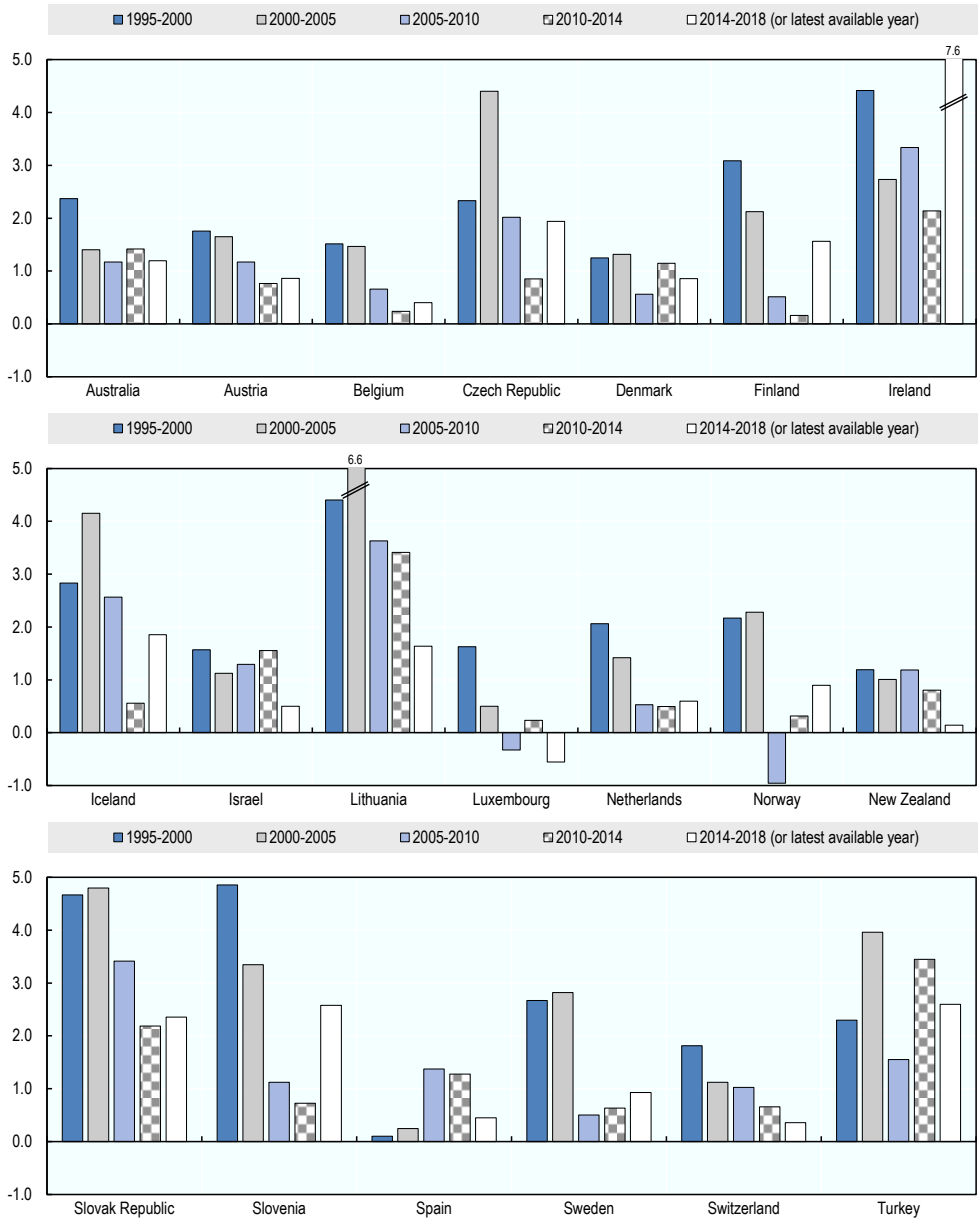
# Annex 1.A.

**Annex Figure 1.A.1. Labour productivity growth in the OECD**

GDP per hour worked, percentage rate at annual rate




*Source*: *OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en, March 2019.

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# Chapter 2. **Economic growth and productivity**

Size of GDP
Growth in GDP per capita
GDP per capita convergence
Labour productivity
Alternative measures of labour productivity
Alternative measures of income
Capital productivity and the role of ICT and intangible assets
Growth accounting
Multifactor productivity

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## Size of GDP

Gross Domestic Product (GDP) is the standard measure of the value of final goods and services produced in a country during a given period of time minus the value of imports. GDP per capita is a core indicator of economic performance and commonly used as a broad measure of average living standards or economic well-being.

**Key findings**

In 2017, the size of GDP for the OECD as a whole was USD 56 613 billion based on current PPPs. G7 countries accounted for almost 70% of that total. GDP per capita was on average USD 44 300 for the OECD area and USD 12 900 on average for the BRIICS, and there are also large disparities in GDP per capita across OECD countries. Within the OECD, GDP per capita was above USD 50 000 in Australia, Austria, Denmark, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Sweden, Switzerland and the United States and less than half the OECD average in Mexico. Similar disparities exist among the BRIICS. GDP per capita in the Russian Federation was twice the BRIICS average and almost four times higher than in India.

GDP growth remains below pre-crisis rates in most countries, particularly in Finland, Greece, Spain, the Baltic States and most Eastern European economies. GDP growth has also eased significantly in Brazil, the Russian Federation and South Africa and although growth in China remains high relative to other large economies, it too has slowed considerably compared to the pre-crisis period.

### *Definition*

Countries measure GDP in their own currencies. In order to compare these estimates across countries, they have to be converted into a common currency. The conversion is often made using current exchange rates but these can give a misleading comparison of the true volumes of final goods and services measured in the GDP. A better approach is to use purchasing power parities (PPPs), which are currency converters that control for differences in the price levels between countries and allow an international comparison of the volumes of GDP and the size of economies (Chapter 8. ).

### *Comparability*

GDP measures are generally very comparable across countries, although not all countries have yet implemented the latest international standards for the compilation of national accounts, the System of National Accounts 2008 (2008 SNA), which can have an impact on comparisons of GDP across countries. Indeed, data reported here for Colombia are in line with the 1993 SNA. The measurement of the non-observed economy can also affect comparability as exhaustive coverage of production activities missed by the statistical system can be difficult to achieve and national estimates may differ in their coverage of non-observed activities. The size of the non-observed economy is generally larger in emerging economies reflecting, in part, the higher degree of informal activities and employment.

Population estimates are comparable across countries. However, some care is needed in interpretation: for example Luxembourg and, to a lesser extent, Switzerland, have a relatively large number of frontier workers. Such workers contribute to GDP but are excluded from the population figures, which is one of the reasons why cross-country comparisons of income per capita based on gross or net national income are also relevant.

## References

*OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.

OECD (2002), *Measuring the Non-Observed Economy: A Handbook*, International Labour Office, Geneva 22/IMF, Washington D.C./CIS STAT, Moscow/OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264175358-en.

**Figure 2.1. Gross domestic product, current PPPs and current exchange rates**

The seven largest economies in the OECD, percentage of OECD total, 2017

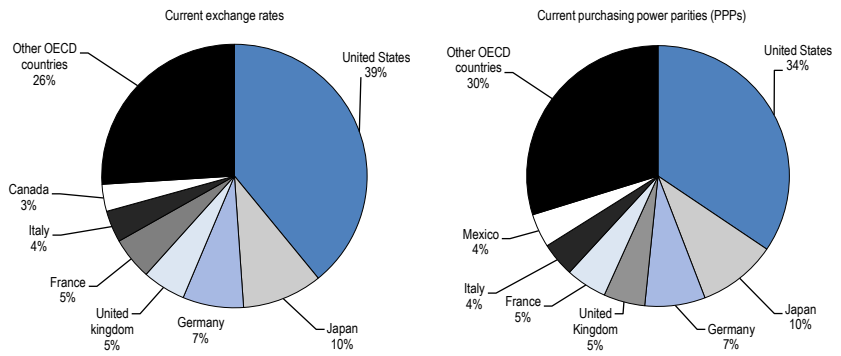


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**Figure 2.2. Growth in gross domestic product**

Volume, percentage change at annual rate

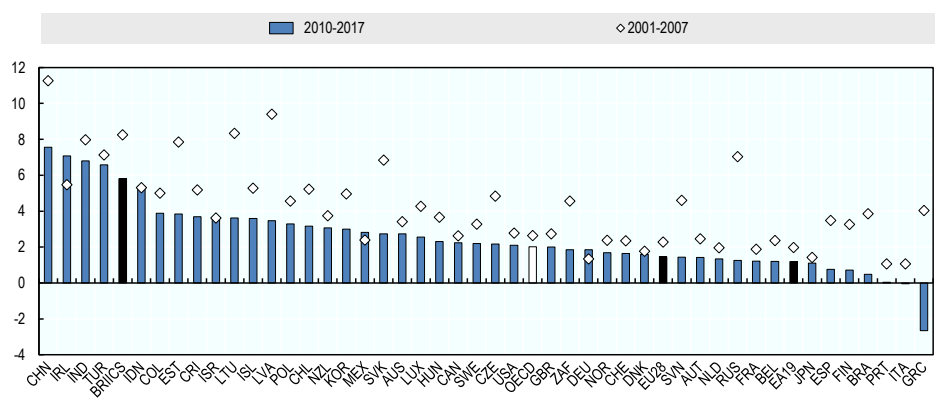


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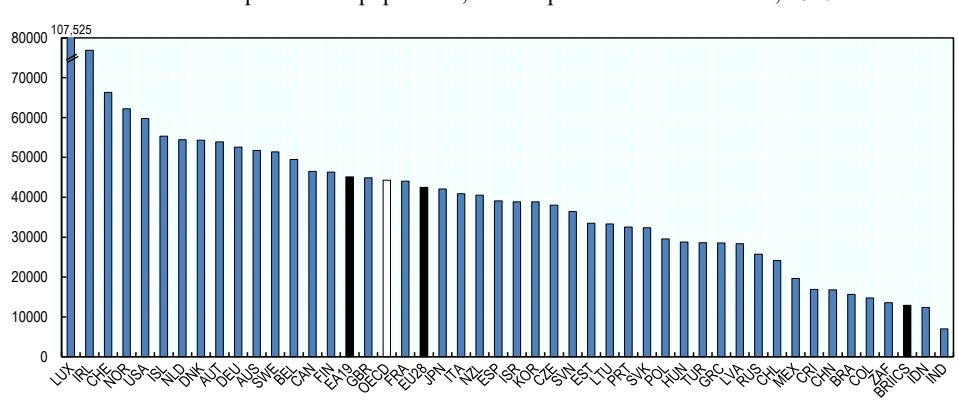
**Figure 2.3. GDP per capita**

US dollar per head of population, current prices and current PPPs, 2017

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## Growth in GDP per capita

Gross Domestic Product (GDP) per capita measures economic activity or income per person and is one of the core indicators of economic performance. Growth in GDP per capita can result from changes in labour productivity (GDP per hour worked) and labour utilisation (hours worked per capita). A slowing or declining rate of labour utilisation combined with high labour productivity growth can be indicative of a greater use of capital and/or of structural shifts to higher-productivity activities.

**Key findings**

Differences in GDP per capita growth across countries can be mainly attributed to differences in labour productivity growth. While labour productivity growth remains a significant driver of growth, it has slowed across the board in recent years. In Estonia, Hungary, Iceland, Lithuania, New Zealand, Turkey, the United Kingdom and the United States, in particular, increased labour utilisation rates were significant drivers of growth. In many other countries, including some large European economies, growth in labour utilisation rates slowed considerably, and in many, labour utilisation rates fell.

### *Definition*

Growth in GDP per capita is calculated using GDP and population series published in the *OECD National Accounts Statistics* (database). Labour productivity is measured as GDP per hour worked and labour utilisation as hours worked per capita. Total hours worked are primarily sourced from the *OECD National Accounts Statistics* (database). For some countries, however, longer time series and/or more recent estimates need to be derived from the *OECD Employment and Labour Market Statistics* (database), the *OECD Economic Outlook: Statistics and Projections* (database) and national statistical offices (Chapter 8. ).

### *Comparability*

Most countries derive annual estimates of real GDP using annually chain-linked volume indices. However, China, India, Indonesia, Mexico and South Africa currently produce fixed-base volume estimates with the base year updated less periodically. The System of National Accounts 2008 (2008 SNA) recommends the production of estimates on the basis of annual chain volume series. These produce better estimates of growth as the weights used for the contribution of different goods and services are more relevant to the period in question.

## References

*OECD Economic Outlook: Statistics and Projections* (database), http://dx.doi.org/10.1787/eo-data-en.
*OECD Employment and Labour Market Statistics* (database), http://dx.doi.org/10.1787/lfs-data-en.
*OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.
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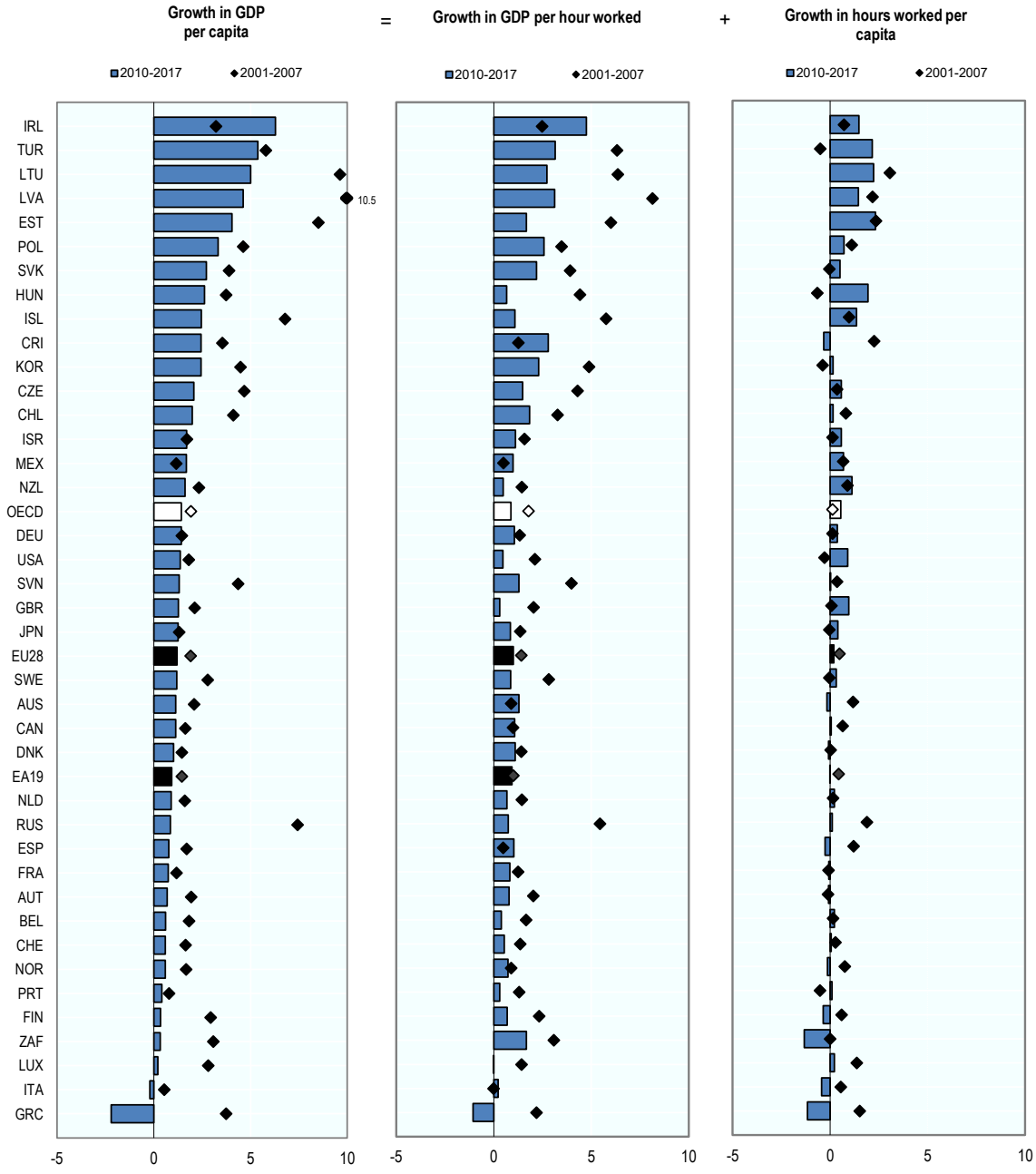
OECD (2001), *Measuring Productivity – OECD Manual*, http://dx.doi.org/10.1787/9789264194519-en.

**Figure 2.4. Contributions to growth in GDP per capita**

Total economy, percentage change at annual rate

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## GDP per capita convergence

GDP per capita convergence, often described as the catch-up process, refers to the process by which less advanced economies with lower-income per capita converge towards more advanced economies through higher growth rates, as they capitalise on technology transfer, inward investment, and relatively lower labour costs.

**Key findings**

Between 2001 and 2017, gaps in GDP per capita with respect to the United States have narrowed significantly in most emerging economies (except Brazil and South Africa), the Baltic States and Eastern European countries, although the pace of convergence has slowed. In addition, in countries severely hit by the financial crisis, such as Greece, Italy and Portugal, gaps widened. In 2017, GDP per capita levels were more than 50% lower than those of the United States in the BRIICS, Latin American countries, Greece, Hungary, Latvia, Poland and Turkey.

### *Definition*

GDP is measured as gross value added in market prices. Data on GDP at current prices are sourced from the *OECD National Accounts Statistics* (database). For international comparisons, these data are converted to a common currency, US dollars, using *Purchasing Power Parities* (PPPs). Unlike currency exchange rates, the PPPs are currency converters that control for differences in the price levels between countries, making possible to compare absolute volumes across them (Chapter 8. ).

### *Comparability*

For Colombia, indicators are based on the System of National Accounts 1993 (1993 SNA). For the Russian Federation, the indicators are on a 1993 SNA basis for data up to 2010 and 2008 SNA thereafter. For all the other countries, the indicators presented are based on the 2008 SNA. The 2008 SNA includes items such as the capitalisation of research and development (R&D) and military weapons systems which increase GDP levels (Chapter 8. ).

Population estimates are comparable across countries and are also sourced from the *OECD National Accounts Statistics* (database). However, some care is needed in interpretation as countries like Luxembourg and, to a lesser extent, Switzerland, have a relatively large number of frontier workers that contribute to GDP but are excluded from the population figures. In this context, cross-country comparisons of income per capita based on gross or net national income are also relevant.

## References

*OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.
*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.
OECD (2001), *Measuring Productivity – OECD Manual*, http://dx.doi.org/10.1787/9789264194519-en.

**Figure 2.5. GDP per capita convergence, 2001-2017**

Percentage change at annual rate (Y-axis); US dollars, current prices, current PPPs (X-axis)

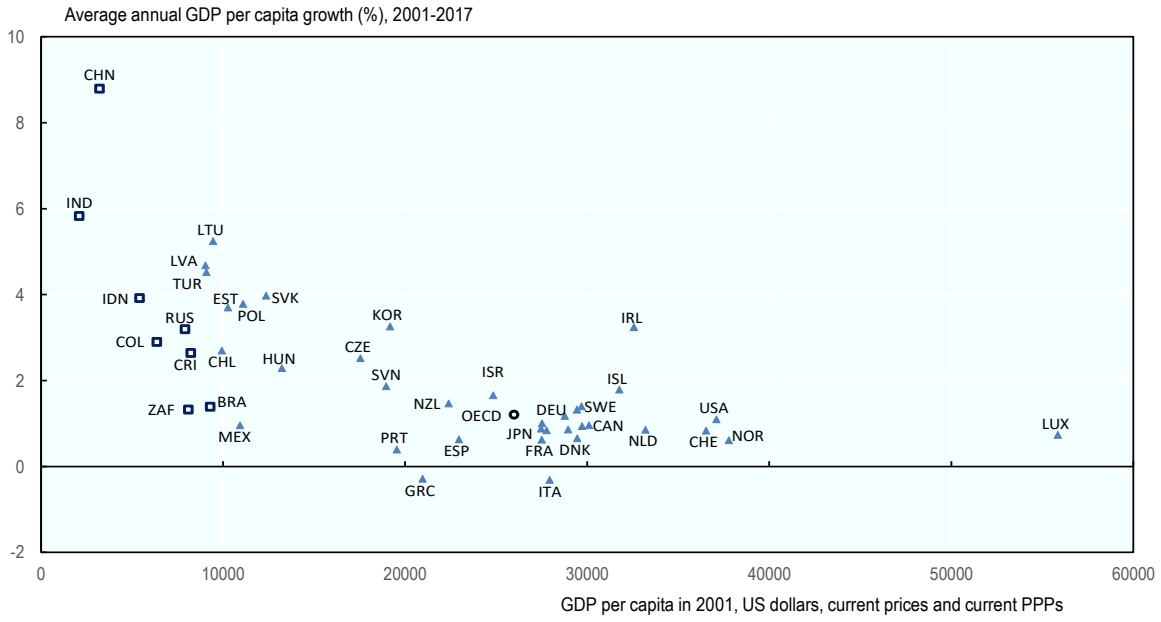


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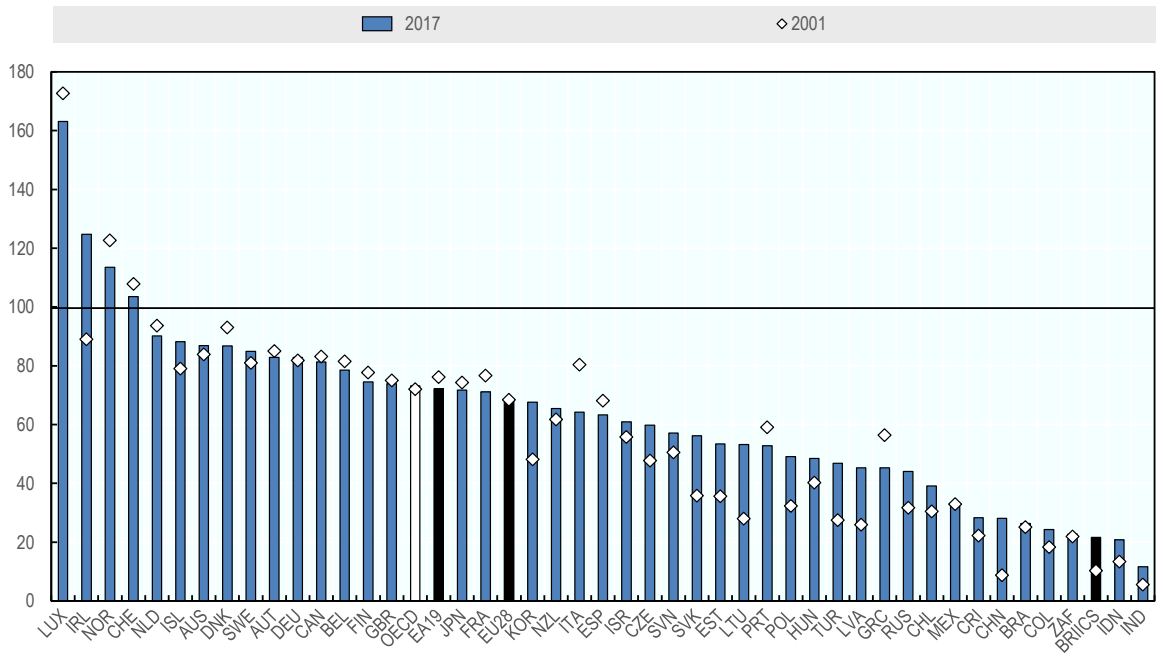
**Figure 2.6. Gaps in GDP per capita**

As a percentage of the United States (USA=100), constant prices and constant PPPs

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## Labour productivity

Labour productivity is the most frequently computed productivity indicator. It represents the volume of output produced per unit of labour input. The ratio between output and labour input depends to a large degree on the presence of other inputs, such as physical capital and increasingly intangible fixed assets used in production, and technical efficiency and organisational change. Labour productivity is a key dimension of economic performance and an essential driver of changes in living standards.

**Key findings**

In countries with relatively low labour productivity levels, stronger labour productivity growth over the last two decades has helped to reduce the productivity gap, especially in many Eastern European economies and Korea. However their labour productivity levels remain below the OECD average and post crisis rates of convergence have slowed. Labour productivity growth has also been relatively weak in the United States and in some large European economies – Italy and the United Kingdom – compared with the OECD average. In Ireland, corporate restructuring, including through the relocation of firms with significant intellectual property assets and aircraft leasing companies, led to significant increases in GDP and labour productivity in 2015, leading to the highest annual post-crisis labour productivity growth rate among OECD member countries (4.7%).

### *Definition*

Labour productivity is defined as GDP per hour worked. GDP is measured as gross value added in market prices. For international comparisons of labour productivity levels, the series of GDP in national currency and at current prices are converted to a common currency, US dollars, using current Purchasing Power Parities (PPPs). Growth rates of labour productivity, instead, are based on measures of GDP in national currency and at constant prices.

In productivity analysis, and ignoring quality differences for the moment, labour input is most appropriately measured as the total number of hours actually worked, this is, effectively used in production, whether paid or not (System of National Accounts 2008, 2008 SNA, 19.47). Hours actually worked reflect regular hours worked by full-time and part-time workers, paid and unpaid overtime, hours worked in additional jobs, excluding time not worked because of public holidays, annual paid leaves, strikes and labour disputes, bad weather, economic conditions, among other reasons (Chapter 8. ).

### *Comparability*

GDP measures follow the 2008 SNA, except for Colombia, which follows the 1993 SNA, and for the Russian Federation, which follows the 1993 SNA (data up to 2010) and the 2008 SNA (from 2011 onwards) (Chapter 8. ).

In most countries, the main source for measuring hours actually worked is their labour force survey. However, many countries rely – only or in addition – on establishment surveys and administrative sources (Chapter 8. ). The use of different sources may affect the comparability of labour productivity levels but comparisons of labour productivity growth are less likely to be affected (Ward et al., 2018).

In practice, the effective quantity of labour input depends not only on the total number of hours actually worked but also on the education, working experience, business functions and other worker characteristics. The measure of labour input used in this publication, i.e. total hours worked, does not account for the composition of the labour force and likely underestimates the effective use of labour in production affecting cross-country comparability.

## References

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Ward, A., M. Zinni and P. Marianna (2018), "International productivity gaps: Are labour input measures comparable?", *OECD Statistics Working Papers*, 2018/12, OECD Publishing, Paris, http://dx.doi.org/10.1787/5b43c728-en.

**Figure 2.7. Labour productivity, 2017**

GDP per hour worked, total economy, US dollars, current prices and current PPPs

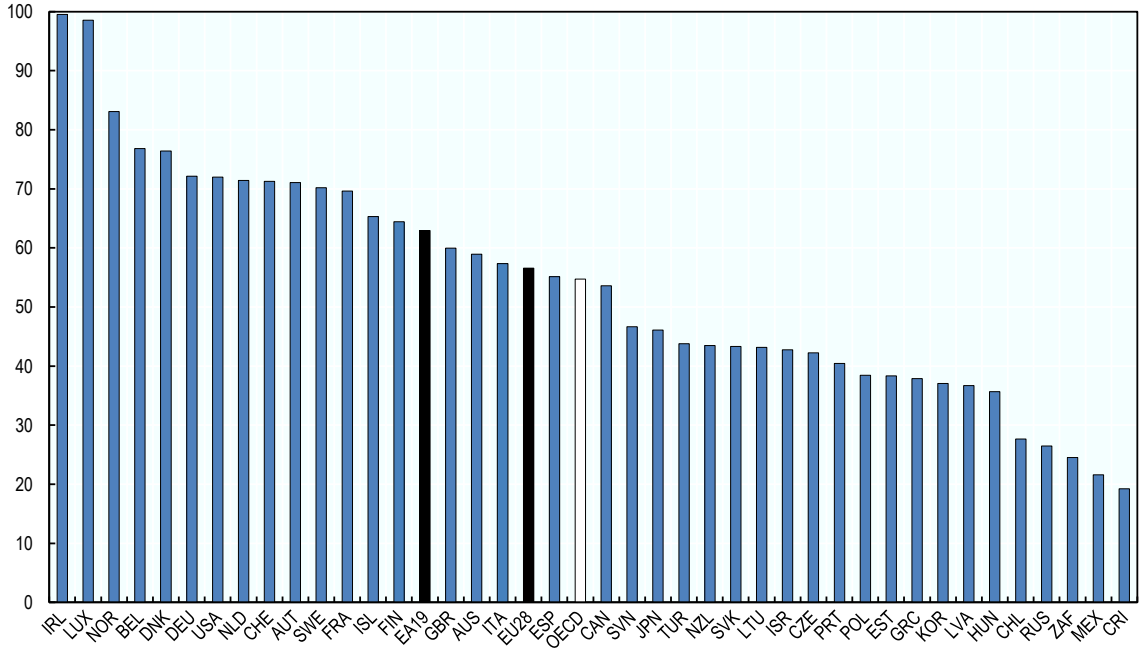


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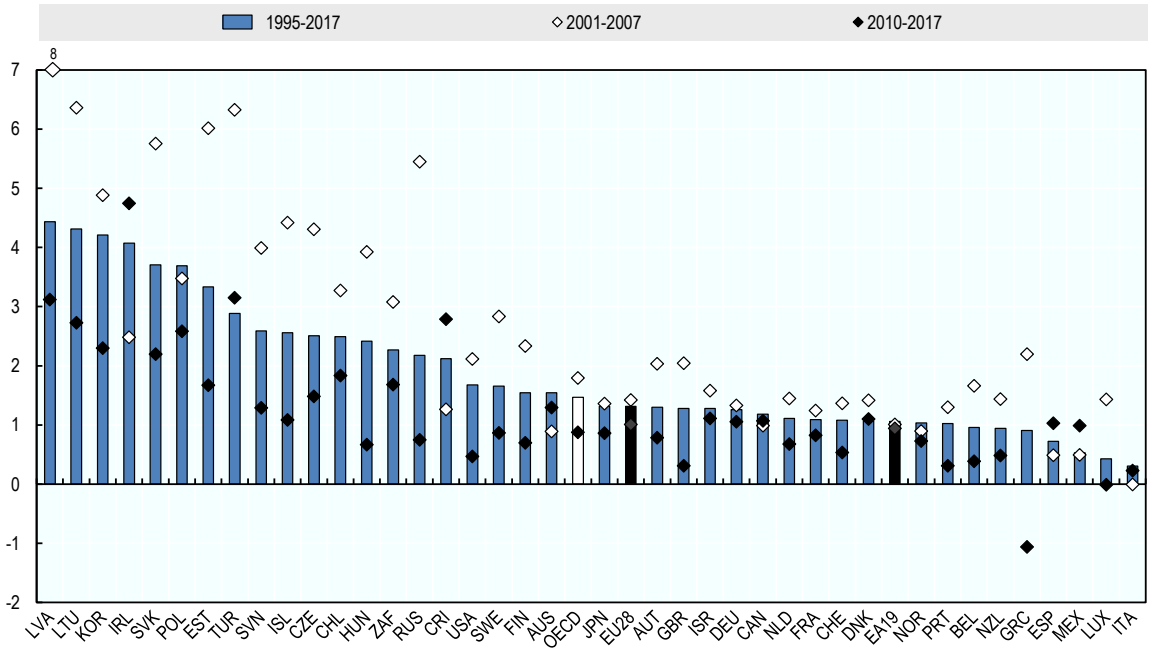
**Figure 2.8. Growth in labour productivity**

GDP per hour worked, total economy, percentage change at annual rate

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## Alternative measures of labour productivity

Labour productivity is most appropriately measured as a volume of output generated per hour worked. However the number of persons employed (i.e. total employment) is often used as a proxy for labour input, in particular, when data on total hours worked cannot be estimated.

**Key findings**

International and inter-temporal comparisons of labour productivity can differ depending on the measures of labour input used. For example, higher incidence of part-time employment in Germany and the Netherlands, or lower statutory hours, for example in France, are likely to result in lower international rankings of labour productivity for these countries, when calculated on a head-count basis, compared with measures based on hours worked. The opposite is true for countries with longer statutory hours or average working weeks (like Costa Rica, Chile, Eastern European economies, Mexico, South Africa and Turkey), or with a lower incidence of part-time employment (Eastern European countries, the Russian Federation and South Africa).

Over the period 2001-2017, GDP per hour worked increased more rapidly than GDP per person employed in nearly all countries, partly reflecting a higher incidence of part-time employment.

### *Definition*

Total employment is measured as the total number of persons engaged in production, including both employees and self-employed. Hours worked refer to the total number of hours actually worked, whether paid or not, by both employees and self-employed. They reflect regular hours worked by full-time and part-time workers, paid and unpaid overtime, hours worked in additional jobs, excluding time not worked because of public holidays, annual paid leaves, strikes, labour disputes, bad weather, economic conditions, among other reasons (Chapter 8. ).

### *Comparability*

Variations in working patterns (e.g. part-time vs full time employment) and employment legislations (e.g. statutory hours) across countries and over time affect the time consistency and cross-country comparability of total employment figures, justifying, when possible, the use of total hours worked as a measure of labour input.

The preferred source for total employment is *OECD National Accounts Statistics* (database). For some countries, however, longer time series and/or more recent estimates need to be derived from the *OECD Employment and Labour Market Statistics* (database), the *OECD Economic Outlook*: *Statistics and Projections* (database) and national statistics office websites (Chapter 8. ).

## References

*OECD Economic Outlook: Statistics and Projections* (database), http://dx.doi.org/10.1787/eo-data-en.
*OECD Employment and Labour Market Statistics* (database), http://dx.doi.org/10.1787/lfs-data-en.
*OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.
*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.

**Figure 2.9. GDP per hour worked and GDP per person employed, 2017**

As percentage of the OECD average (OECD=100), current prices and current PPPs

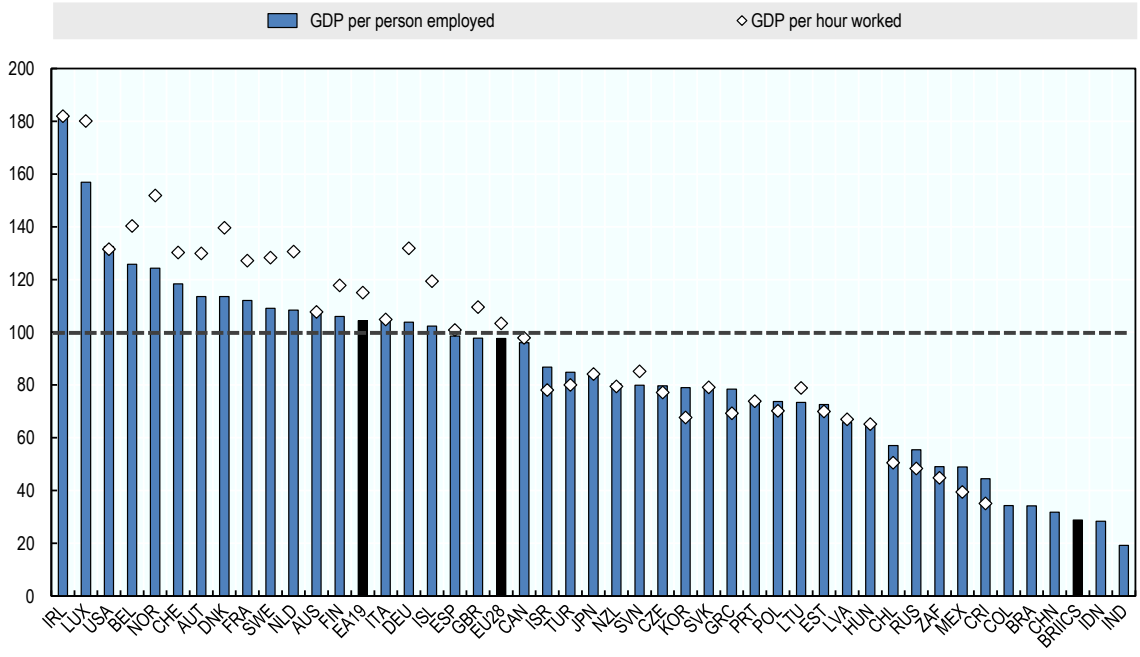


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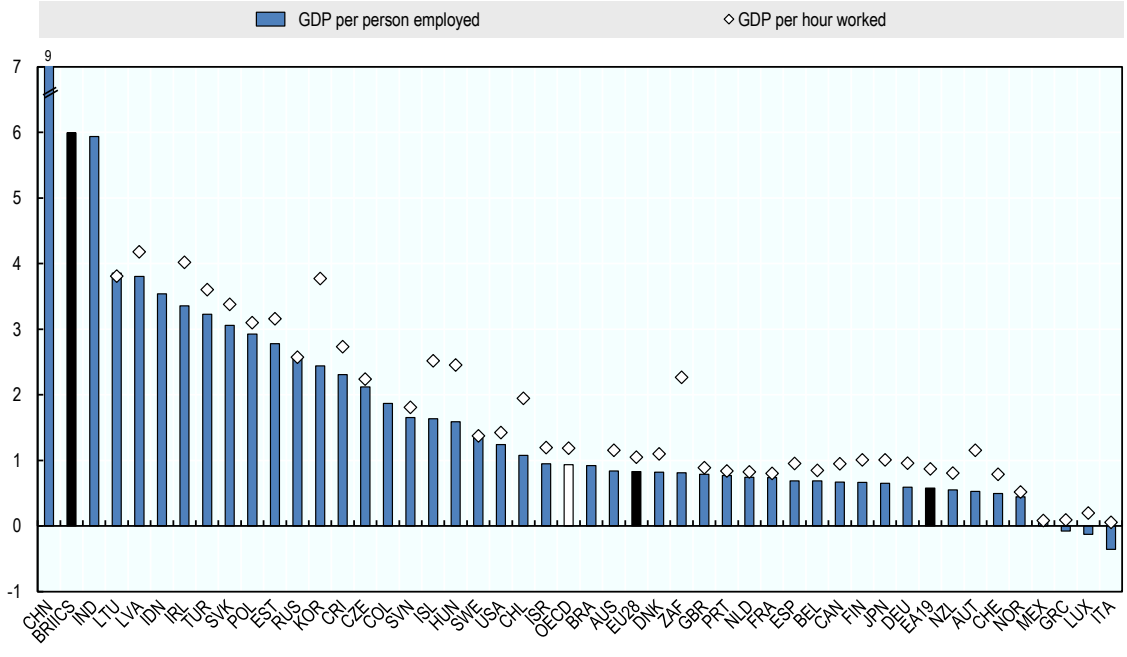
**Figure 2.10. Growth in GDP per hour worked and growth in GDP per person employed, 2001-2017**

Total economy, percentage change at annual rate

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## Alternative measures of income

It is a stylised fact that intangible capital plays an increasingly important role in growth and productivity. But less well known are the potential measurement challenges these bring, in particular with regards to whether the underlying use of the intangible is recorded in the accounts as generating cross-border services flows – which increase gross domestic product (GDP) – or cross-border flows of primary income, recorded in gross national income (GNI). This matters for labour productivity measures. In this regard, productivity measures based on GNI are able to provide a complementary view that may shed light on possible measurement distortions.

**Key findings**

In most countries labour productivity measures based on GDP and GNI are similar, as the underlying income flows are relatively small or offset each other. In Ireland and Luxembourg, however, significant differences arise between the two measures reflecting the significant role played by multinationals with high intellectual property content in generating value added, and in turn the significant redistribution of that value added to shareholders, and often parents, as income flows.

### *Definition*

GNI is defined as GDP plus net receipts from abroad of compensation of employees and property income plus net taxes and subsidies receivable from abroad. In most countries, net receipts of property income account for most of the difference between GDP and GNI. Property income from abroad includes interest, dividends and all or part of the retained earnings of foreign enterprises owned fully or in part by residents. Compensation of employees from abroad is that earned by residents who essentially live and consume inside the economic territory but work abroad. They also include compensation of employees earned by non-residents who live and work abroad only for short periods (seasonal workers).

### *Comparability*

There are practical difficulties in the measurement of international flows of both compensation of employees and property income. In practice, many flows related to the use of intellectual property assets are often recorded as property income flows between affiliates. This impacts directly on GDP levels but it also creates possible inconsistencies for productivity as the underlying intellectual property being used in production in one country may be recorded on the balance sheets of another. Measures of labour productivity based on GNI in part "correct" for these potential inconsistencies.

Some care is also needed when interpreting productivity in countries with high numbers of cross-border workers. Labour compensation earned by these workers will not be included in the GNI of the country in which they work but their hours worked will be included in the calculation of labour input.

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*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.
OECD (2009), *Handbook on Deriving Capital Measures of Intellectual Property Products*, http://dx.doi.org/10.1787/9789264079205-en.

**Figure 2.11. GDP and GNI per hour worked, 2017**

Percentage point difference from the OECD (OECD=0), current prices and current PPPs

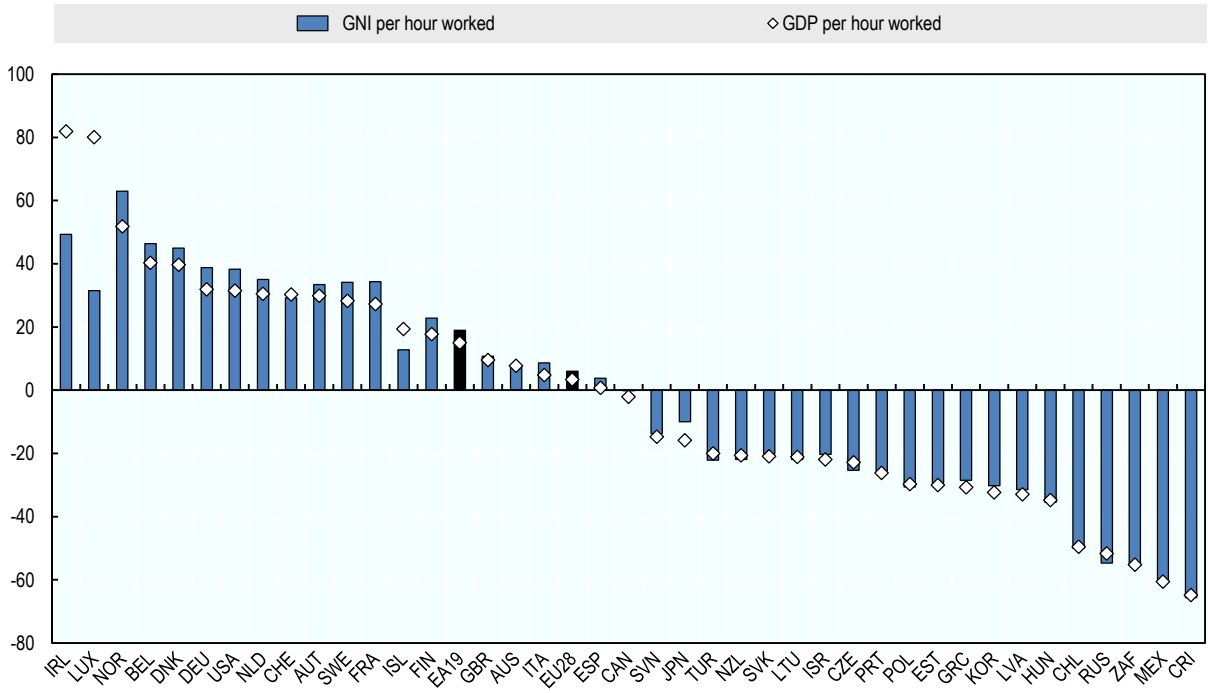


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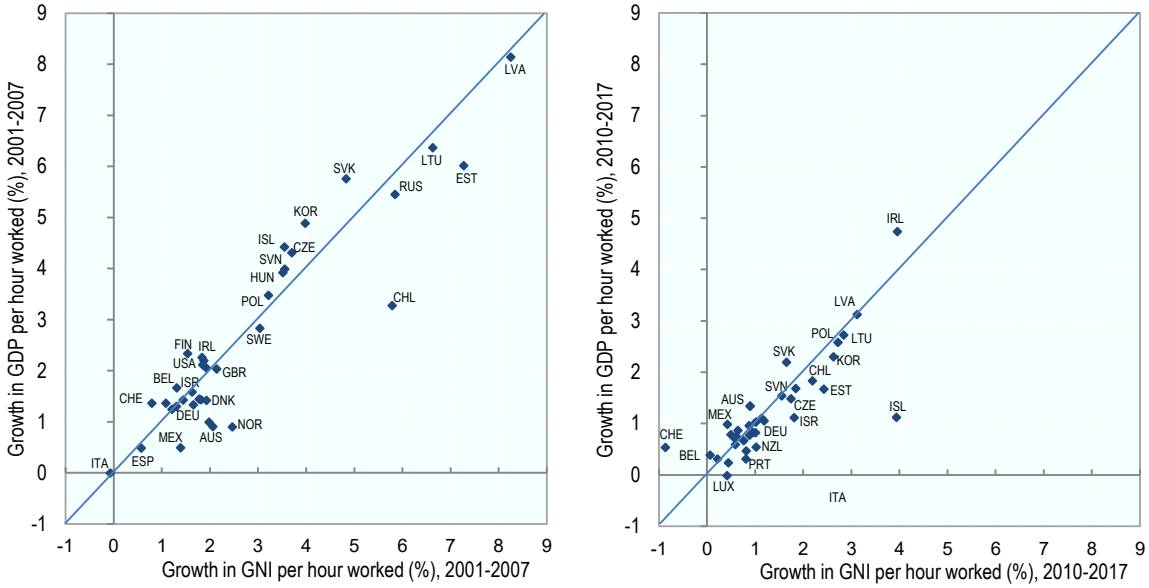
**Figure 2.12. Growth in GDP per hour worked and growth in GNI per hour worked**

Total economy, percentage change at annual rate

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## Capital productivity and the role of ICT and intangible assets

Capital productivity shows how efficiently capital is used to generate output. Investment in information and communication technologies (ICT) enables new technologies to enter the production process and is seen as an important driver of productivity growth. Investment in intellectual property products, such as R&D, not only contributes to expand the technological frontier but also enhances the ability of firms to adopt existing technologies, playing an important role in productivity performance.

**Key findings**

Declining costs of using capital relative to labour and the resulting fall in the use of labour input per unit of capital services have led to a fall in capital productivity in most OECD countries over the past 20 years. Some of the decline in overall costs of capital relates to ICT assets where new products' prices have typically fallen very rapidly, and which in turn may have spurred the increased use of ICT in production. In fact, the shares of ICT assets in total non-residential investment increased in nearly all countries over the last two decades.

However, the pace of decline in capital productivity has been less pronounced since the crisis, partly reflecting the sluggish recovery in investment in tangible assets and substantial increases in labour utilisation in many countries, and the possibility that firms have extended the service lives of capital. Investment in intellectual property products has however performed much better; indeed, while there are still significant differences across countries, investment in intellectual property products, in particular, in R&D, has accounted for an increasing share of total investment in most economies over the past 20 years.

### *Definition*

Capital productivity is measured as the ratio between the volume of output, measured as GDP, and the volume of capital input, defined as the flow of productive services that capital delivers in production, i.e. capital services (Chapter 8. ). Series of gross fixed capital formation by asset type are used to estimate productive capital stocks and to compute an aggregate measure of total capital services, in line with the asset boundary of the System of National Accounts 2008 (2008 SNA). ICT capital includes: i) computer hardware; ii) telecommunications equipment; and iii) computer software and databases. Non-ICT capital includes: i) non-residential construction; ii) transport equipment; iii) other machinery and equipment and weapons systems; iv) R&D; v) other intellectual property products.

While the 2008 SNA recognises a number of intellectual property assets (i.e. R&D, computer software and databases, mineral exploration and evaluation costs and artistic and literary originals), other forms of knowledge-based assets such as organisational capital, brand-equity, copyrights and design, can play an important role for GDP growth and productivity. Their exclusion from the SNA asset boundary, and therefore from the capital services measures here presented, relies on the practical difficulties involved in their measurement.

### *Comparability*

Countries use different approaches to deflate ICT investment, where constant quality price changes are particularly important but difficult to measure, and assume different depreciation rates and assets' service lives. To counteract for these differences, the OECD computes aggregate measures of capital services using a set of harmonised ICT investment deflators as well as common depreciation rates and average service lives for the different assets across countries (Schreyer, 2002).

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*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.

OECD (2009), *Handbook on Deriving Capital Measures of Intellectual Property Products*, http://dx.doi.org/10.1787/9789264079205-en.

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Schreyer, P. (2002), "Computer prices and international growth and productivity comparisons", *Review of Income and Wealth*, Series 48, Number 1.

**Figure 2.13. Growth in capital productivity**

Total economy, percentage change at annual rate

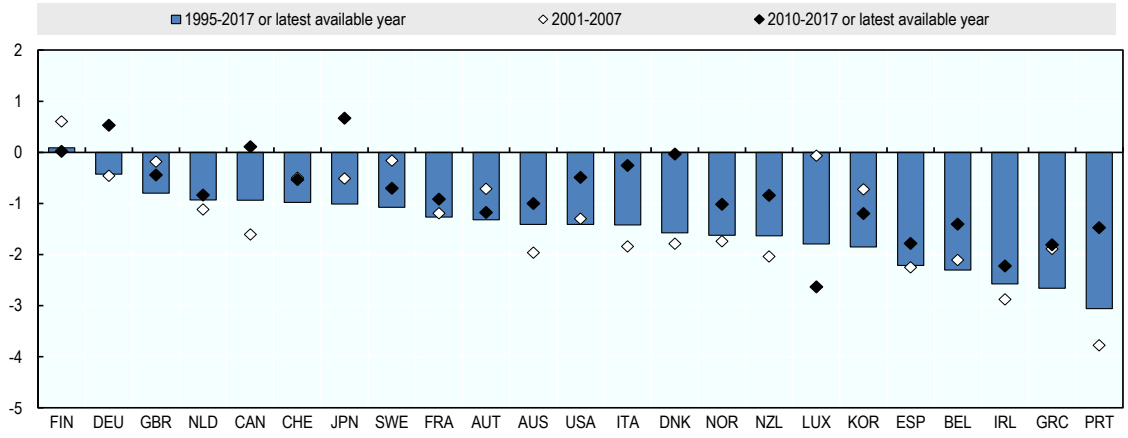


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**Figure 2.14. Contributions of ICT and non-ICT capital to total capital services**

Total economy, percentage change at annual rate

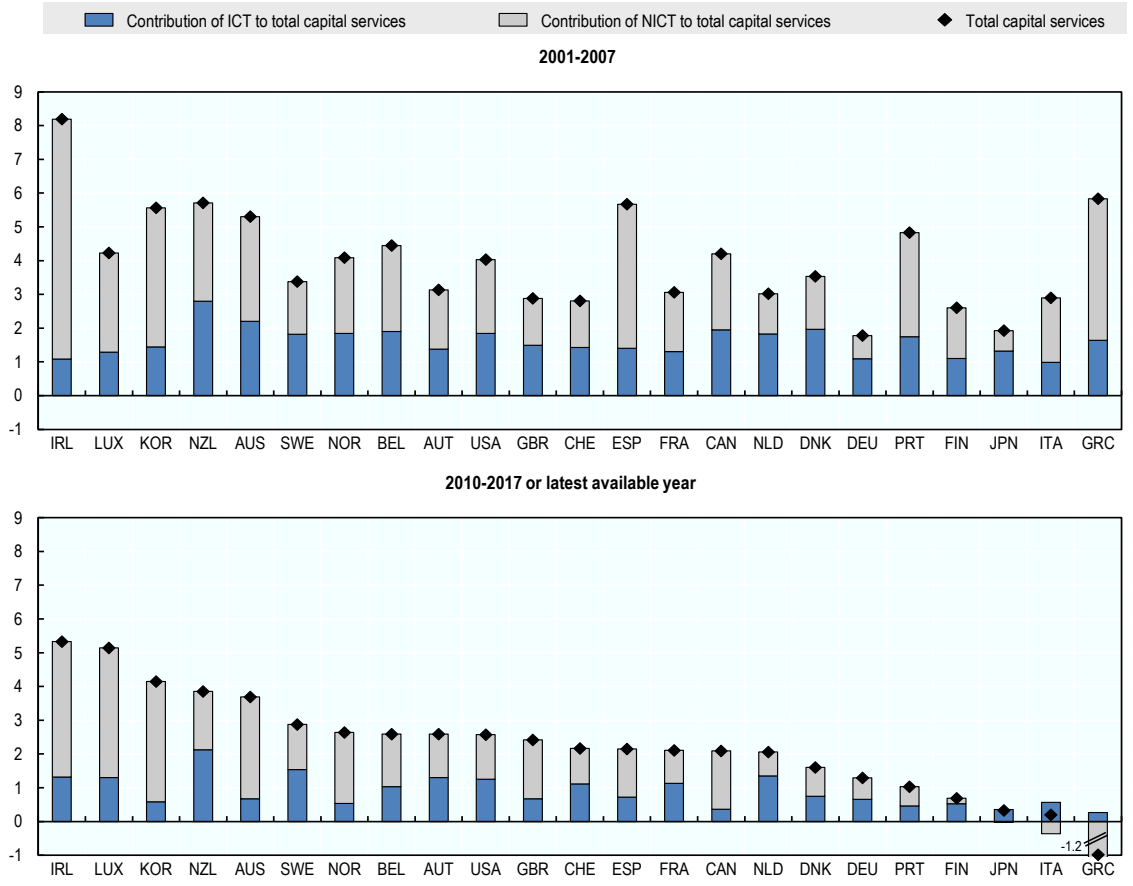


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**Figure 2.15. Share of ICT investment**

Total economy, current prices, as a percentage of total non-residential investment

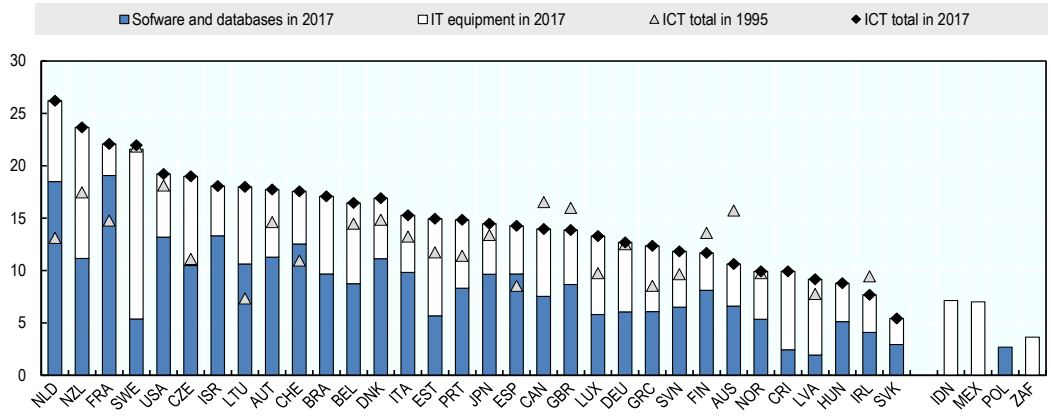


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**Figure 2.16. Share of investment in intellectual property products**

Total economy, current prices, as a percentage of gross fixed capital formation

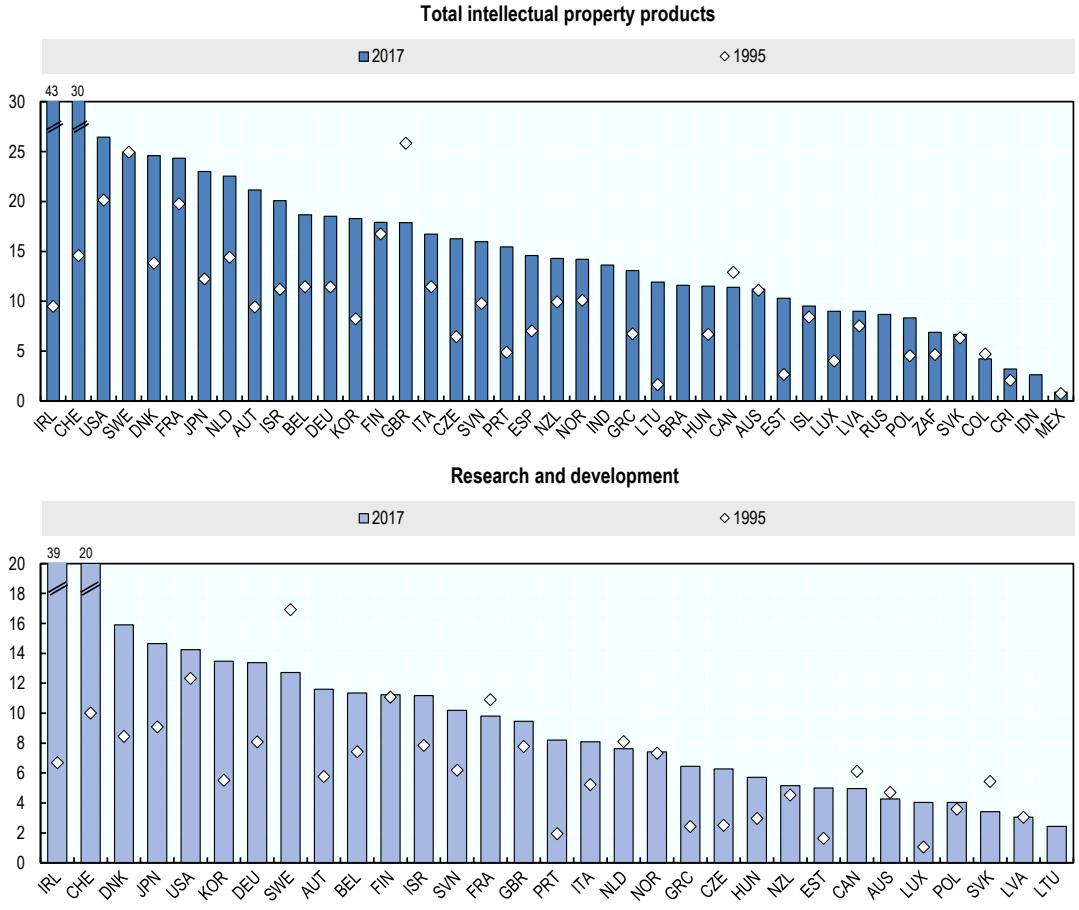


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**Figure 2.17. Investment in tangible assets and intellectual property products**

Total economy, constant prices, index 2007=100

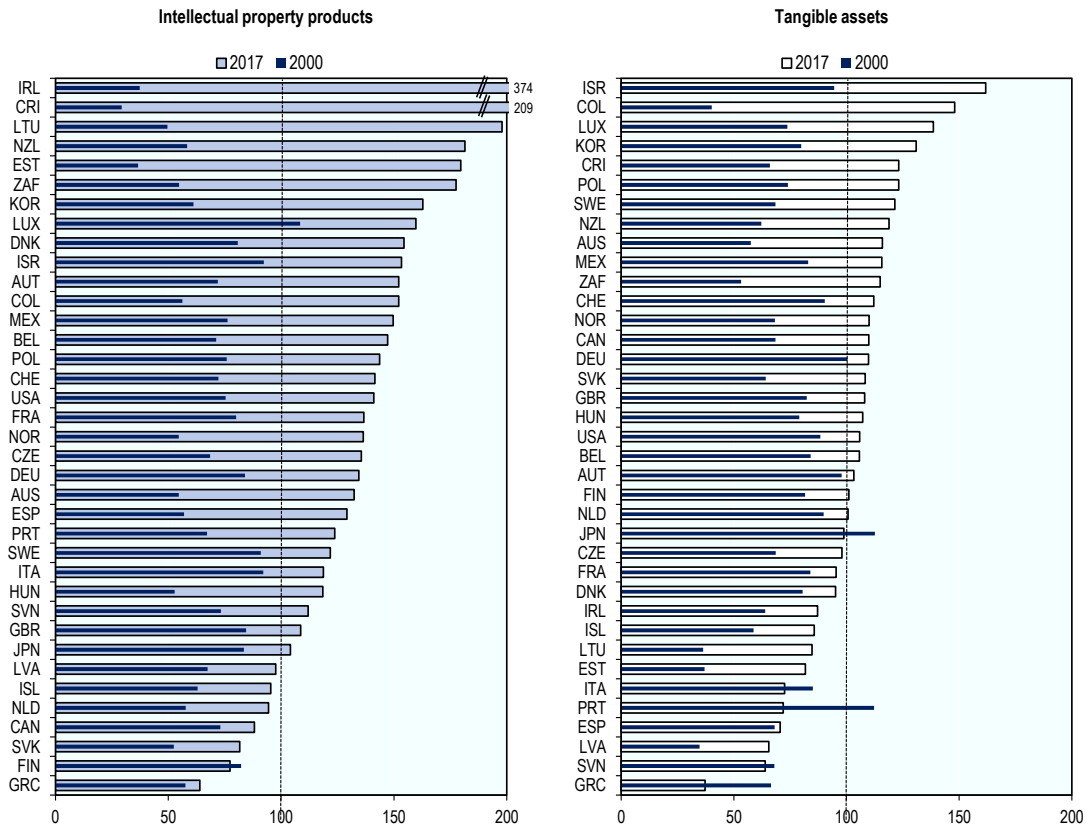


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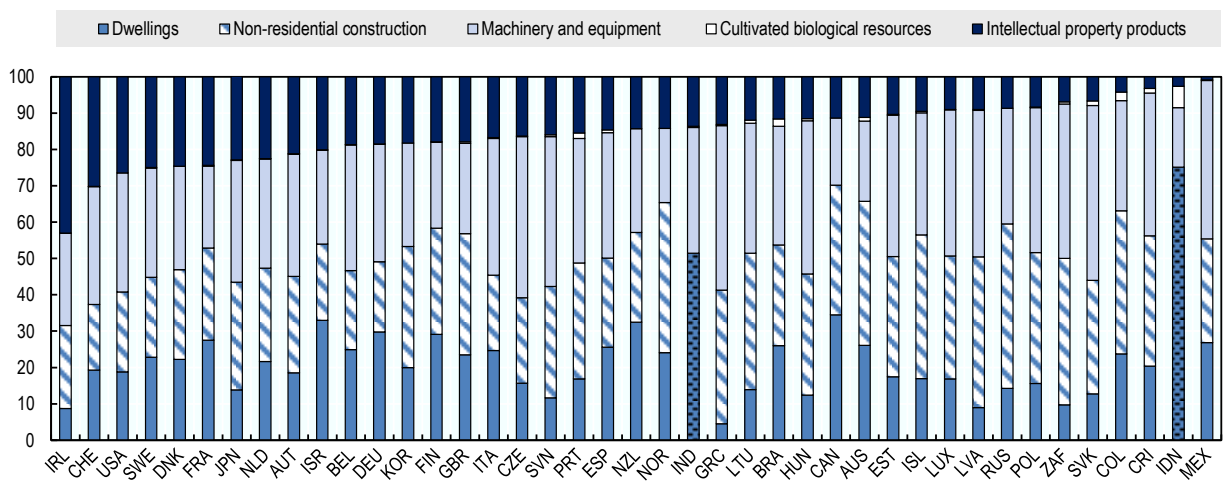
**Figure 2.18. Gross fixed capital formation by asset type**

Total economy, as a percentage of total gross fixed capital formation, 2017 or latest available year

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## Growth accounting

Economic growth can be fostered either by raising the labour and capital inputs used in production, or by improving the overall efficiency with which these inputs are used together, i.e. higher multifactor productivity growth (MFP). Growth accounting involves decomposing total output growth, measured here as GDP growth, into these three components. As such, it provides an essential tool for policy makers to identify the underlying drivers of growth.

**Key findings**

Over the past 20 years, capital services and MFP accounted for the largest part of GDP growth in most OECD countries. ICT capital services represented between 0.2 and 0.7 percentage point of growth in GDP, with the largest contributions recorded in New Zealand and Sweden, and the smallest in Finland and Italy. Growth in labour input was important for a few countries between 1995 and 2017, notably Australia, Luxembourg, New Zealand and Spain, while non-ICT capital accounted for almost 40% of GDP growth in Spain, 60% in Portugal and 70% in Greece. Over the same period, MFP growth was a significant source of GDP growth in Finland, Germany, Japan and Korea, but was negligible in Belgium, New Zealand and Portugal, and negative in Greece, Italy, Luxembourg and Spain.

However, when contributions to GDP growth are analysed before and after the crisis, important differences arise. The slowdown in GDP growth over the period 2010-2017 was driven by the lower contribution of labour input in Australia, Greece, Italy, Portugal, Spain, and, to a lesser extent, Ireland, and by the smaller contribution of MFP in Austria, Belgium, Finland, Greece, Korea, Luxembourg, Sweden, the United Kingdom and the United States. However, over the same period, GDP growth was driven by the larger contribution of labour input in Germany, Sweden, the United Kingdom and the United States, partly reflecting higher employment rates, and by higher MFP growth in Australia, Canada, and, to a lesser extent, Denmark and Germany.

### *Definition*

GDP growth can be decomposed into a labour input component, a capital input component and MFP growth, computed as a residual (Chapter 8. ). The contribution of labour (capital) to GDP growth is measured as the growth in labour (capital) input, multiplied by the share of labour (capital) in total costs of production. In the figures below, the contribution of capital to GDP growth is further broken down to highlight the contribution made by information and communication technologies (ICT) as compared with more traditional assets (non-ICT).

### *Comparability*

In productivity analysis, the appropriate measure for capital input is the flow of capital services, this is, the flow of productive services that can be drawn from the cumulative stock of past investments in capital assets. Conceptually, capital services reflect a quantity, or physical concept, not to be confused with the value, or price concept of capital. To illustrate, the services flows provided by a taxi relate to the number of trips, distance driven, comfort of the taxi, etc., rather than the value of the motor vehicle. These services are estimated using the rate of change of the productive capital stock of different capital goods (Chapter 8. ).

The measure of total hours worked is an incomplete measure of labour input because it does not account for changes in the skill composition of workers, such as those due to higher educational attainment and work experience. In the absence of these adjustments, as is the case in the series presented here, more rapid output growth due to a rise in workers skills is captured by the MFP, rather than being attributed to the labour input.

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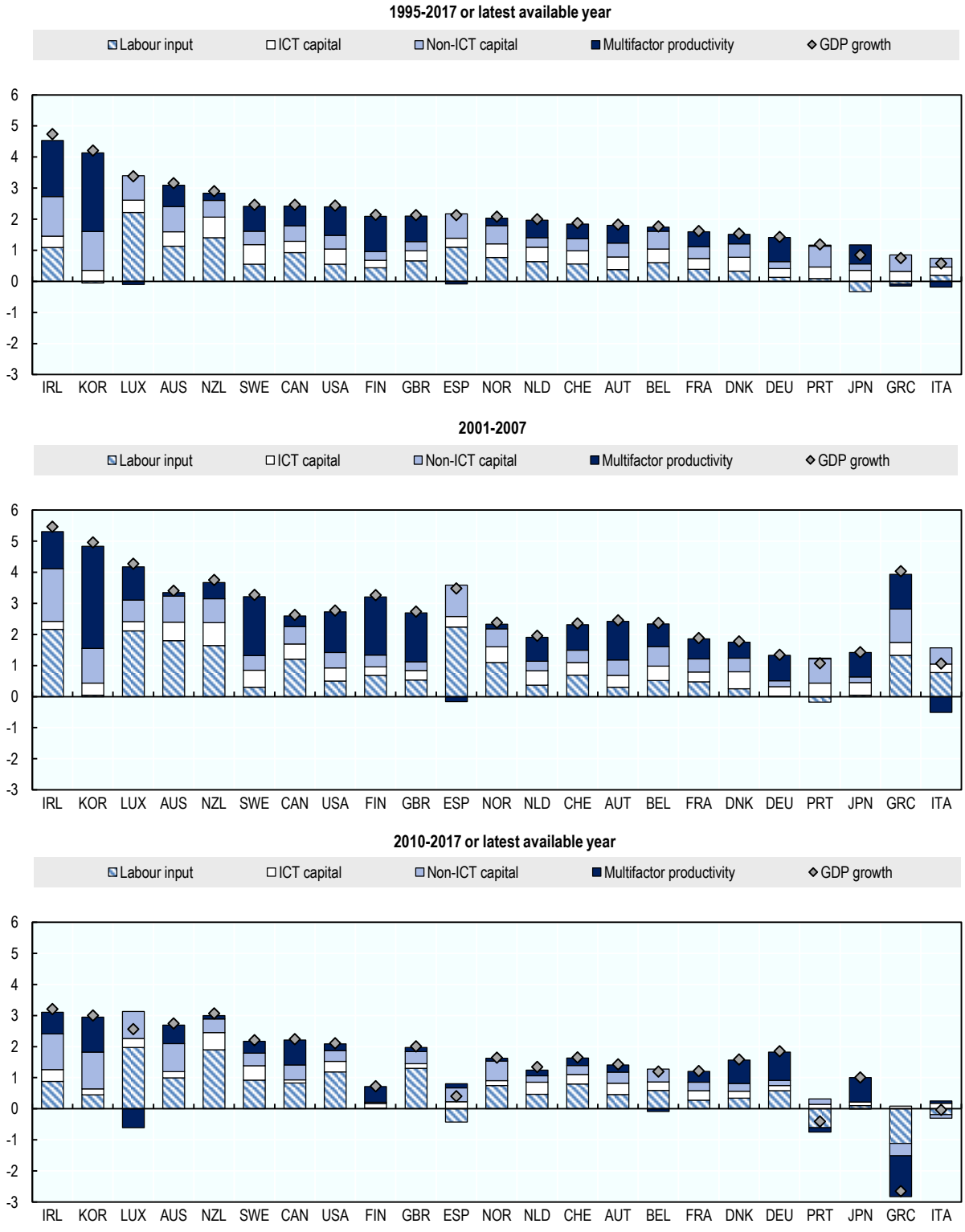
**Figure 2.19. Contributions to GDP growth**

Total economy, annual percentage point contribution

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## Multifactor productivity

Multifactor productivity (MFP) reflects the overall efficiency with which labour and capital inputs are used together in the production process. Labour productivity growth represents a higher level of output for every hour worked. This can be achieved if more capital per labour unit, i.e. capital deepening, is used in production, or by improving the overall efficiency with which labour and capital are used together, i.e. higher MFP.

**Key findings**

Over the past two decades, MFP growth varied considerably among OECD countries. Greece, Italy, Luxembourg and Spain recorded the lowest (and negative) rates, lagging far behind the top performers Ireland and Korea. MFP growth decelerated in nearly all countries after the crisis compared with the 2001-2007 period, with significant slowdowns in Austria, Belgium, Finland, Greece, Korea, Luxembourg, Sweden, the United Kingdom and the United States.

Large differences in MFP growth heavily affected labour productivity growth differentials. Prior to the crisis, relatively high MFP growth in most OECD countries contributed strongly to labour productivity growth, compared with the contributions of ICT and non-ICT capital deepening. In the post-crisis period, MFP appears to have moved pro-cyclically in most countries, as reflected by the slowdown in MFP growth and its much lower contribution to labour productivity growth, notably in Austria, Belgium, Finland, Greece, Luxembourg, the Netherlands, New Zealand, Sweden, Switzerland, the United Kingdom and the United States.

### *Definition*

By reformulating the growth accounting framework, labour productivity growth can be decomposed into the contribution of capital deepening and MFP. Capital deepening is defined as changes in the ratio of the total volume of capital services to total hours worked. Its contribution to labour productivity growth is calculated by weighting it with the share of capital costs in total costs (Chapter 8. ).

### *Comparability*

Growth in MFP is measured as a residual, i.e. that part of GDP growth that cannot be explained by growth in labour and capital inputs. Traditionally, MFP growth is seen as capturing technological progress but, in practice, this interpretation needs some caution. Some part of technological change is embodied in capital input, e.g. improvements in design and quality between two vintages of the same capital asset, and so its effects on GDP growth are attributed to the respective factor. The measure of capital services in the *OECD Productivity Statistics* (database) takes explicit account of different productivities across assets, and price indices of ICT assets are adjusted for quality changes (Chapter 8. ). Therefore, MFP only picks up disembodied technical change, e.g. network effects or spillovers from production factors, the effects of better management practices, brand names, organisational change and general knowledge.

Moreover, MFP also captures other factors such as adjustment costs, economies of scale, effects from imperfect competition and measurement errors. For instance, increases in educational attainment or a shift towards a more skill-intensive production process, if not captured in the form of quality adjusted labour input – as is the case here – are captured by the MFP.

## References

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**Figure 2.20. Multifactor productivity growth**

Total economy, percentage change at annual rate

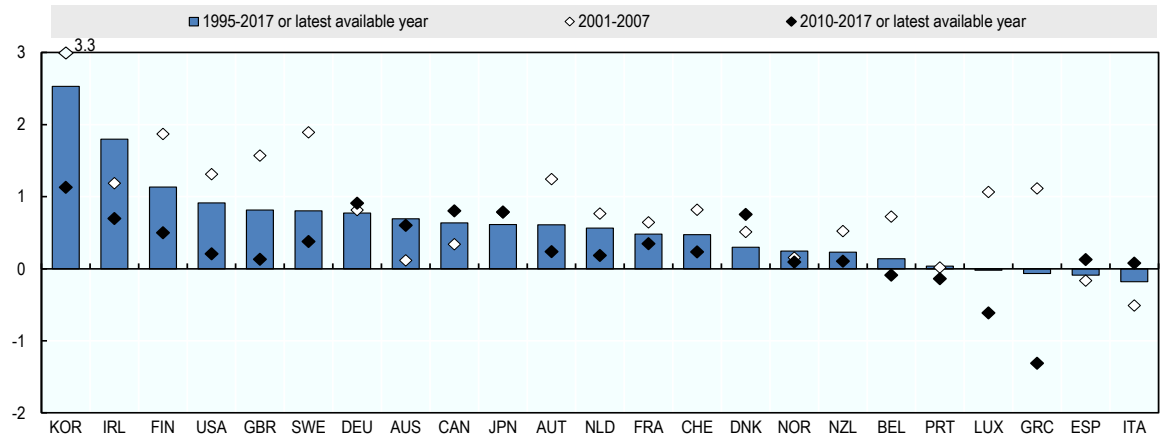


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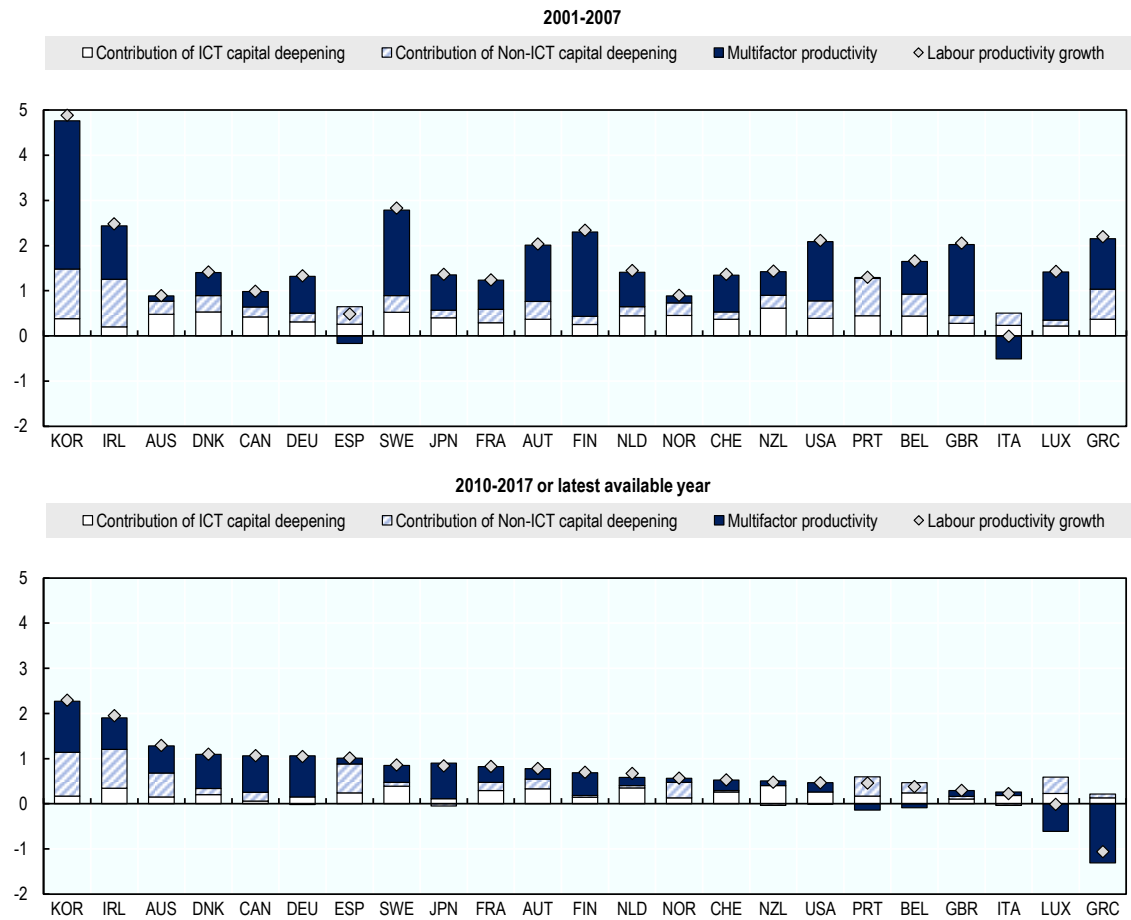
**Figure 2.21. Contributions to labour productivity growth**

Total economy, annual percentage point contribution

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# Chapter 3. **Productivity by industry**

Labour productivity by main economic activity
Industry contribution to business sector productivity
Labour productivity in manufacturing
Labour productivity in business sector services
Contributions to business sector services' productivity
Labour productivity in information and communication services

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## Labour productivity by main economic activity

Sectors differ from each other with respect to their productivity growth. Such differences may relate, for instance, to the intensity with which sectors use skilled labour and physical and knowledge-based capital in their production, the scope for product and process innovation, the absorption of external knowledge, the degree of product standardisation, the scope for economies of scale, and the exposure to international competition through their participation in global value chains.

**Key findings**

Differences in productivity growth rates across countries at the total economy level cannot be explained by differences in economic structures alone as even at the sectoral level significant differences in productivity growth exist across countries; although in general, in most countries, growth rates in the manufacturing sector have typically outpaced those in the services sector.

Compared with pre-crisis rates, labour productivity in manufacturing slowed in most OECD countries after the crisis, particularly in the Czech Republic, Finland, Hungary, Korea, Poland, Sweden and the United States. Between 2010 and 2017, labour productivity growth rates in manufacturing ranged from minus 0.6% in the United States to 5.1% in the Slovak Republic. In Ireland, corporate restructuring, including through the relocation of firms with significant intellectual property assets and aircraft leasing companies, led to significant increases in labour productivity in 2015.

In business sector services, labour productivity also slowed after the crisis, notably in Estonia, Greece, Hungary, Latvia, and, to a lesser extent, the United Kingdom. Growth rates of labour productivity in business sector services ranged from minus 3.7% in Greece to 5.8% in Costa Rica between 2010 and 2017.

### *Definition*

Labour productivity is defined as real gross value added per hour worked. The non-agricultural business sector, excluding real estate, covers mining and quarrying; manufacturing; utilities; construction; and business sector services. The latter covers wholesale and retail trade, repair of motor vehicles and motor cycles; accommodation and food services; transportation and storage; information and communication services; financial and insurance activities; and professional, scientific and support activities. This publication presents sectoral productivity growth for those countries for which sectoral data for real gross value added (in basic prices) and total hours worked by all persons employed (employees and self-employed) are available by ISIC Rev.4 breakdown in the *OECD National Accounts Statistics* (database). For Japan, Korea and the United States, in the absence of national accounts data on total hours worked by main ISIC Rev.4 economic activity, the total number of persons employed (employees and self-employed) is used as a measure of labour input.

### *Comparability*

The comparability of productivity growth across industries and countries may be affected by problems in measuring real value added. This is particularly relevant for services, as measurement of price changes is complicated by difficulties in identifying quality changes and the provision of bundled services (Chapter 8. ). In some industries, estimates of real value added may be based on a sum-of-costs approach, which deflates, using some assumptions, compensation of employees in the specific sector. For example, most countries assume no change in labour productivity for public administration activities, which is why this industry is not included here. Real estate services are also excluded, as their value added includes the imputation made for the dwelling services provided and consumed by home-owners.

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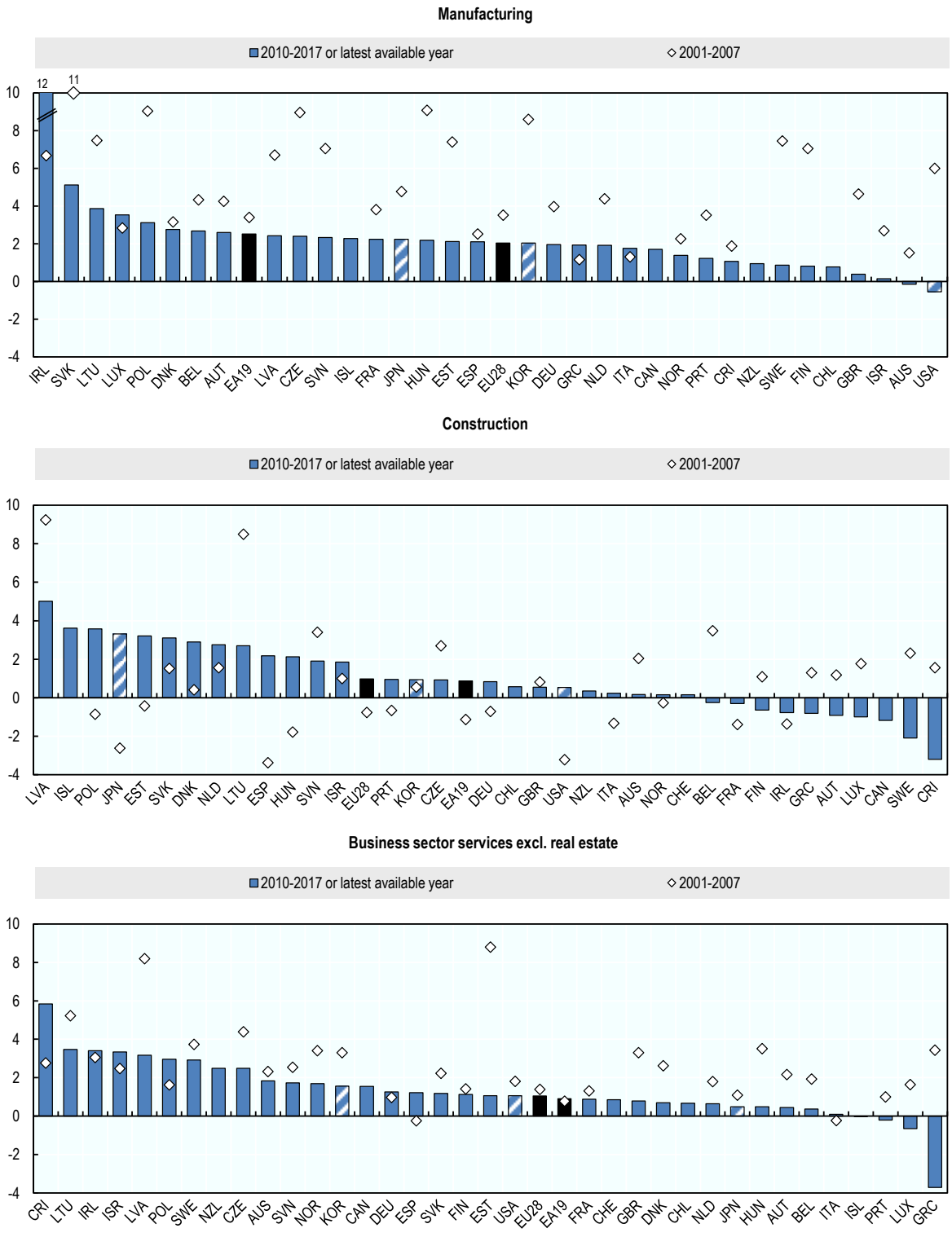
**Figure 3.1. Labour productivity by main economic activity**

Real gross value added per hour worked, percentage change at annual rate

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## Industry contribution to business sector productivity

Understanding the drivers of productivity growth in the business sector requires an awareness of the contribution that each industry makes. The contribution of an individual sector depends not only on its productivity growth but also on its share in total value added and total hours worked.

**Key findings**

Over the past 15 years, labour productivity growth was almost entirely driven by manufacturing and business sector services. In the case of manufacturing, this reflects the typically higher productivity growth rates of the sector. In the case of business sector services, the strong contribution also reflects its increasing share in the overall economy. Excluding real estate, business sector services account for about 35 to 50% of total value added and total employment across OECD countries.

When contributions to business sector productivity growth are analysed before and after the crisis, important differences arise. In the Czech Republic, Finland, Hungary, Korea, Slovenia, the Slovak Republic, Sweden and the United States, the productivity slowdown was mainly driven by lower contributions from the manufacturing sector compared with the pre-crisis period. In the Baltic States, Belgium, Greece, Hungary, Luxembourg and the United Kingdom, the slowdown was driven by lower contributions from business sector services.

### *Definition*

Labour productivity growth by industry is defined as the rate of change of real gross value added (in basic prices) per hour worked. The contribution of each sector to labour productivity growth of the total business sector is computed as the difference between the growth rate of value added and that of hours worked, with each weighted by the sector's share in total nominal value added and total hours worked respectively. Data are presented for those countries for which real gross value added and hours worked by sector are available by ISIC Rev.4 breakdown in the *OECD National Accounts Statistics* (database). Hours worked comprises the total number of hours worked by all persons employed, i.e. employees and self-employed. For Japan, Korea and the United States, in the absence of national accounts data on total hours worked by main ISIC Rev.4 economic activity, the total number of persons employed (employees and self-employed) is used as the measure of labour input.

### *Comparability*

Business sector refers to non-agricultural business sector excluding real estate activities. Real estate activities are excluded, as value added in this sector includes the imputation made for the dwelling services provided and consumed by home-owners.

In addition to the difficulties encountered in measuring real value added, particularly in the services sector, it is also difficult to accurately measure nominal output in some cases. This is for example the case for the financial services sector, where some financial intermediation services, such as implicit banking charges, are indirectly measured.

Under- or over-estimation of the output of a particular sector, notably for services, will be partially offset by intermediate consumption of this output by other production sectors, and hence their value added. Therefore, while this mis-measurement may have an impact on the comparability across sectors, it may have a smaller impact on overall productivity growth.

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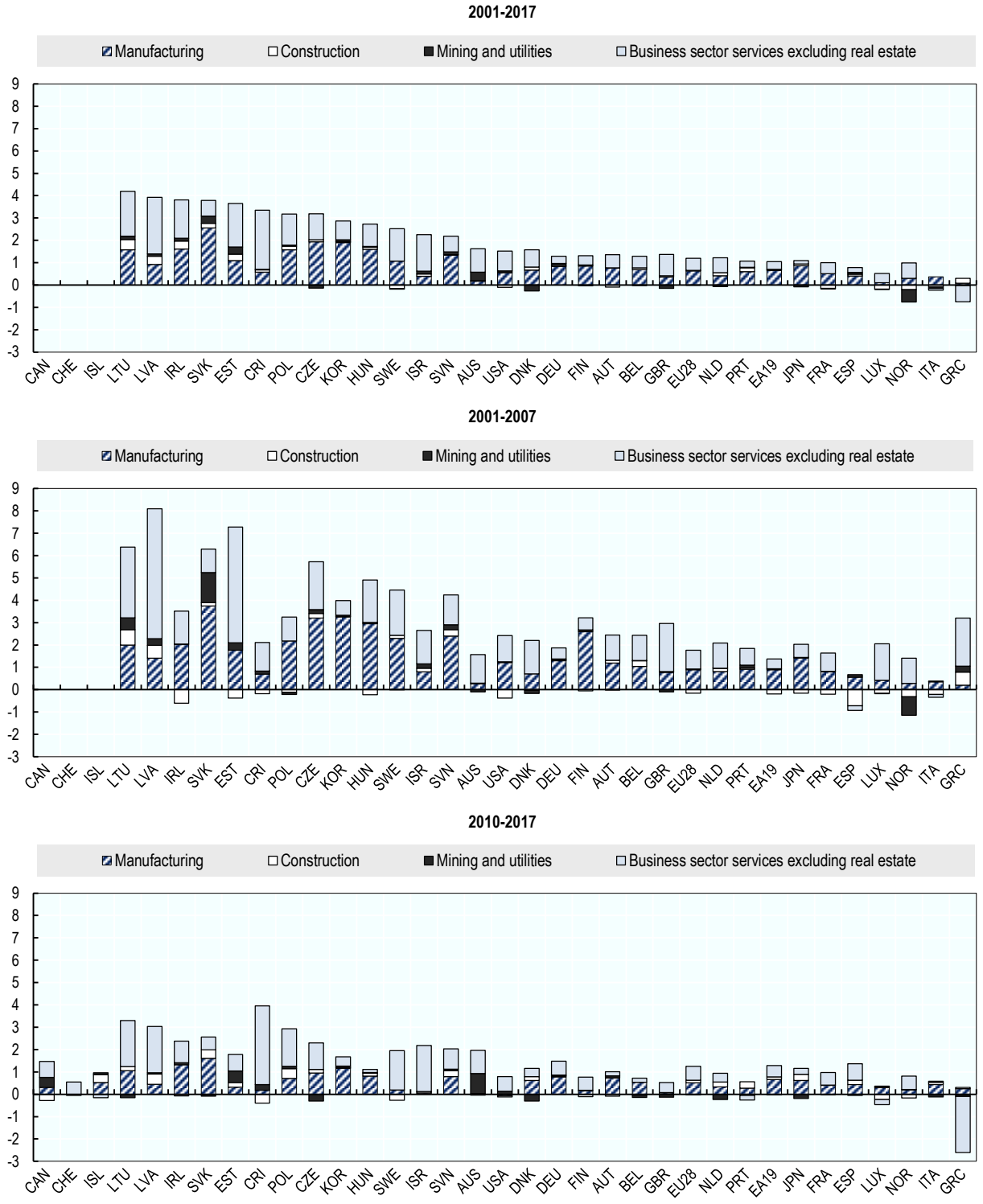
**Figure 3.2. Industry contribution to business sector productivity growth**

Real gross value added per hour worked, percentage point contribution at annual rate

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## Labour productivity in manufacturing

The manufacturing sector has historically been the main driver of aggregate productivity growth in most economies. While its contribution to aggregate productivity growth has become less important in recent years, it remains a key driver of productivity growth.

**Key findings**

The post-crisis slowdown in labour productivity growth in manufacturing has been widespread, spanning nearly all sub-sectors of manufacturing from higher-tech, higher skilled activities such as computers and electronics to those traditionally viewed as lower-tech and lower-skilled, such as textiles. Labour productivity growth slowed significantly in the Czech Republic, Lithuania, Poland, Sweden and the United States, in the former and in Belgium, the Czech Republic, Greece, the Slovak Republic, Slovenia and the United Kingdom in the latter.

### *Definition*

Labour productivity is calculated as the ratio between each sector's value added and the total number of hours worked. For Japan, Latvia, Mexico and the United States, in the absence of national accounts data on total hours worked by manufacturing sector, the total number of persons employed (employees and self-employed) is used as a measure of labour input.

### *Comparability*

Volume estimates of value added in ICT-producing sectors (such as manufacturing of computer, electronic and optical products) are complicated by challenges in measuring output prices of the activities, and in particular, how these capture quality improvements associated with technological advances. The use of hedonic deflators is generally considered as the best way to address these problems. However, comparisons of price movements of ICT goods (and also services) point to significant differences in price measurement across countries (Ahmad et. al, 2017), which although not significantly impacting on whole economy productivity estimates can have an impact on more detailed sectoral analyses.

## References

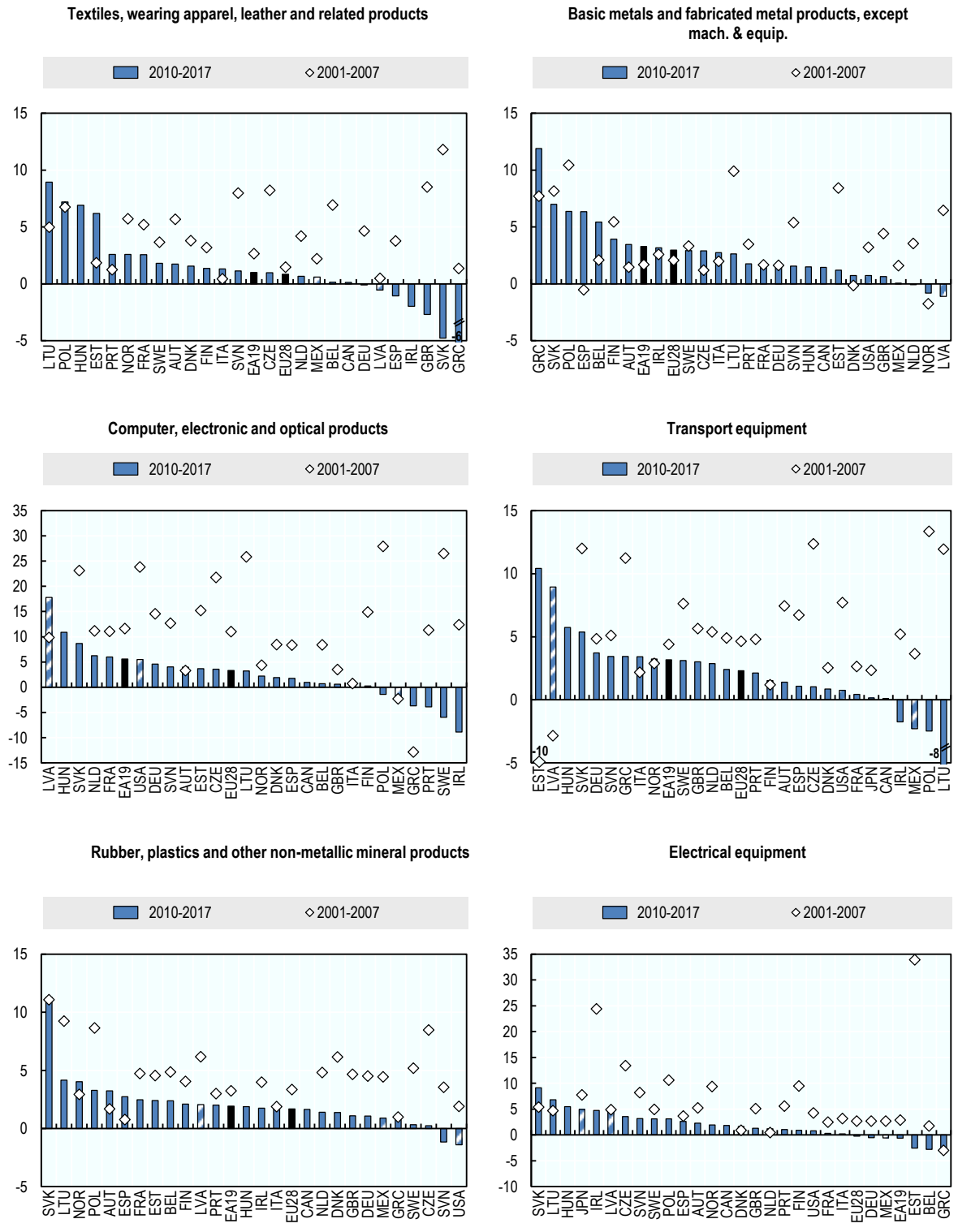
Ahmad, N., J. Ribarsky and M. Reinsdorf (2017), "Can potential mismeasurement of the digital economy explain the post-crisis slowdown in GDP and productivity growth?", *OECD Statistics Working Papers*, No. 2017/09, OECD Publishing, Paris, http://dx.doi.org/10.1787/a8e751b7-en.

OECD *National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.

Schreyer, P. (2002), "Computer prices indices and international growth and productivity comparisons", *Review of Income and Wealth*, Number 1, Series 48.

**Figure 3.3. Labour productivity in manufacturing, selected sectors**

Real gross value added per hour worked, percentage change at annual rate

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## Labour productivity in business sector services

Developments in information and communication technologies (ICT) combined with internationally fragmented production processes are making business services increasingly dynamic, transportable and tradeable. As a result, several business sector services show characteristics similar to high-productivity manufacturing industries; they intensively use ICT and knowledge-based capital, exploit economies of scale, and are increasingly exposed to international competition.

**Key findings**

Labour productivity growth varies substantially across business sector services. In the pre-crisis period, services that are traded internationally and thus with a higher exposure to international competition, such as information and communication services and finance and insurance activities, showed labour productivity growth rates that were as high as or even higher than those in the manufacturing sector. However, post the crisis, labour productivity growth in manufacturing was higher in most countries than in finance and insurance, and information and communication services.

Labour productivity growth decelerated significantly in finance and insurance services in most countries, with negative growth rates in countries whose banking sectors were severely hit by the crisis, such as Iceland, Portugal, Spain and the United Kingdom. Productivity growth also slowed considerably in information and communication services, especially in Austria, Estonia, Greece, Hungary, Latvia, Luxembourg, the Netherlands, Norway, the Slovak Republic and the United States. In Ireland, high labour productivity growth in information and communication services in the post-crisis period reflects increasing flows of high-tech foreign direct investment of IT multinationals.

### *Definition*

Labour productivity growth by industry is defined as the rate of growth in real gross value added (in basic prices) per hour worked by industry. The figures present sectoral productivity growth for those countries which data on real gross value added and hours worked by sector are available by ISIC Rev.4 breakdown in the *OECD National Accounts Statistics* (database). For Japan, Korea and the United States, in the absence of national accounts data on total hours worked by main ISIC Rev.4 economic activity, the total number of persons employed (employees and self-employed) is used as a measure of labour input. The business sector services covers wholesale and retail trade, repair of motor vehicles and motorcycles, transportation and storage as well as accommodation and food services –presented here as "distributive trade, repairs; transport; accommodation, food services"–; information and communication services; financial and insurance activities; and professional, scientific and support activities.

### *Comparability*

The comparability of productivity growth across industries and countries may be affected by problems in measuring real value added. This is particularly relevant for those business sector services where it is difficult to isolate price effects that are due to changes in the quality (or in the mix of services provided as a bundle) from pure price changes. Despite substantial progress made over the past 15 years in compiling service producer price indices (SPPIs), the methods used to compute constant price value added still vary across countries, affecting the measurement of productivity growth (Chapter 8. ). Real estate activities are excluded from the business sector services, as their value added includes the imputation made for the dwelling services provided and consumed by home-owners.

## References

Ahmad, N., J. Ribarsky and M. Reinsdorf (2017), "Can potential mismeasurement of the digital economy explain the post-crisis slowdown in GDP and productivity growth?", *OECD Statistics Working Papers*, No. 2017/09, OECD Publishing, Paris, http://dx.doi.org/10.1787/a8e751b7-en.

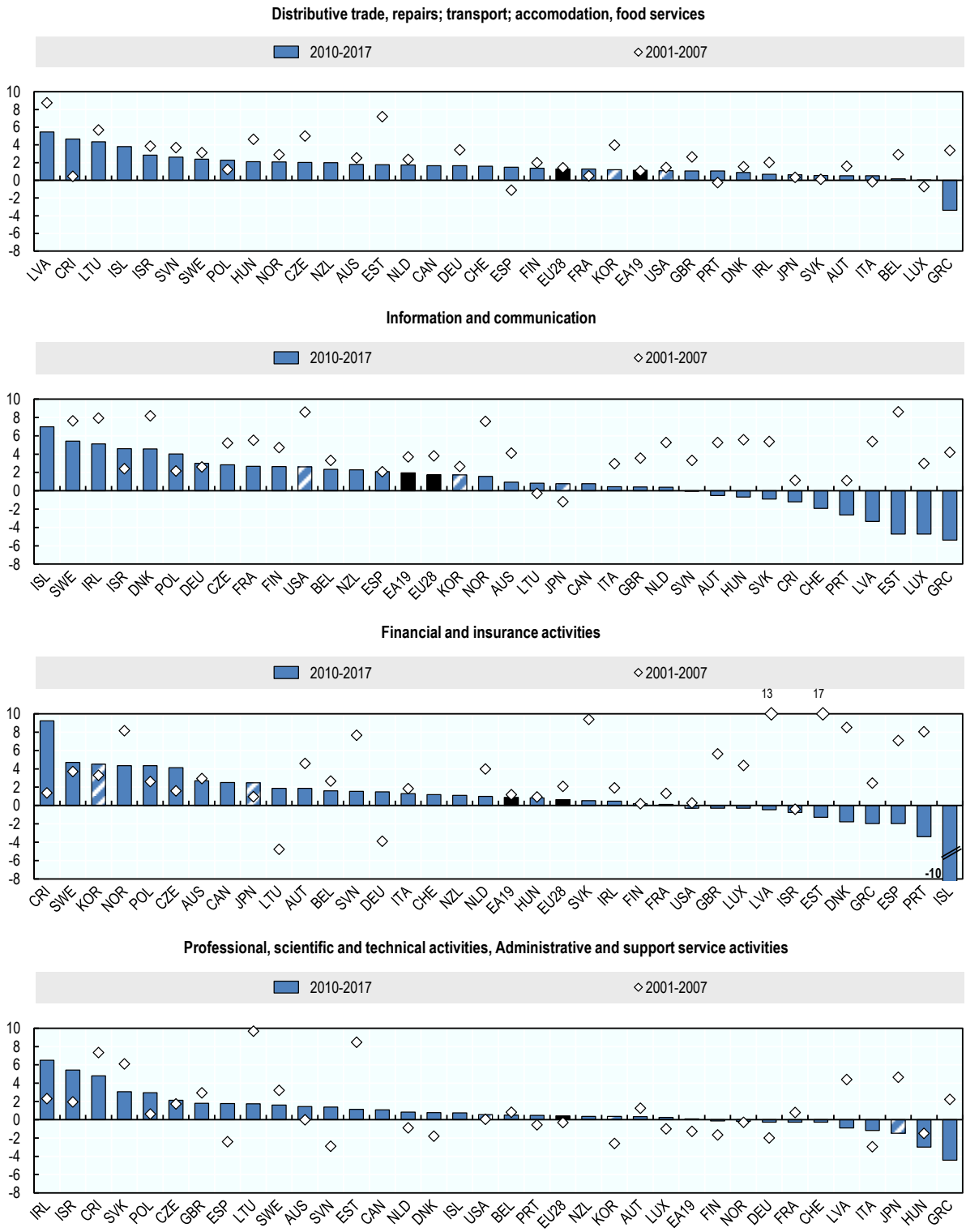
*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.

Wölfl, A. (2005), "The service economy in OECD countries", *OECD Science, Technology and Industry Working Papers*, No. 2005/3, http://dx.doi.org/10.1787/212257000720.

Wölfl, A. (2003), "Productivity growth in service industries – An assessment of recent patterns and the role of measurement", *OECD Science, Technology and Industry Working Papers*, No. 2003/7, http://dx.doi.org/10.1787/086461104618.

**Figure 3.4. Labour productivity in business sector services**

Real gross value added per hour worked, percentage change at annual rate

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## Contributions to business sector services' productivity

The business services sector has contributed significantly to GDP growth across OECD countries in recent decades, driven in large part by an increase in firms providing intermediate services to other firms, also in the manufacturing sector. This process of outsourcing activities previously conducted in-house has increased efficiencies, and hence, labour productivity, of both outsourcing firms and specialised intermediary firms. Over the long term, this may produce a structural shift towards intermediate services industries and a direct positive contribution of high productivity business services to productivity growth of the total economy.

**Key findings**

For most OECD countries, labour productivity growth in the business sector services over the past 15 years was mainly driven by distributive trade, hotels and transport services, reflecting their much larger share of overall economic activity and employment. In the pre-crisis period strong productivity growth in finance and insurance activities also acted as a significant contributor, however the post-crisis contribution has been weaker.

### *Definition*

The contribution of each services sector to labour productivity growth of the total business sector services is computed as the weighted difference between the growth rate of real gross value added and that of hours worked. The weights are preferably computed as each individual sector's share in nominal gross value added and total hours worked respectively of total business sector services. For Japan, Korea and the United States, in the absence of national accounts data on total hours worked by main ISIC Rev.4 economic activity, the weights are computed using the total number of persons employed (employees and self-employed). Business sector services include wholesale and retail trade, repair of motor vehicles and motorcycles, transportation and storage as well as accommodation and food services –presented here as "trade, hotels and transport"-; information and communication services; financial and insurance activities; and professional, scientific and support activities – reported here as "professional services".

### *Comparability*

The contribution of any particular services activity to total business sector services productivity depends critically on its share in total nominal value added and total hours worked. In addition to the difficulties encountered in measuring price changes in the services sector, for some services, it is also difficult to accurately measure nominal output and value added. In financial activities, for example, the services provided are not always explicitly charged for and can only be measured indirectly.

## References

*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.

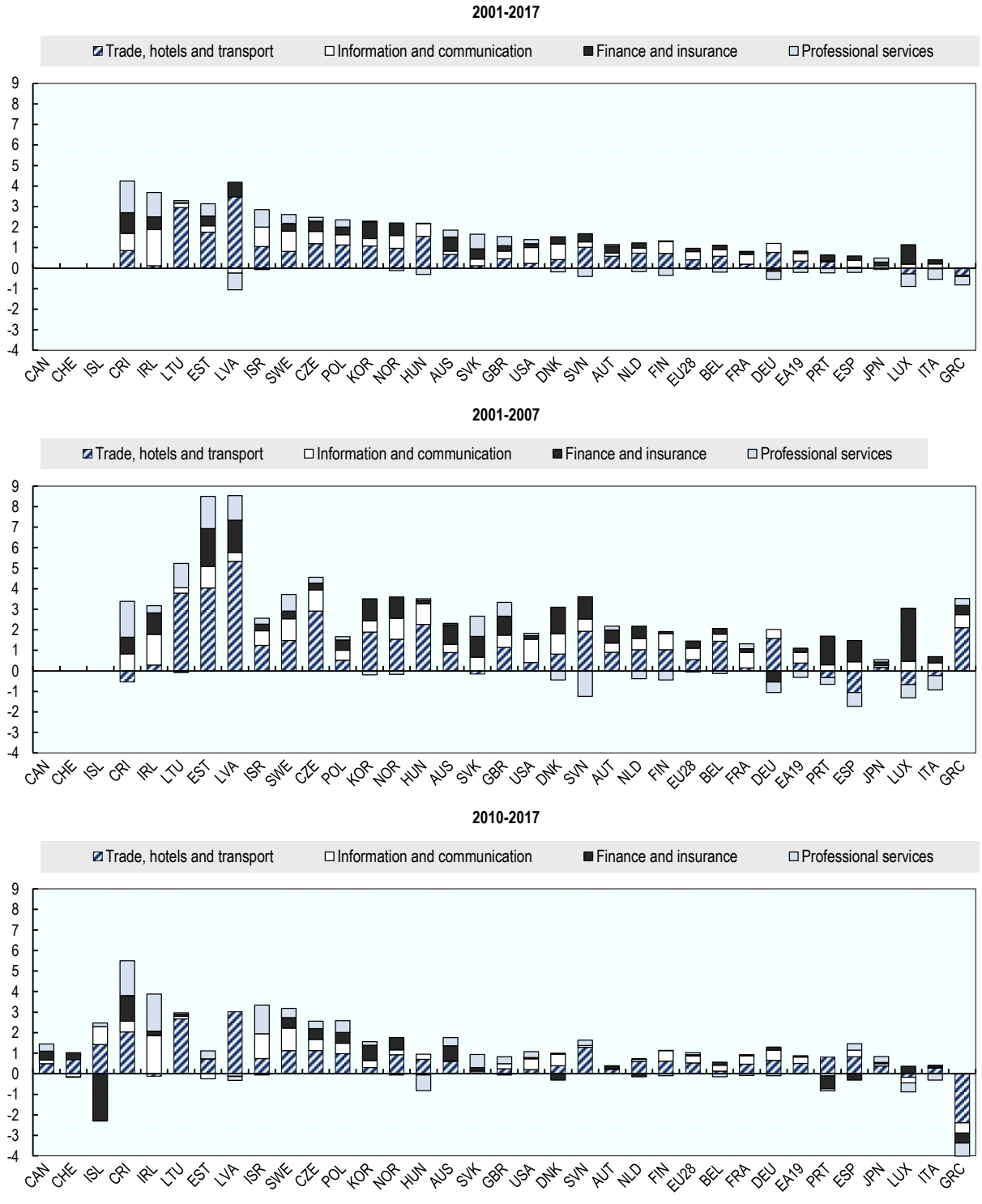
Pilat, D. and A. Wölfl (2005), "Measuring the interaction between manufacturing and services", *OECD Science, Technology and Industry Working Papers, No.* 2005/5, http://dx.doi.org/10.1787/882376471514.

Wölfl, A. (2005), "The service economy in OECD countries", *OECD Science, Technology and Industry Working Papers*, No. 2005/3, http://dx.doi.org/10.1787/212257000720.

Wölfl, A. (2003), "Productivity growth in service industries – An assessment of recent patterns and the role of measurement", *OECD Science, Technology and Industry Working Papers*, No. 2003/7, http://dx.doi.org/10.1787/086461104618.

**Figure 3.5. Contributions to productivity growth of business sector services excluding real estate**

Real gross value added per hour worked, percentage point contribution at annual rate

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## Labour productivity in information and communication services

Information and communication technologies (ICT) facilitate the processing, transmission and display of information, playing an increasingly important role in the production, distribution and consumption of goods and services. ICT services enable firms in different industries to adopt new technologies and processes, and, as such, are an important driver of productivity growth.

**Key findings**

Labour productivity levels in information and communication services are generally higher than average levels in the total economy. In 2017, Costa Rica, Ireland and Mexico, showed labour productivity levels in information and communication services that were more than twice the total economy average but this is not universally true: in Australia, Luxembourg and New Zealand, for example, they were lower.

Like other sectors, however labour productivity growth has slowed in information and communication services, and this has been widespread, spanning nearly all sub-sectors, including publishing, audiovisual and broadcasting activities; telecommunications; information technology and other information services.

### *Definition*

Labour productivity is calculated as the ratio between each sector's value added and the total number of hours worked. For Japan, Korea, and the United States, in the absence of national accounts data on total hours worked in the information and communication services sector (ISIC Rev.4 category J), the total number of persons employed (employees and self-employed) is used as a measure of labour input. For Latvia, Mexico and the United States, in the absence of national accounts data on total hours worked in the sub-sectors of information and communication services, the total number of persons employed (employees and self-employed) is used as a measure of labour input.

### *Comparability*

Volume estimates of value added in information and communication services are complicated by challenges in measuring output prices of the activities, and in particular, how these capture quality improvements associated with technological advances. The use of hedonic deflators is generally considered as the best way to address these problems. However, comparisons of price movements of ICT services point to significant differences in price measurement across countries (Ahmad et. al, 2017), which although not significantly impacting on whole economy productivity estimates can have an impact on more detailed sectoral analyses.

## References

Ahmad, N., J. Ribarsky and M. Reinsdorf (2017), "Can potential mismeasurement of the digital economy explain the post-crisis slowdown in GDP and productivity growth?", *OECD Statistics Working Papers*, No. 2017/09, OECD Publishing, Paris, http://dx.doi.org/10.1787/a8e751b7-en.

*OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.

Schreyer, P. (2002), "Computer prices indices and international growth and productivity comparisons", *Review of Income and Wealth*, Number 1, Series 48.

**Figure 3.6. Labour productivity in information and communication services, 2017**

As a ratio of real gross value added per hour worked in the total economy

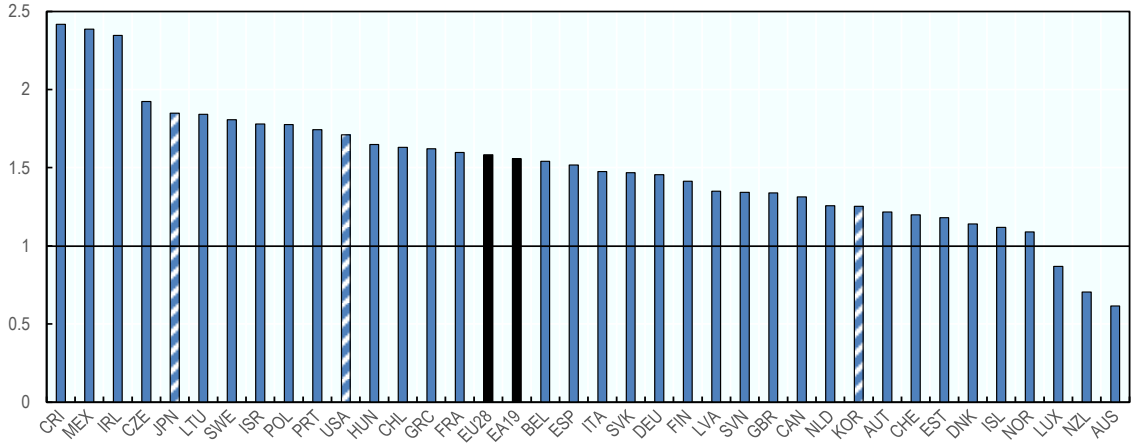


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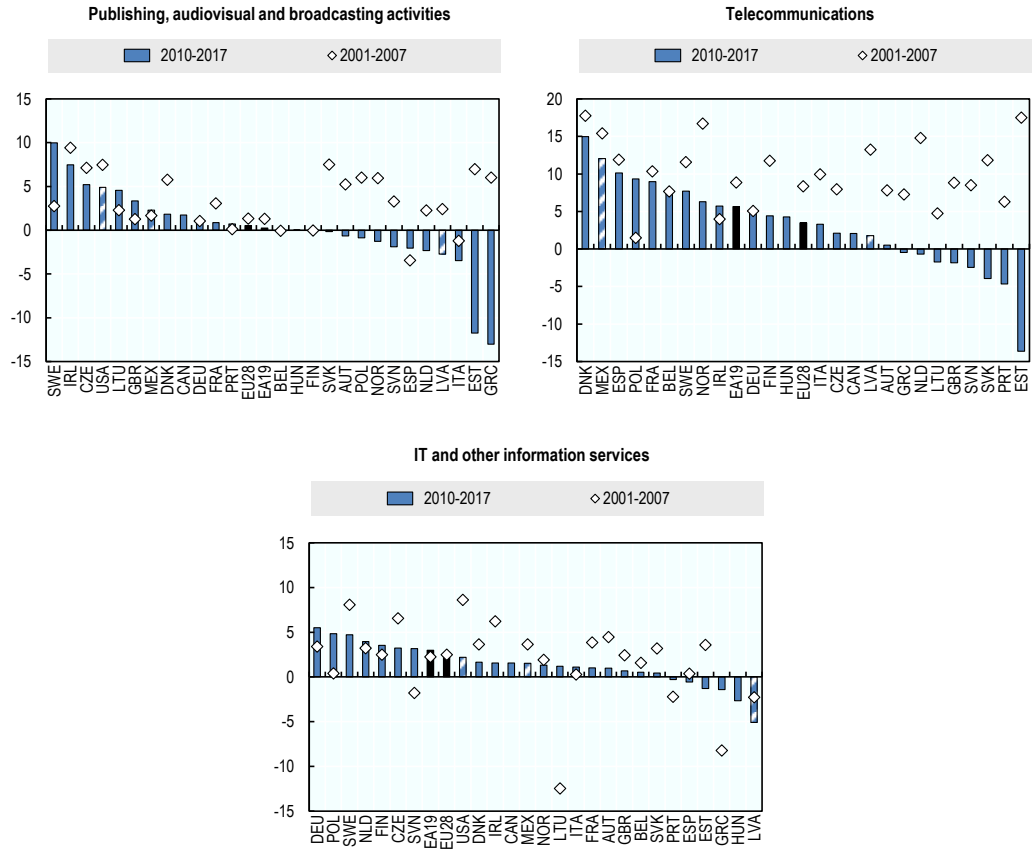
**Figure 3.7. Labour productivity in information and communication services, selected sectors**

Real gross value added per hour worked, percentage change at annual rate

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# Chapter 4. **Productivity in SMEs and large firms**

Productivity gaps between SMEs and large firms
Productivity growth in SMEs and large firms
Productivity in SMEs and large firms in ICT activities

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## Productivity gaps between SMEs and large firms

Productivity analyses typically focus on relatively aggregated industries, masking the heterogeneity in productivity among firms within the same sector and, in particular, the contribution of SMEs; these recognised as important drivers of growth as they scale-up. In this sense, firm heterogeneity matters for productivity. To the extent that large firms can exploit increasing returns to scale, productivity tends to increase with firm size. However, new small firms are often found to spur aggregate productivity growth as they enter with new technologies and stimulate productivity-enhancing changes by incumbents.

**Key findings**

In the manufacturing sector, where production tends to be more capital-intensive and larger firms can exploit increasing returns to scale, large firms show almost consistently higher levels of productivity than smaller ones. However, the relative size of productivity differences between larger and smaller manufacturing firms varies considerably across countries, reflecting in part composition effects (i.e. the specific sub-sectors in which SMEs engage). In the United Kingdom, micro-firms in the manufacturing sector have about 60% the productivity of large firms compared with about 10% in Greece and Mexico. Similarly for services, SMEs in Denmark and Sweden operate at productivity levels closer to those of larger firms but in Greece productivity levels of SMEs are between 15% and 80% lower than large firms.

Differences in productivity across firms of different size are relatively smaller in the services sector. In many countries, medium-sized firms outperform large firms, pointing to competitive advantages in niche, high brand or high intellectual property content activities as well as the intensive use of affordable ICT.

### *Definition*

Labour productivity by enterprise size class is measured as gross value added in current prices per person employed. Labour input is measured as total employment, which includes employees and all other paid or unpaid persons who worked for the concerned unit during the reference year. Data on hours worked by all persons employed are typically not available by enterprise size class.

In the *OECD Structural and Demographic Business Statistics* (database), 'business economy' covers: mining and quarrying, manufacturing, electricity, gas, steam and air conditioning supply, water supply, sewerage, waste management and remediation activities, construction and business services (excluding finance and insurance activities). Business services include wholesale and retail trade, repair of motor vehicles and motorcycles; transportation and storage; accommodation and food services; information and communication services; real estate activities; and professional, scientific, administrative and support activities.

### *Comparability*

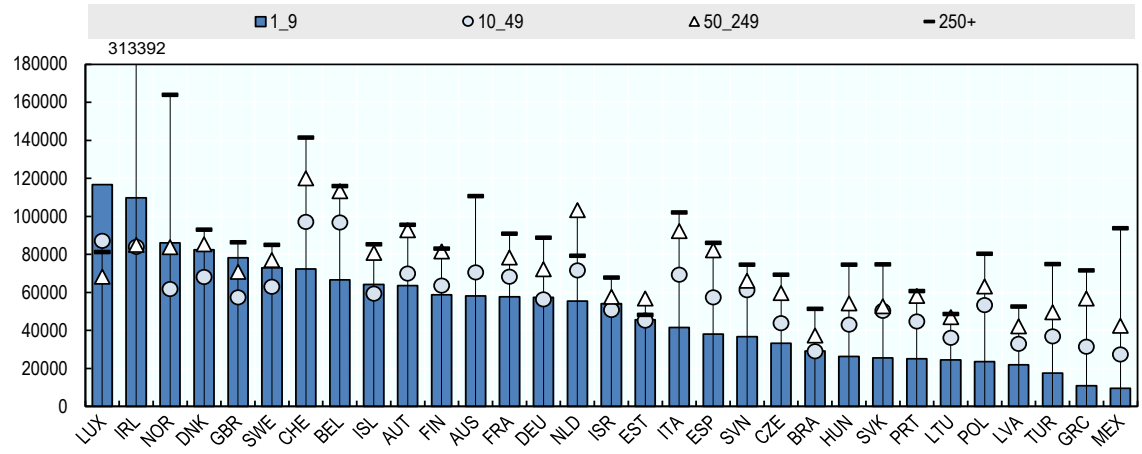
Value added estimates for different enterprise size classes are based on *OECD Structural and Demographic Business Statistics* (database) and will typically not align with estimates in national accounts. The latter include a number of adjustments to reflect businesses and activities that may not be covered in structural business statistics, such as those made to reflect the non-observed economy. Since labour input is measured as total employment, comparability of labour productivity measures by size class may be affected by differences in the share of part-time employment. In addition, productivity differences in main aggregate sectors could mask different productivity patterns in more narrowly defined industries.

## References

*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.
*OECD Structural and Demographic Business Statistics* (database), http://dx.doi.org/10.1787/sdbs-data-en.
OECD (2017), *Entrepreneurship at a Glance 2017*, OECD Publishing, Paris. http://dx.doi.org/10.1787/entrepreneur_aag-2017-en.

**Figure 4.1. Labour productivity in SMEs and large firms, business economy**

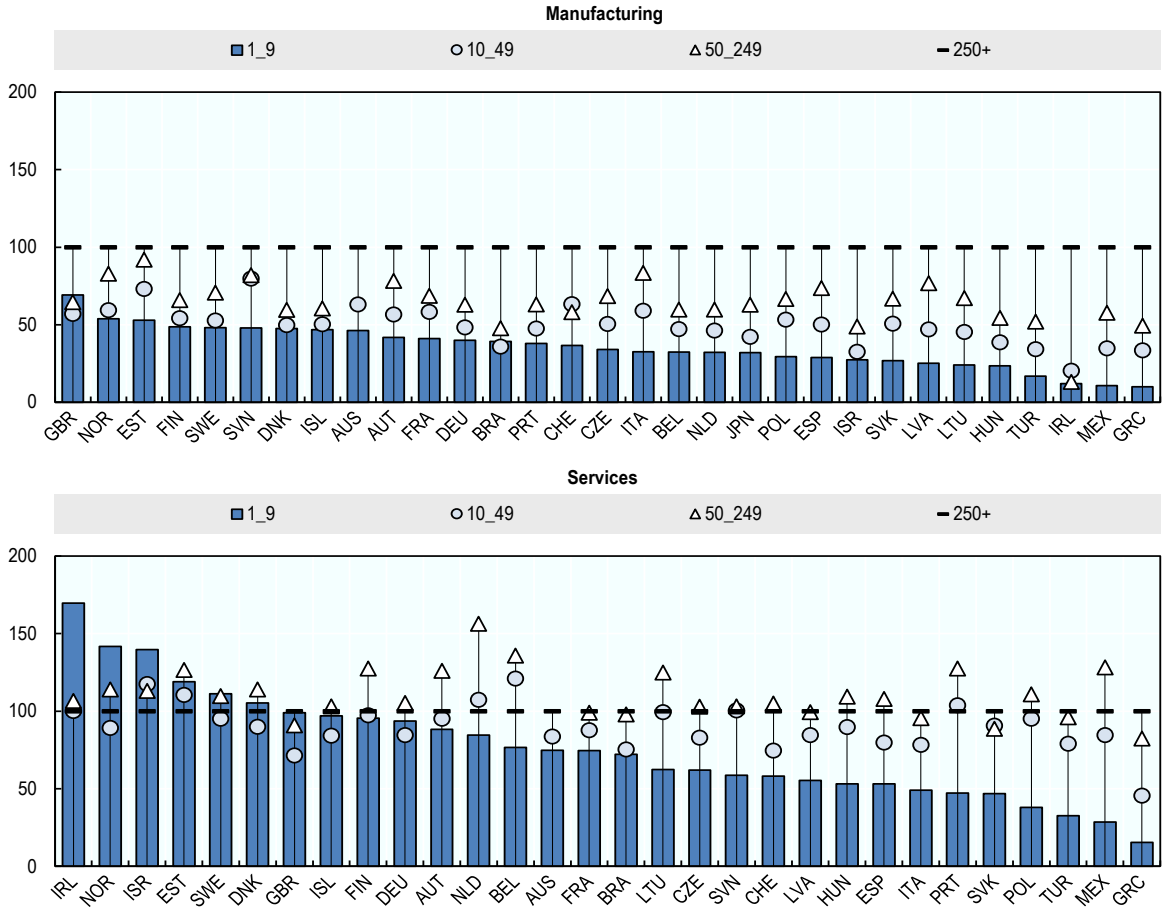
Value added per person employed, USD, current PPPs, 2016 or latest available year




StatLink http://dx.doi.org/10.1787/888933968801

**Figure 4.2. Labour productivity in SMEs and large firms, manufacturing and business services**

Value added per person employed, index 250+=100, 2016 or latest available year

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## Productivity growth in SMEs and large firms

Firm-level performance depends on a variety of factors, including the size of the enterprise and its sector of activity. While larger firms tend to be more productive than smaller ones, productivity growth in smaller firms may be spurred by the intensive use of information and communication technologies (ICT), digital tools, and new innovations particularly in new or younger firms.

**Key findings**

Labour productivity growth in SMEs and large firms varies significantly across countries and sectors. Although there have been growing concerns of winner-take all dynamics of larger firms, and a slowdown in the diffusion of productivity from frontier firms, this is not universally true. In many economies, post-crisis labour productivity growth in SMEs in manufacturing, construction, wholesale and retail trade, and professional, scientific and technical activities has outpaced that in large firms.

### *Definition*

Labour productivity by enterprise size class is measured as gross value added in current prices per person employed, divided by the industry deflator sourced from the *OECD National Accounts Statistics* (database). Labour input is measured as total employment, which includes employees and all other paid or unpaid persons who worked for the concerned unit during the reference year. Data on hours worked by all persons employed are typically not available by industry and enterprise size class.

### *Comparability*

Value added estimates for different enterprise size classes are based on *OECD Structural and Demographic Business Statistics* (database) and will typically not align with estimates in national accounts. The latter include a number of adjustments to reflect businesses and activities that may not be covered in structural business statistics, such as those made to reflect the non-observed economy. In the absence of gross value added deflators by firm size class, deflators for gross value added in each industry are necessarily assumed to be equal across firm size classes and might affect the comparability across firms, industries and countries.

Since labour input is measured as total employment, comparability of labour productivity measures by size class may be affected by differences in the share of part-time employment. In addition, productivity differences in main aggregate sectors could mask different productivity patterns in more narrowly defined industries. This may in turn reflect differences in the value of goods and services produced, as well as different intensities in the use of knowledge-based capital.

Because the estimates presented here are not based on a fixed cohort of firms, estimates of productivity growth by firm size may be biased. SMEs exhibiting higher productivity growth at the start of the period are also more likely to become larger enterprises while low productivity large enterprises are more likely to contract and become SMEs.

## References

*OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.
*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.
*OECD Structural and Demographic Business Statistics* (database), http://dx.doi.org/10.1787/sdbs-data-en.
OECD (2017), *Entrepreneurship at a Glance 2017*, OECD Publishing, Paris. http://dx.doi.org/10.1787/entrepreneur_aag-2017-en.

**Figure 4.3. Labour productivity growth in SMEs and large firms, manufacturing, 2010-2016**

Real value added per person employed, percentage change at annual rate

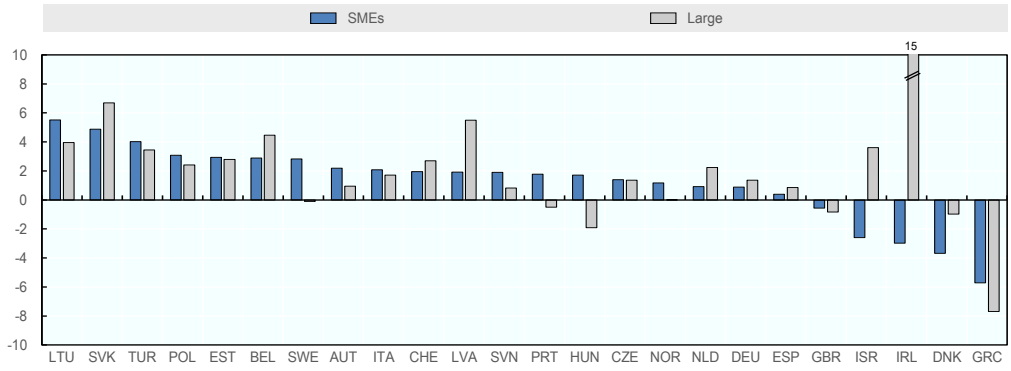


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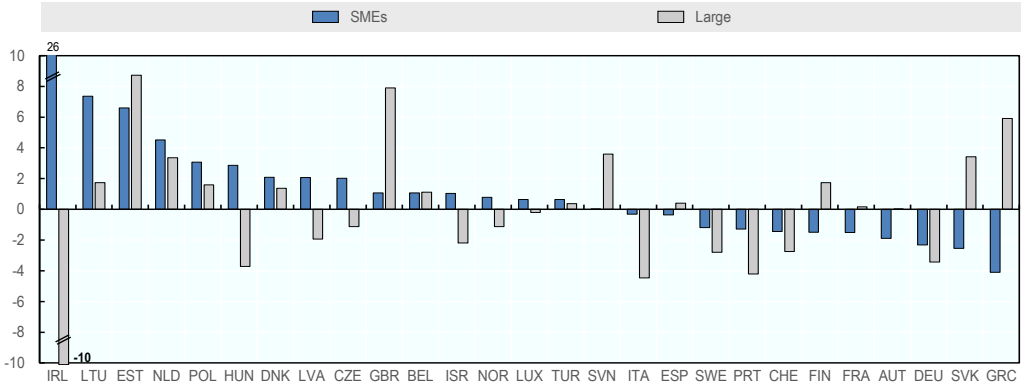
**Figure 4.4. Labour productivity growth in SMEs and large firms, construction, 2010-2016**

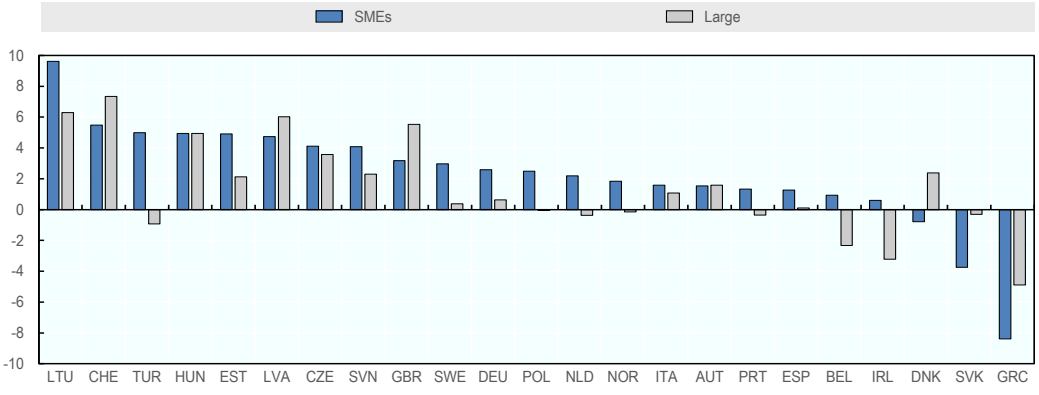
Real value added per person employed, percentage change at annual rate




StatLink http://dx.doi.org/10.1787/888933968858

**Figure 4.5. Labour productivity growth in SMEs and large firms, wholesale and retail trade, 2010-2016**

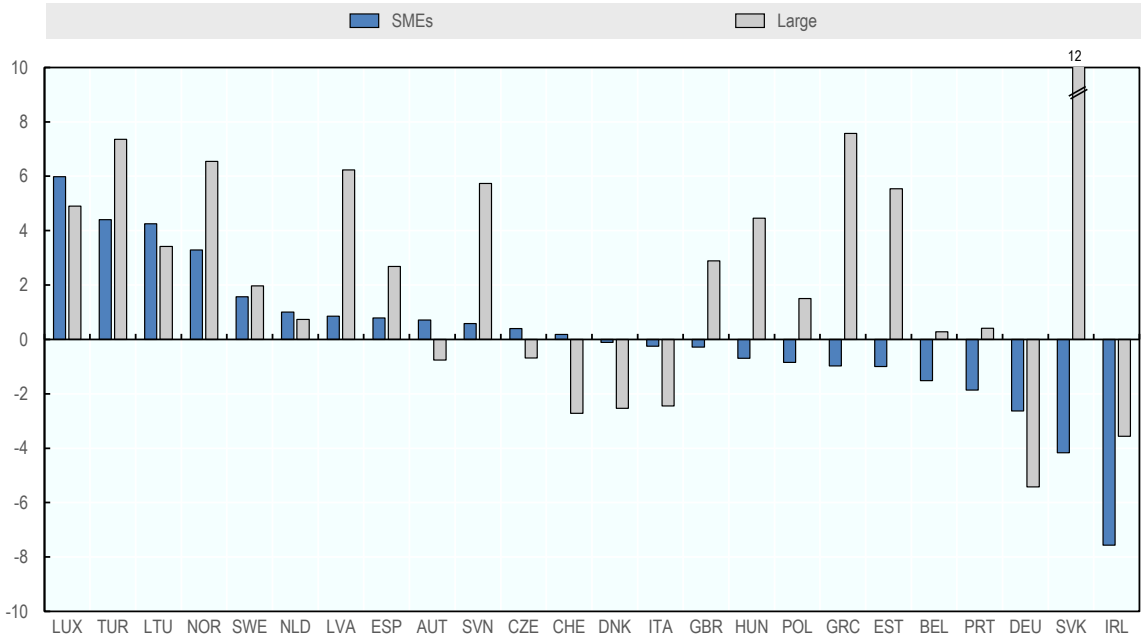
Real value added per person employed, percentage change at annual rate




StatLink http://dx.doi.org/10.1787/888933968877

**Figure 4.6. Labour productivity growth in SMEs and large firms, transportation and storage, 2010-2016**

Real value added per person employed, percentage change at annual rate




StatLink http://dx.doi.org/10.1787/888933968896

**Figure 4.7. Labour productivity growth in SMEs and large firms, accommodation and food service activities, 2010-2016**

Real value added per person employed, average annual rate

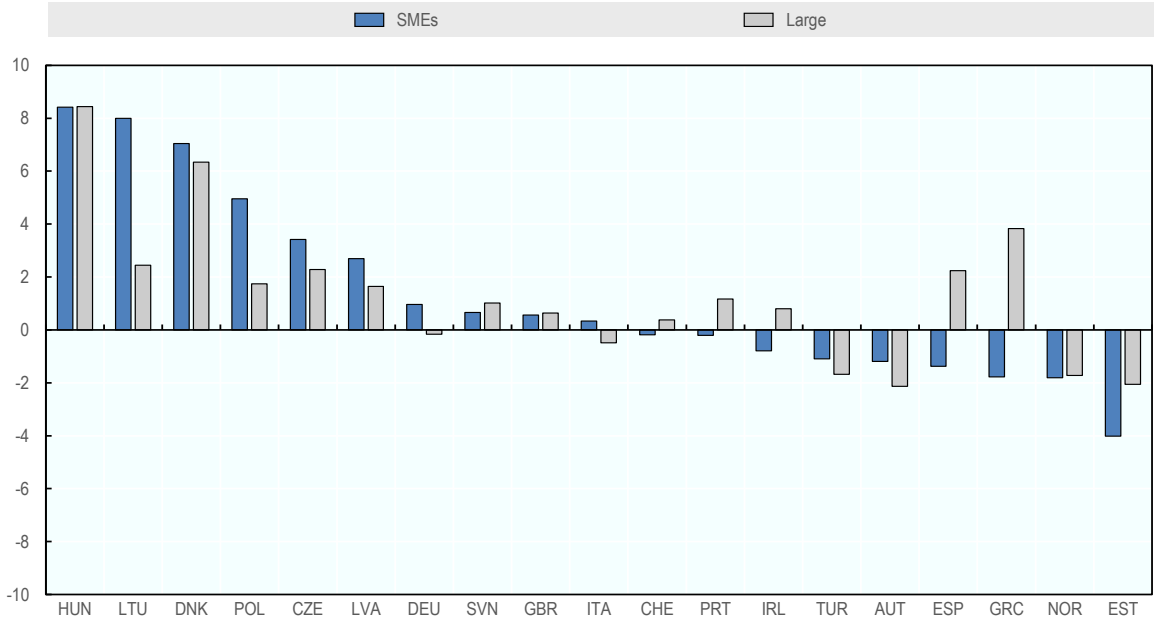



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**Figure 4.8. Labour productivity growth in SMEs and large firms, professional, scientific and technical activities, 2010-2016**

Real value added per person employed, percentage change at annual rate

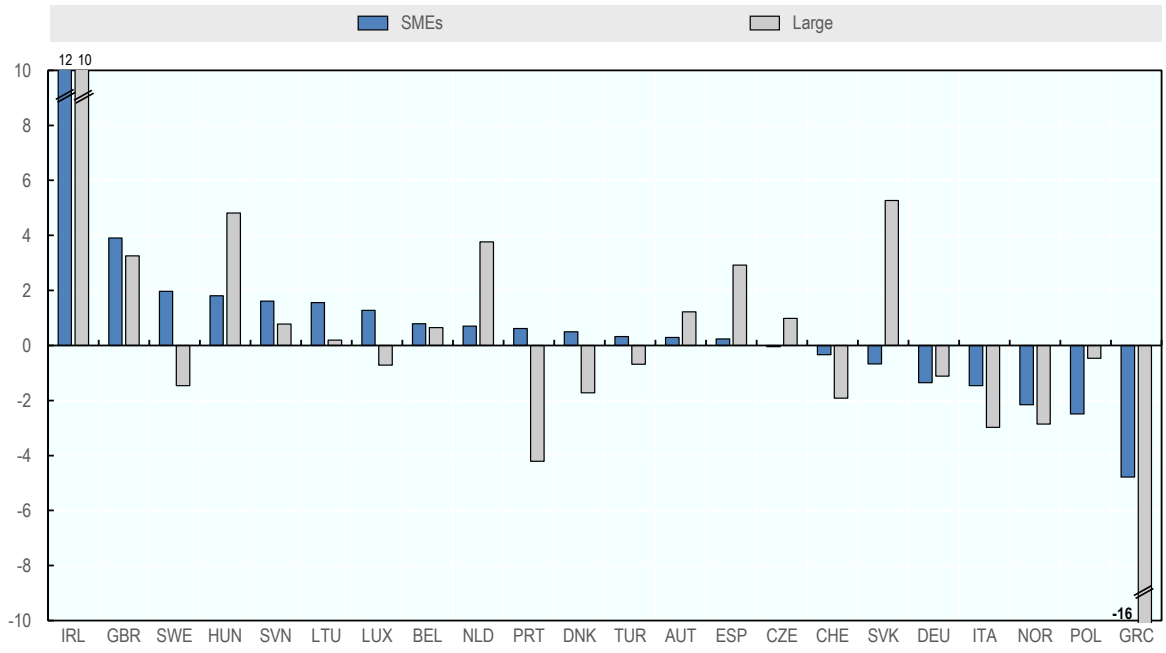


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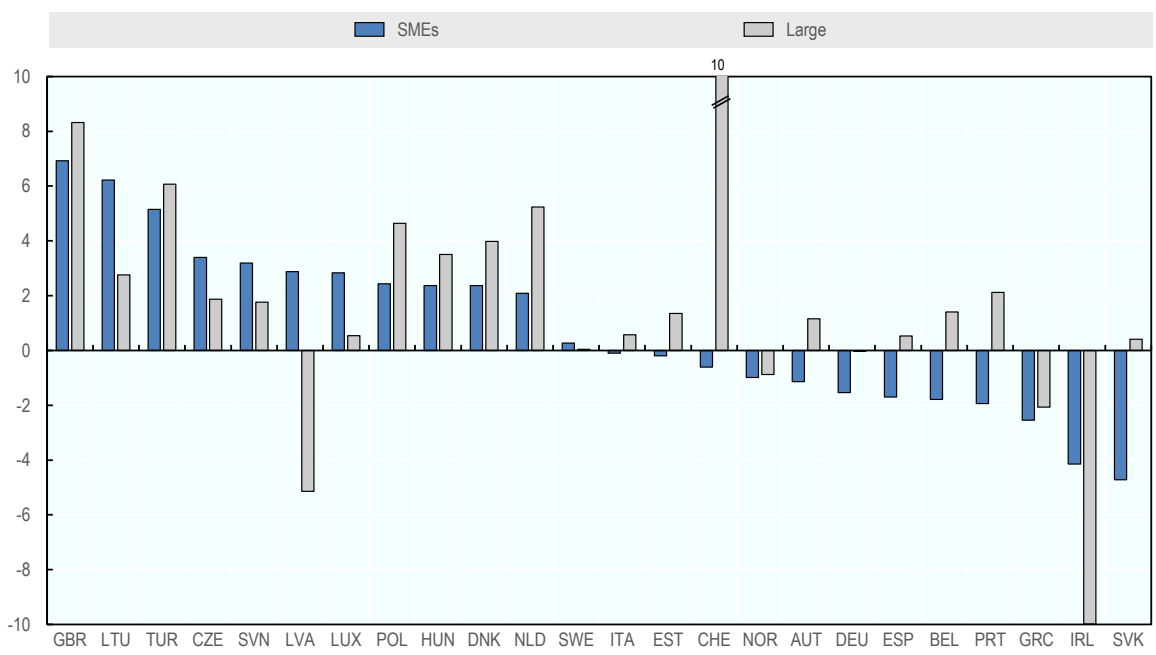
**Figure 4.9. Labour productivity growth in SMEs and large firms, administrative and support service activities, 2010-2016**

Real value added per person employed, percentage change at annual rate

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## Productivity in SMEs and large firms in ICT activities

Information and communication technologies play an increasingly important role in modern economies. By reducing the cost of innovation and increasing market access, ICT have created business opportunities for new, typically small, tech firms that can compete with well-established large tech enterprises.

**Key findings**

In most OECD economies, start-up rates in information and communication services (ICT) have been above those in the business economy, particularly in Denmark, Iceland, Poland, and Portugal.

Large firms typically have higher labour productivity than SMEs in information and communication activities. However, gaps vary considerably across countries. In Iceland and Sweden, for example, micro firms have about 60% the productivity of large firms compared with less than 20 percent in Greece, Hungary, Korea, Mexico and Portugal. In addition, medium-sized firms in the ICT services sector in Denmark and Finland operate at productivity levels closer to those of large firms, compared to around 40% to 80% in most countries.

Although significant gaps in levels exist, in most economies, SME productivity growth has outpaced that of large firms, in particular in the Baltic States and Portugal.

### *Definition*

Labour productivity by enterprise size class is measured as gross value added in current prices per person employed, divided by the industry deflator sourced from *OECD National Accounts Statistics* (database). Labour input is measured as total employment, which includes employees and all other paid or unpaid persons who worked for the concerned unit during the reference year. Data on hours worked by all persons employed are typically not available by industry and enterprise size class.

### *Comparability*

Value added estimates for different enterprise size classes are based on *OECD Structural and Demographic Business Statistics* (database) and will typically not align with estimates in national accounts. The latter include a number of adjustments to reflect businesses and activities that may not be covered in structural business statistics, such as those made to reflect the non-observed economy. Since labour input is measured as total employment, comparability of labour productivity measures by size class may be affected by differences in the share of part-time employment. In addition, productivity differences in main aggregate sectors could mask different productivity patterns in more narrowly defined industries. This may in turn reflect differences in the value of goods and services produced, as well as different intensities in the use of knowledge-based capital.

## References

*OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.
*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.
*OECD Structural and Demographic Business Statistics* (database), http://dx.doi.org/10.1787/sdbs-data-en.
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OECD (2019), *SME and Entrepreneurship Outlook*, OECD Publishing, Paris, forthcoming.

**Figure 4.10. Start-up rates in information and communication services over 2010-2016**

Share of employer firms with 0-2 years in total number of firms in the sector, average of the period, percentage

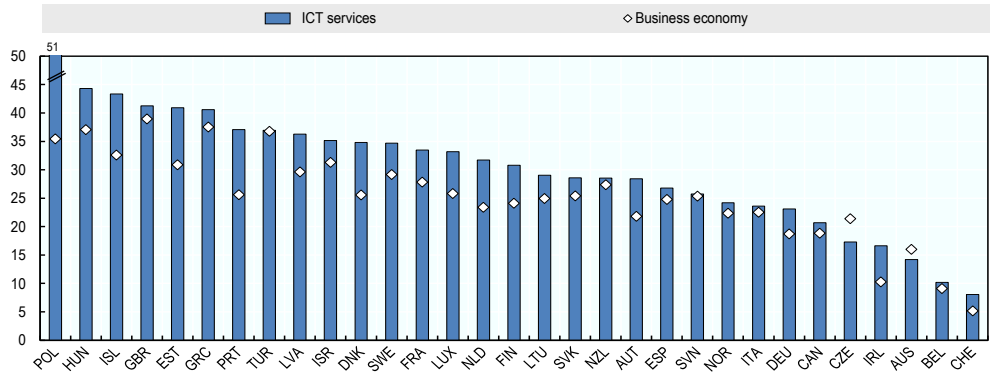


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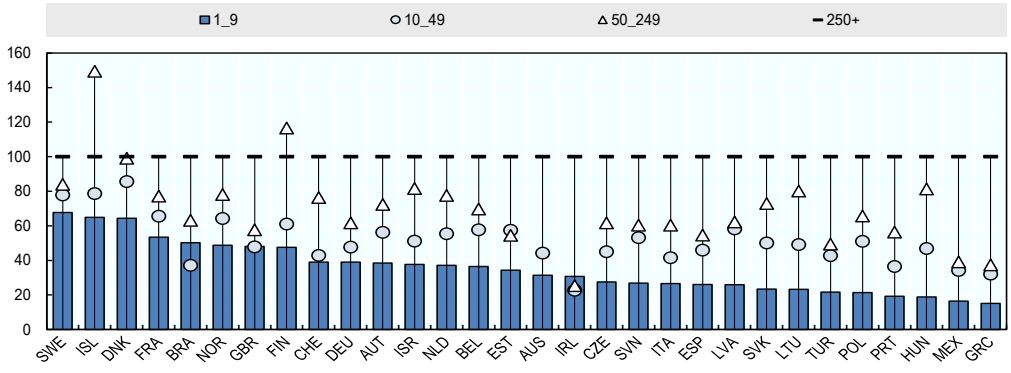
**Figure 4.11. Labour productivity in SMEs and large firms, ICT services**

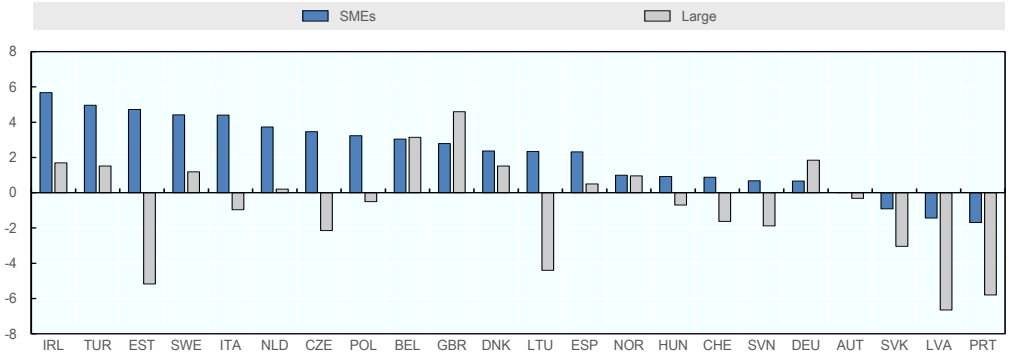
Value added per person employed, index 250+=100, 2016 or latest available year




StatLink http://dx.doi.org/10.1787/888933968991

**Figure 4.12. Labour productivity growth in SMEs and large firms, ICT services, 2010-2016**

Real value added per person employed, percentage change at annual rate




StatLink http://dx.doi.org/10.1787/888933969010

# Chapter 5. **Productivity, trade and international competitiveness**

Unit labour costs
International competitiveness
The importance of global value chains

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## Unit labour costs

Unit labour costs (ULCs) reflect total labour costs relative to a volume of output. Hence, growth in unit labour costs is often viewed as a broad measure of the international cost competitiveness of firms within a country.

**Key findings**

Over the last 15 years, many OECD countries improved their relative competitiveness by keeping ULCs in check in both manufacturing and business sector services, as was the case in Belgium, Germany, Ireland, and Portugal. In these countries, low increases in ULCs reflected relatively strong labour productivity growth and/or moderate wage increases. In the Czech Republic, Korea, Poland, the Slovak Republic and Slovenia, large productivity gains helped to keep ULCs in check despite significant wage increases.

Within Europe, Greece, Ireland, Portugal and Spain saw strong falls in their ULCs since the onset of the financial crisis. However, care is needed in interpreting these results as improved relative competiveness, as they need to be balanced against the significant falls in output and labour input seen during that period.

### *Definition*

ULCs are defined as the average cost of labour per unit of output produced. They can be expressed as the ratio of total labour compensation per hour worked to output per hour worked (labour productivity). Total output is measured here as Gross domestic product (GDP) in constant prices for the total economy and as gross value added in constant prices for economic activities; while total labour compensation is expressed in current prices. Compensation of employees is defined as the total remuneration payable by an enterprise to an employee in return for work done by the latter during the accounting period. It includes wages and salaries payable in cash or in kind, as well as social insurance contributions paid by employers. Total labour compensation is for total persons employed (i.e. employees and self-employed).

### *Comparability*

The data are presented for the total economy, manufacturing and business sector services (which exclude real estate activities) according to the ISIC Rev.4 classification. The series used to construct the ULC measures and its components are primarily sourced from the *OECD National Accounts Statistics* (database) and disseminated in the *OECD Productivity Statistics* (database). The figures present the data for those countries for which time series of sectoral hours worked are available in the *OECD National Accounts Statistics* (database).

Manufacturing ULCs are often perceived as more representative for assessing competition in tradable products. Services prices are often not very reliable, which may affect the cross-country comparability of measured business sector services ULCs.

## References

*OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.
*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.

**Figure 5.1. Unit labour costs, hourly labour compensation and productivity, total economy**

Percentage change at annual rate

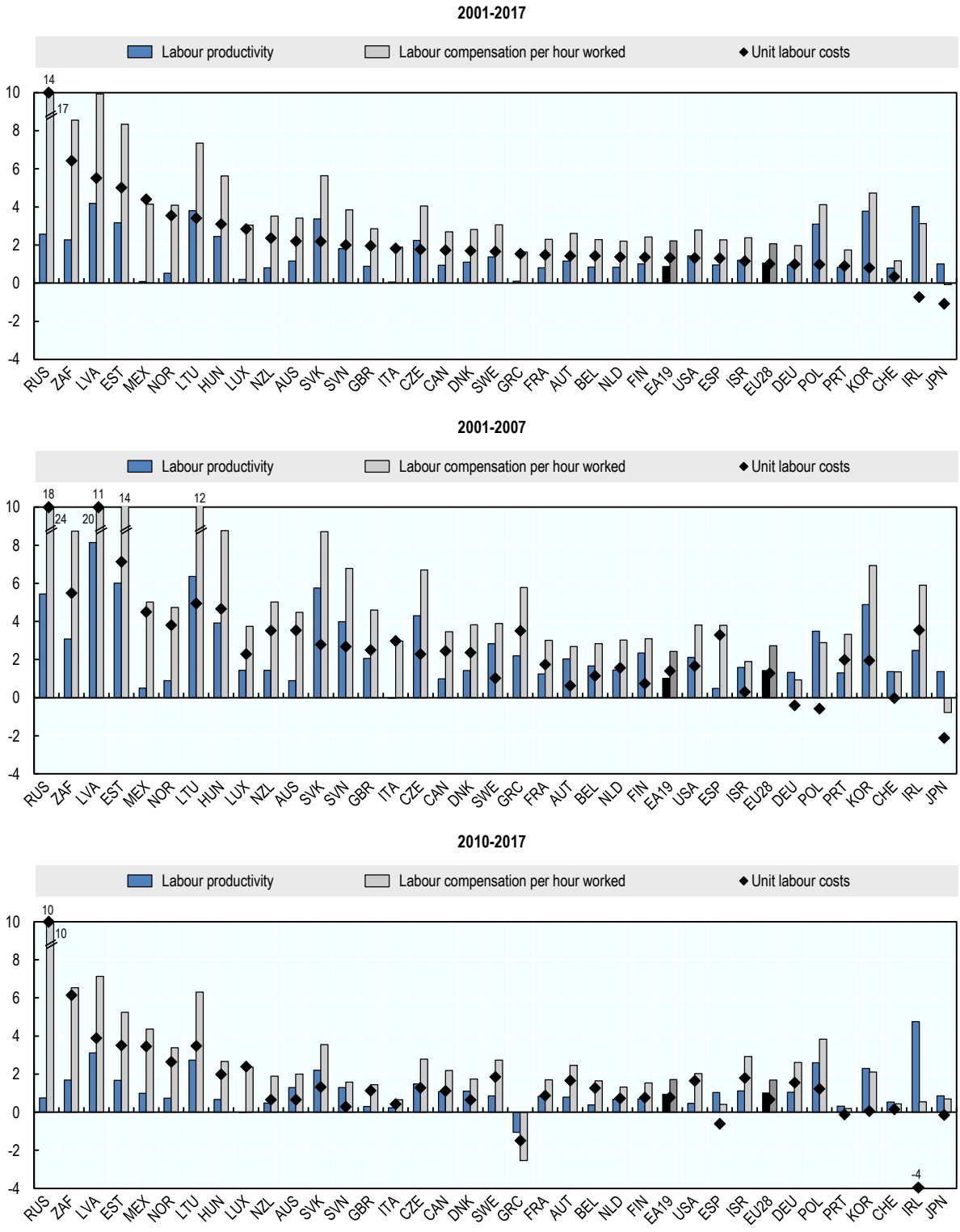



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**Figure 5.2. Unit labour costs, hourly labour compensation and productivity, manufacturing**

Percentage change at annual rate

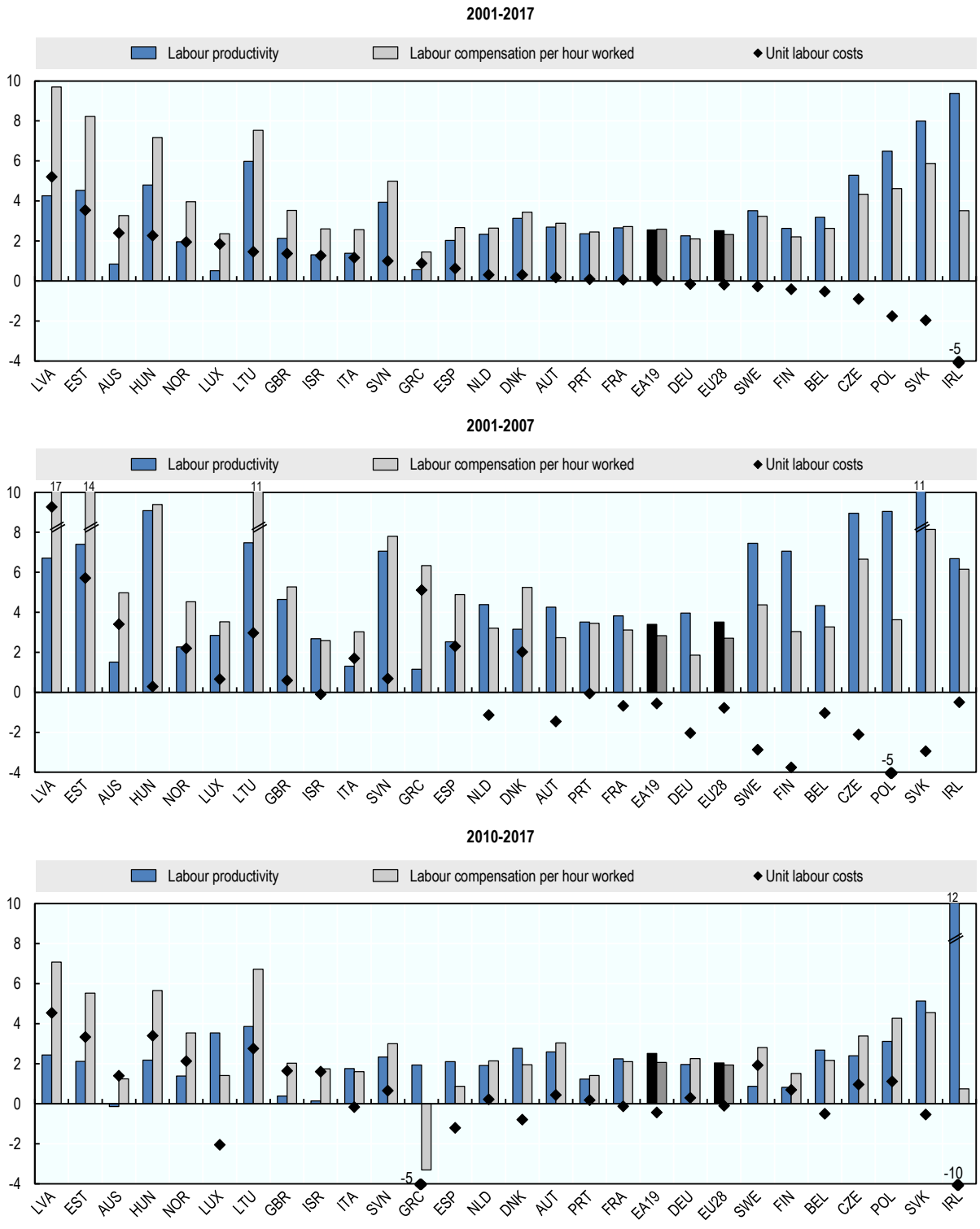


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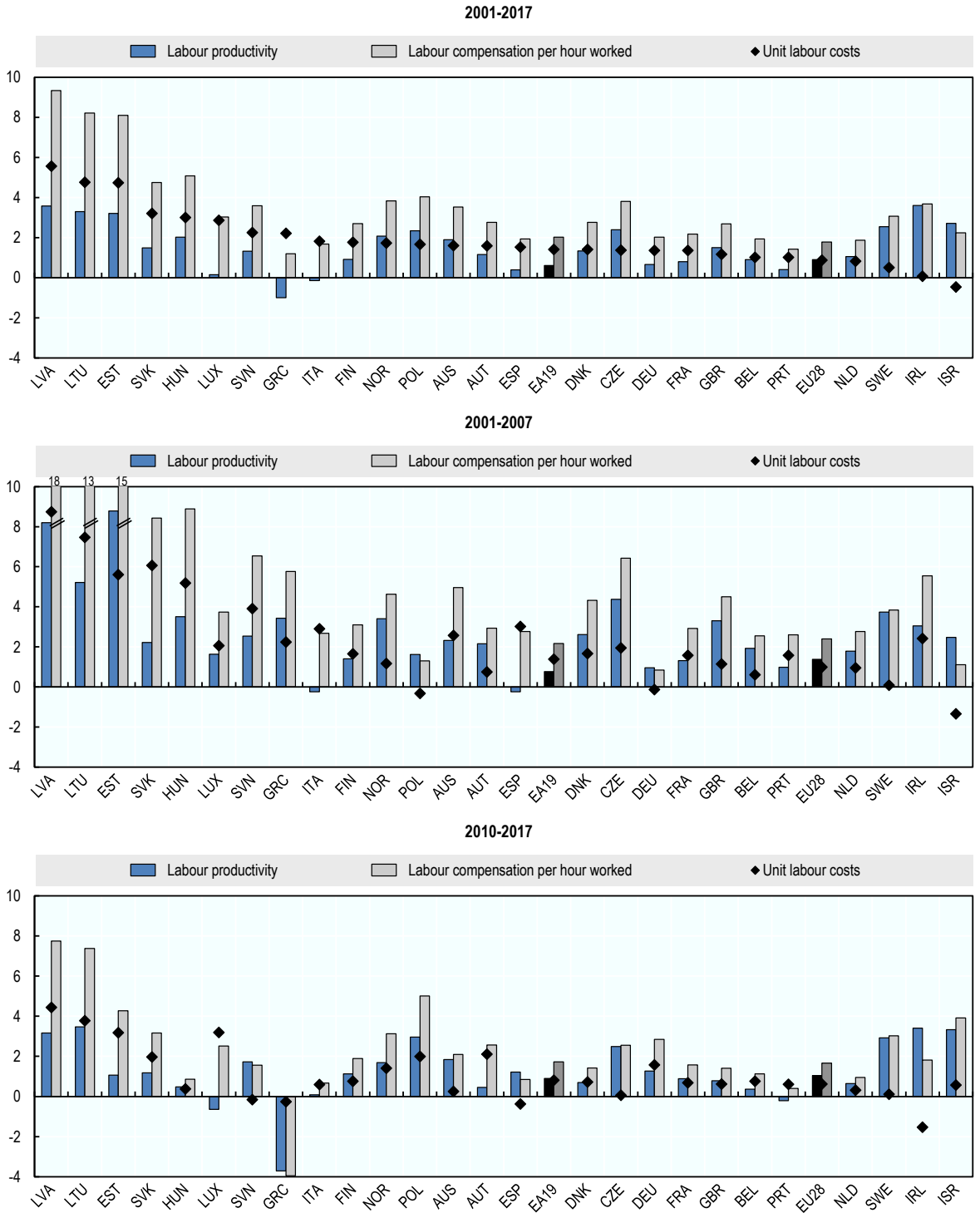
**Figure 5.3. Unit labour costs, hourly labour compensation and productivity, business sector services excluding real estate**

Percentage change at annual rate

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## International competitiveness

Despite their frequent use, unit labour costs (ULCs) are an incomplete measure of international competitiveness, as they deal exclusively with the cost of labour and do not consider changes in the cost of capital or intermediate inputs. For this reason, they need to be complemented with other indicators. In an era of global value chains, a measure based only on the costs of domestic labour may not be representative of overall cost competitiveness of firms within a country. Moreover, ULCs as a measure of cost-competitiveness cannot capture the capacity of firms to serve international markets through high quality goods and services and where demand is relatively price inelastic.

**Key findings**

Over the last 15 years, global market shares for all G7 countries have decreased, partly reflecting the growth of emerging economies. But the pace of this decline has varied across countries. In Germany and the United States, for example, where ULCs have been kept in check compared with other countries, export performance held up well, while the opposite was true for Canada, France, Italy, and the United Kingdom. In Japan, the market share fell despite declining ULCs and real effective exchange rates.

### *Definition*

Export performance is measured as actual growth in exports relative to the growth of the country's export market. The export market share for a single country measures the share of exports by firms in that country in relation to world exports of all countries. Real effective exchange rates take account of price level differences between trading partners and provide an indication of the evolution of a country's aggregate external price competitiveness. ULCs are defined as the average cost of labour per unit of output produced.

### *Comparability*

Export performance and export market shares are based on gross trade data which may overstate the performance of countries specialised in goods and services that are typically downstream in global value chains, and so have lower value added to export ratios.

Trade statistics do not always consistently measure flows between affiliated enterprises. This is especially so for trade in intellectual property products where payments may often be recorded as property income payments.

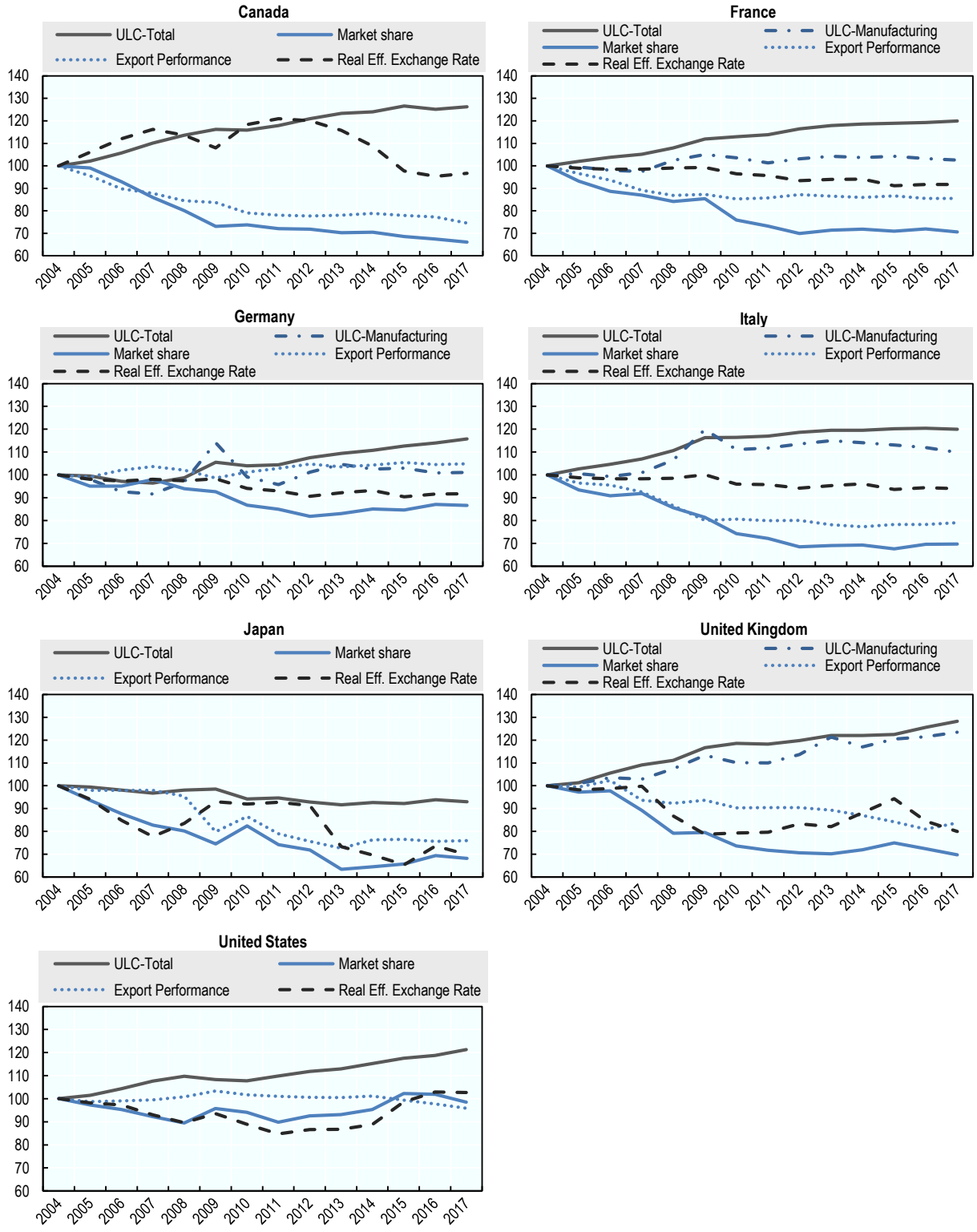
Manufacturing ULCs are often perceived as more representative for competition in tradable products, but they do not account for the increasing trade in services. Services prices are often not very reliable, and therefore may affect cross-country comparability of ULCs in business sector services. Looking at total economy ULCs somewhat alleviates these concerns, but their coverage goes significantly beyond the tradable sector. ULC data are only presented for those countries for which sectoral hours worked data are available according to the ISIC Rev.4 classification in the *OECD National Accounts Statistics* (database).

## References

Durand, M., J. Simon and C. Webb (1992), "Indicators of international competitiveness", *OECD Economics Department Working Papers,* No. 120, http://dx.doi.org/10.1787/708306180711.
*OECD Economic Outlook: Statistics and Projections* (database), http://dx.doi.org/10.1787/eo-data-en.
*OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.
*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.

**Figure 5.4. Indicators of international competitiveness**

Indices, 2004=100

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## The importance of global value chains

Economic theory suggests that countries more open to international trade should grow faster and have higher income levels than less open ones. International trade enables firms to specialise in goods and services that can be most efficiently produced in the home country; to sell to larger markets, hence exploiting economies of scale; and to benefit from higher quality and variety of inputs as well as technological spillovers and knowledge exchange. Trade also puts pressure on prices for final goods and intermediate inputs and facilitates international fragmentation of production processes, further reducing costs. Firms exposed to international competition ought to innovate continuously in order to succeed.

**Key findings**

The empirical evidence confirms the strong link between trade and growth. Countries more open to international trade, where openness is measured by imports plus exports as a percentage of GDP, typically have a higher level of GDP per capita. Moreover, with the exception of Greece, countries that have been able to increase their exports-to-GDP ratio over time have also improved labour productivity over the same period. This is especially true for catch-up economies such as Central and Eastern European countries, which suggests that participation in global value chains (GVCs) has contributed to the catch-up process.

Measures of exports based on gross terms can, however, overstate the importance that a given growth in exports makes to overall GDP growth; this reflects the fact that exports increasingly embody imports. Indeed, the foreign value added share of gross exports has augmented in nearly all countries over the past fifteen years, reflecting growing participation in GVCs. This has amplified the opportunities for specialisation, and so increased export driven growth, reflected in the higher ratios of direct domestic value content of gross exports to GDP, possibly contributing to productivity gains.

### *Definition*

Typically, trade openness is measured as the ratio of total trade, i.e. gross exports plus gross imports, to gross domestic product (GDP). Exports on a gross basis include the value of imports embodied in goods and services as well as some value added created in other domestic sectors that returns embodied in imports. This "double-counting" particularly affects those countries where firms are closely integrated into global value chains.

Measuring international trade in value added terms attempts to correct for the double-counting. Value added embodied in foreign final demand – as represented in the bottom right panel of Figure 5.6 – can most readily be interpreted as "exports of value added". It shows how industries export value added that is produced in the home country to foreign final consumers, both through direct final exports and via indirect exports of intermediate inputs.

### *Comparability*

The indicators in the joint *OECD/WTO Statistics on Trade in Value Added (TiVA)* (database) are derived from OECD Input Output Tables linked together using bilateral trade flows in goods and services. Some assumptions are necessary to create the TiVA indicators, implying that some care is needed in interpreting the results. Key in this context is the underlying "production assumption" that assumes that for a given industry, all firms allocated to that industry use the same goods and services, and so imports, to produce the same outputs. Firms engaged in global value chains, particularly foreign owned affiliates, are likely to have higher import content than firms in the same sector producing goods or services for domestic markets. This means that TiVA estimates will, more likely than not, underestimate the import content of exports.

## References

*OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.
*OECD-WTO*: *Statistics on Trade in Value Added* (database), http://dx.doi.org/10.1787/data-00648-en.
OECD-WTO (2012), "Trade in Value Added: Concepts, methodologies and challenges" (OECD-WTO, online document), www.oecd.org/sti/ind/49894138.pdf.

**Figure 5.5. Trade openness and GDP per capita, 2017**

Total economy, percentage of GDP (X-axis) ; current prices and current PPPs (Y-axis)

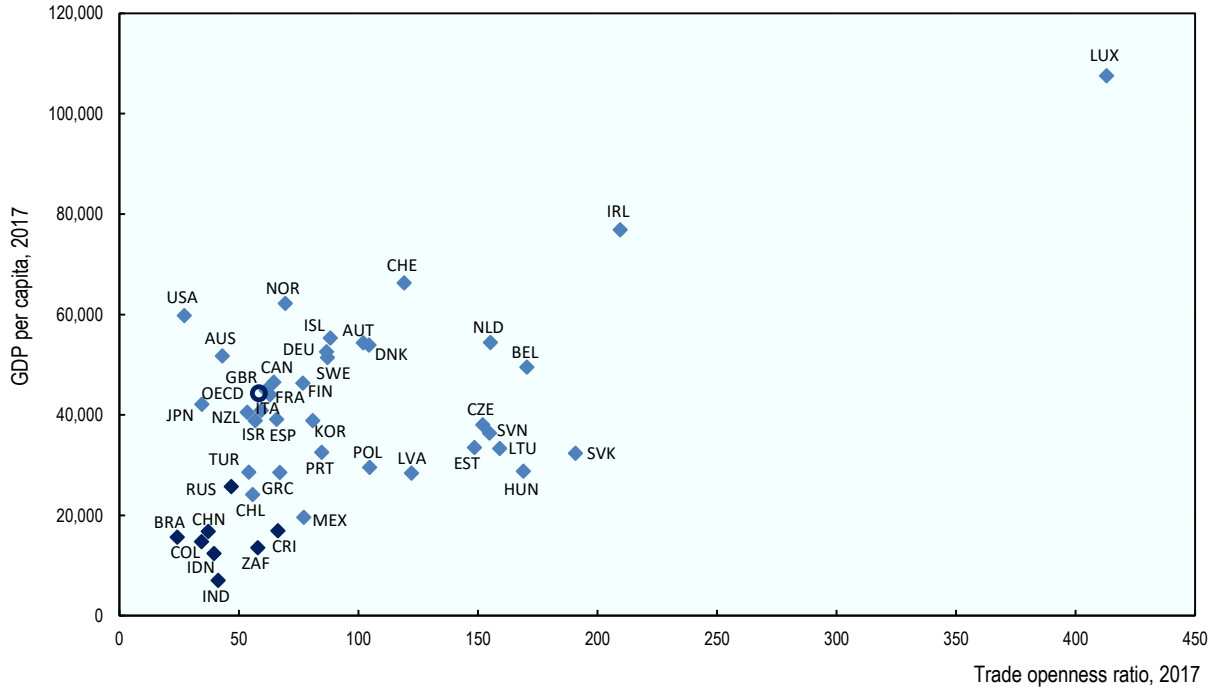


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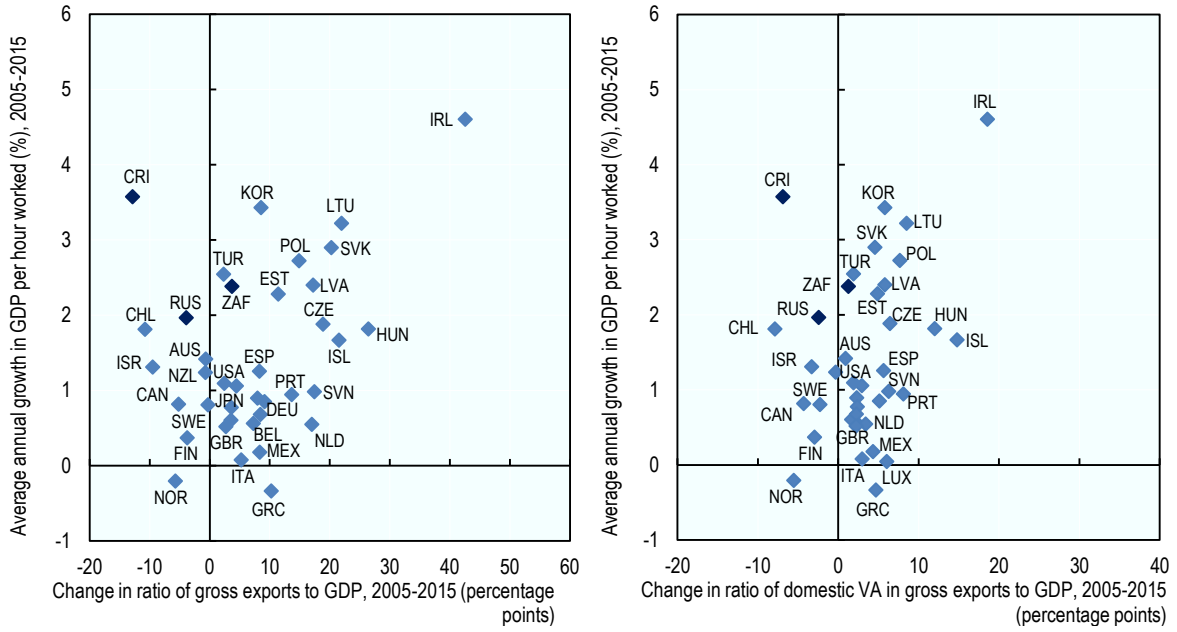
**Figure 5.6. Change in exports to GDP ratio and growth in labour productivity**

Total economy, exports in gross terms (left panel) and in value added terms (right panel)

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# Chapter 6. **Productivity and inclusiveness**

Growth in real wages
Labour income shares
Productivity and real wages over time

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## Growth in real wages

Productivity growth has continued to slow in the post-crisis period, limiting the scope for improvements in material well-being, and the impact of the slowdown has been exacerbated by a decoupling of wage and productivity growth in many countries, which may also be driving income and wealth inequalities.

**Key findings**

Recent years have seen a slowdown in real average compensation growth compared with the pre-crisis period in most countries and in both manufacturing and services activities. In some countries, such as Greece, Italy, Portugal, Spain and the United Kingdom, real average compensation fell over the period 2010-2017.

### *Definition*

Compensation of employees is made up of two components: wages and salaries, and social contributions payable by employers. Wages and salaries are payable in cash or in kind and include the values of any social contributions, income taxes, etc., payable by the employee even if they are actually withheld by the employer and paid on behalf of the employee. The value of social contributions payable by employers include actual social contributions payable by employers to social security schemes or to private funded social insurance schemes and imputed social contributions to unfunded schemes.

Compensation of employees is not payable in respect of unpaid work undertaken voluntarily, including work done by members of a household within an unincorporated enterprise owned by the same household. Any income generated through these activities is recorded as mixed income in the national accounts, which also includes income earned by the self-employed.

For Korea, as total hours worked by employees are not available at industry level, the number of employees is used to compile average real compensation per employee in Figure 6.2.

*Business services excluding real estate*, as shown below, include wholesale and retail trade, repair of motor vehicles and motorcycles; transportation and storage; accommodation and food services; information and communication services and professional, scientific, administrative and support activities.

### *Comparability*

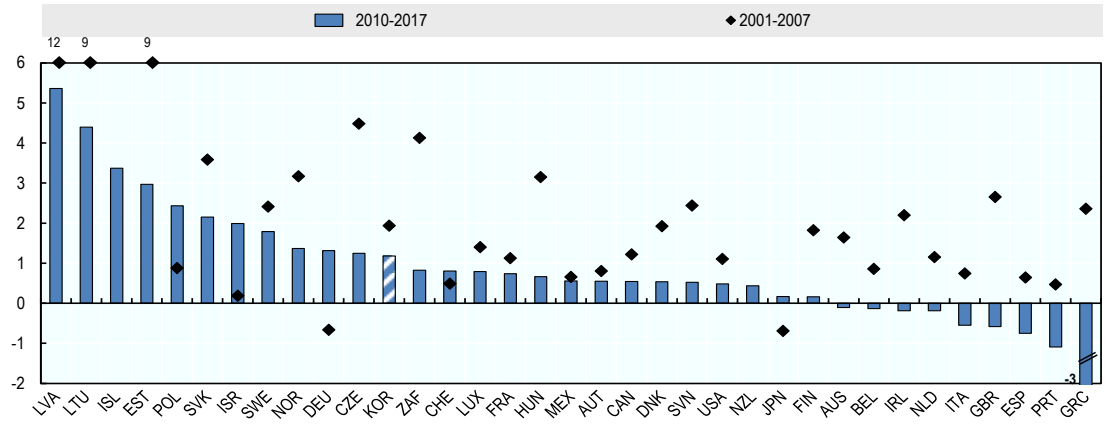
Compensation of employees does not represent the entire value of the contribution of labour to production. Mixed income also reflects a labour income component. In some countries, and notably in some sectors, the shares of self-employed in the labour force may be significant and, so, differences in the shares of compensation of employees across countries may reflect institutional differences, for example tax incentives, to be self-employed or otherwise. This can also have implications in a temporal context. For example, increases in average compensation per employee at the total economy level may merely reflect compositional effects, as would be the case if employees in lower paid activities shifted to self-employed status.

## References

*OECD Employment and Labour Market Statistics* (database), http://dx.doi.org/10.1787/data-00313-en.
*OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.
*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.
OECD (2017), *OECD Compendium of Productivity Indicators 2017*, OECD Publishing, Paris, http://dx.doi.org/10.1787/pdtvy-2017-en.

**Figure 6.1. Growth in real average compensation per hour worked (employees)**

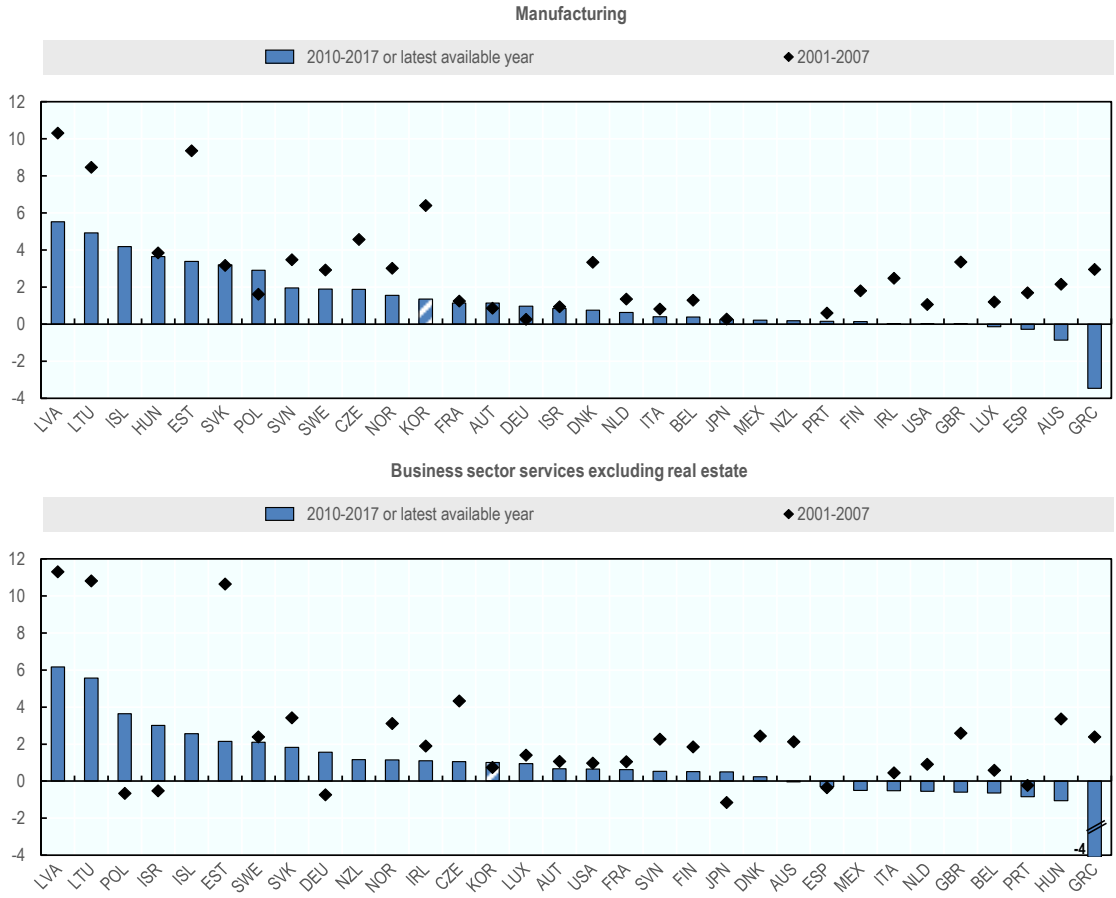
Total economy, CPI all items-deflated, percentage change at annual rate




StatLink http://dx.doi.org/10.1787/888933969143

**Figure 6.2. Growth in real average compensation per hour (employees) in manufacturing and business services**

Total economy, CPI all items-deflated, percentage change at annual rate

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## Labour income shares

The distribution of income between labour and capital has gained considerable attention in recent years in light of declining labour income shares in many countries. As labour income tends to play a larger role as a source of income among lower-income households than among higher-income households, a decline in the labour income share may also translate into widening income inequalities.

**Key findings**

Labour income shares have declined in most countries over the past 15 years, with the largest falls in Ireland, Poland and Portugal (about 10 percentage points); labour income shares in 2017 were particularly low in these economies, ranging from 36% in Ireland to 53% in Portugal. Labour income shares have also declined substantially in Australia, Hungary, Israel, Japan and the United States (about 5 percentage points).

In most countries, the decline has been more significant in manufacturing than in business services, increasing the gap between labour income shares in business services and those in manufacturing, reflecting the relatively capital-intensive nature of manufacturing activities.

### *Definition*

The labour income share is calculated as the ratio of total labour compensation to GDP. The labour component of income earned by the self-employed is not separately identifiable. To estimate this, a simple assumption is used, namely that the self-employed and employees earn the same average hourly compensation for labour. Total labour compensation is therefore calculated as compensation of employees multiplied by the number of hours worked by all persons (employees and self-employed), divided by the hours worked by employees.

For Chile, Japan, Korea and the United States, as total hours worked by main ISIC Rev.4 economic activity are not available, the number of persons employed by sector is used, and so, Figure 6.4 necessarily assumes that the average labour compensation of the self-employed is the same as that of employees for these countries.

*Business services excluding real estate,* as shown below, include wholesale and retail trade, repair of motor vehicles and motorcycles; transportation and storage; accommodation and food services; information and communication services; and professional, scientific, administrative and support activities.

Note that the decline in labour income shares can be decomposed into a labour productivity component and a real labour compensation per hour component, when labour compensation costs are adjusted for inflation using the same price index as that used to deflate value added. In other words, declining labour income shares are consistent with productivity-wage decoupling.

### *Comparability*

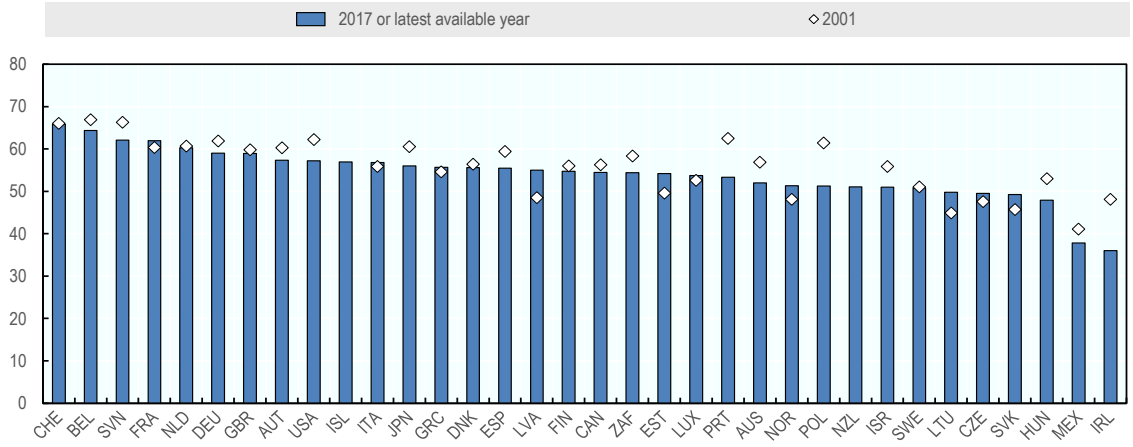
Total labour income represents the compensation received by both employees and self-employed for their labour. The compensation received by employees is readily available in the national accounts. However, total income received by the self-employed is recorded only as mixed income, with no distinction between the returns on their labour and the returns on their capital. Therefore, as described above, self-employed labour compensation is necessarily imputed. These imputations necessarily assume that either the average labour compensation per hour worked of the self-employed and employees or the average labour compensation per self-employed and per employee is the same, within a given sector. To what extent these assumptions (and in particular the latter) are true is likely to differ across countries.

## References

*OECD National Accounts Statistics* (database), http://dx.doi.org/10.1787/na-data-en.
*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.
OECD (2017), *OECD Compendium of Productivity Indicators 2017*, OECD Publishing, Paris, http://dx.doi.org/10.1787/pdtvy-2017-en.

**Figure 6.3. Labour income shares in the total economy**

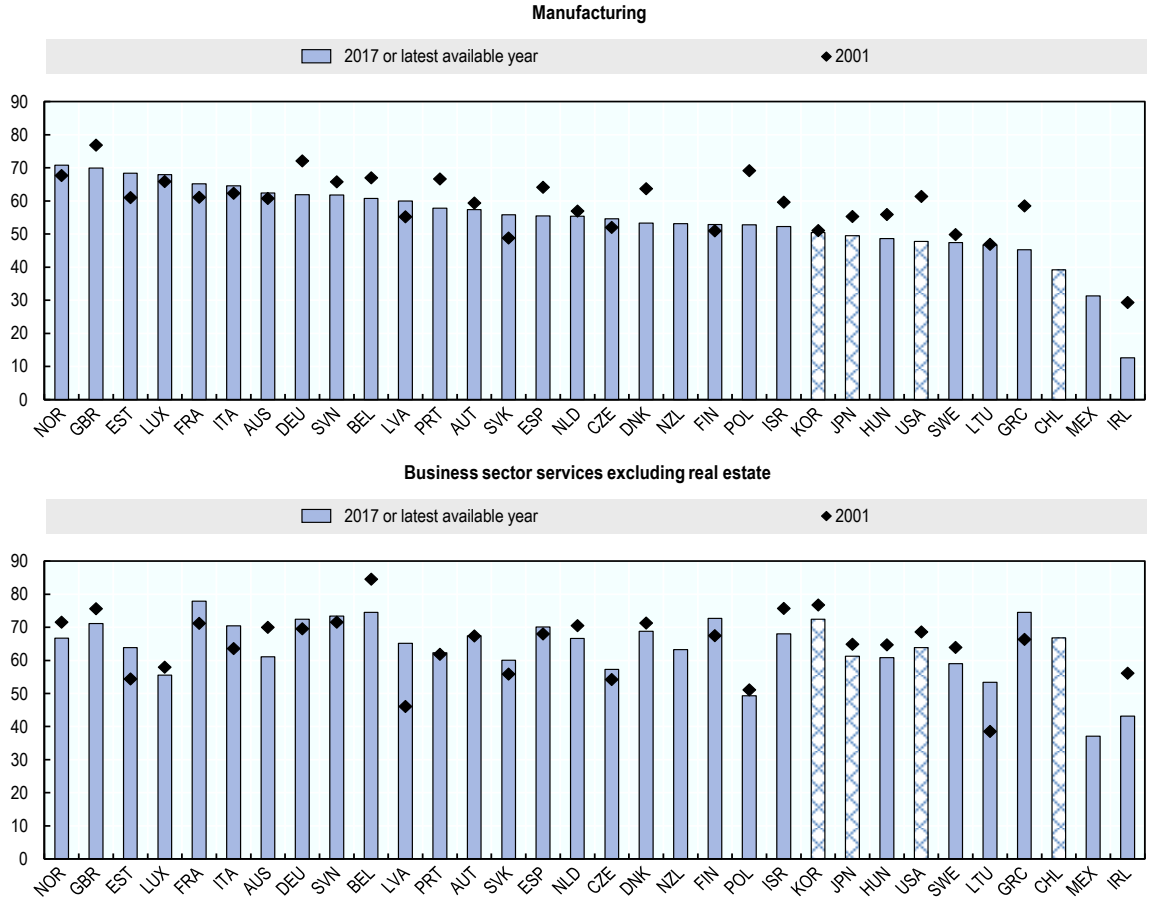
Total compensation as a share of GDP, percentage




StatLink http://dx.doi.org/10.1787/888933969181

**Figure 6.4. Labour income shares in manufacturing and business services**

Total compensation as a share of gross value added, percentage

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## Productivity and real wages over time

Real wages are the most direct mechanism through which the benefits of economic growth, and therefore, productivity gains are transferred to workers. Employers' ability to raise wages and other forms of labour compensation is greatly dependent on increases in labour productivity.

**Key findings**

Decline in labour income shares observed in most countries can be reformulated as a decoupling between growth in labour productivity and real labour compensation, when labour compensation costs are adjusted for inflation using the same price index applied to deflate value added (and so productivity). The impact of a decoupling on material well-being is further exacerbated given the widespread slowdown in productivity growth and even more so when real labour compensation is adjusted for inflation using the consumer price index – i.e. from a consumer/worker perspective – as changes in value-added inflation and general inflation can differ significantly.

### *Definition*

The labour component of income earned by the self-employed is not separately identifiable, as such it is assumed that the self-employed and employees earn the same average hourly compensation for their labour, with total labour compensation calculated as compensation of employees multiplied by the number of hours worked by all persons (employees and self-employed), divided by the hours worked by employees. For Korea, as total hours worked by employees are not available, the number of persons employed and employees are used to compile labour productivity and compensation per employee in Figure 6.6.

Real measures of compensation can be calculated from the a producer's perspective, where real average hourly labour compensation growth is deflated using the same price index as that used for value added, or from a worker's perspective, where compensation is adjusted for general price inflation (in this case the consumer price index, CPI), which is a better reflection of the real purchasing power of households and so more appropriate for analyses of material well-being and inequalities (OECD, 2017).

### *Comparability*

Total labour income represents the compensation received by both employees and self-employed for their labour. The compensation received by employees is readily available in the national accounts. However, total income received by the self-employed is recorded only as mixed income, with no distinction between the returns on their labour and the returns on their capital. Therefore, as described above, self-employed labour compensation is necessarily imputed. These imputations assume that either the average labour compensation per hour worked by the self-employed and employees or the average labour compensation per self-employed and per employee is the same, within a given sector. To what extent these assumptions (and in particular the latter) are true is likely to differ across countries.

## References

*OECD National Accounts Statistics (database)*, http://dx.doi.org/10.1787/na-data-en.
*OECD Productivity Statistics (database)*, http://dx.doi.org/10.1787/pdtvy-data-en.
OECD (2017), *OECD Compendium of Productivity Indicators 2017*, OECD Publishing, Paris, http://dx.doi.org/10.1787/pdtvy-2017-en.

**Figure 6.5. Labour productivity and average labour compensation per hour, total economy**

Selected OECD countries, GVA per hour worked and average hourly labour compensation, indices 1995=100

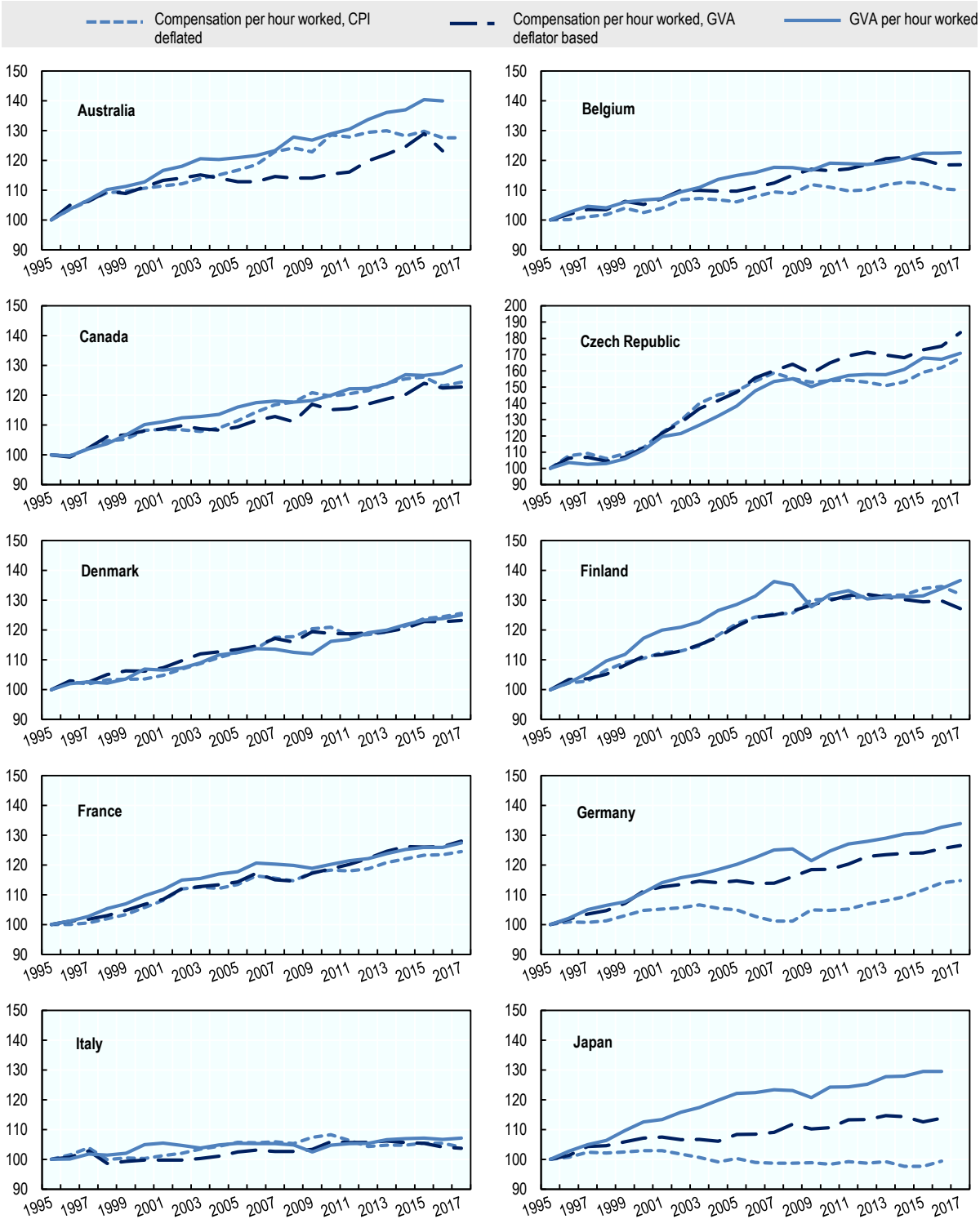


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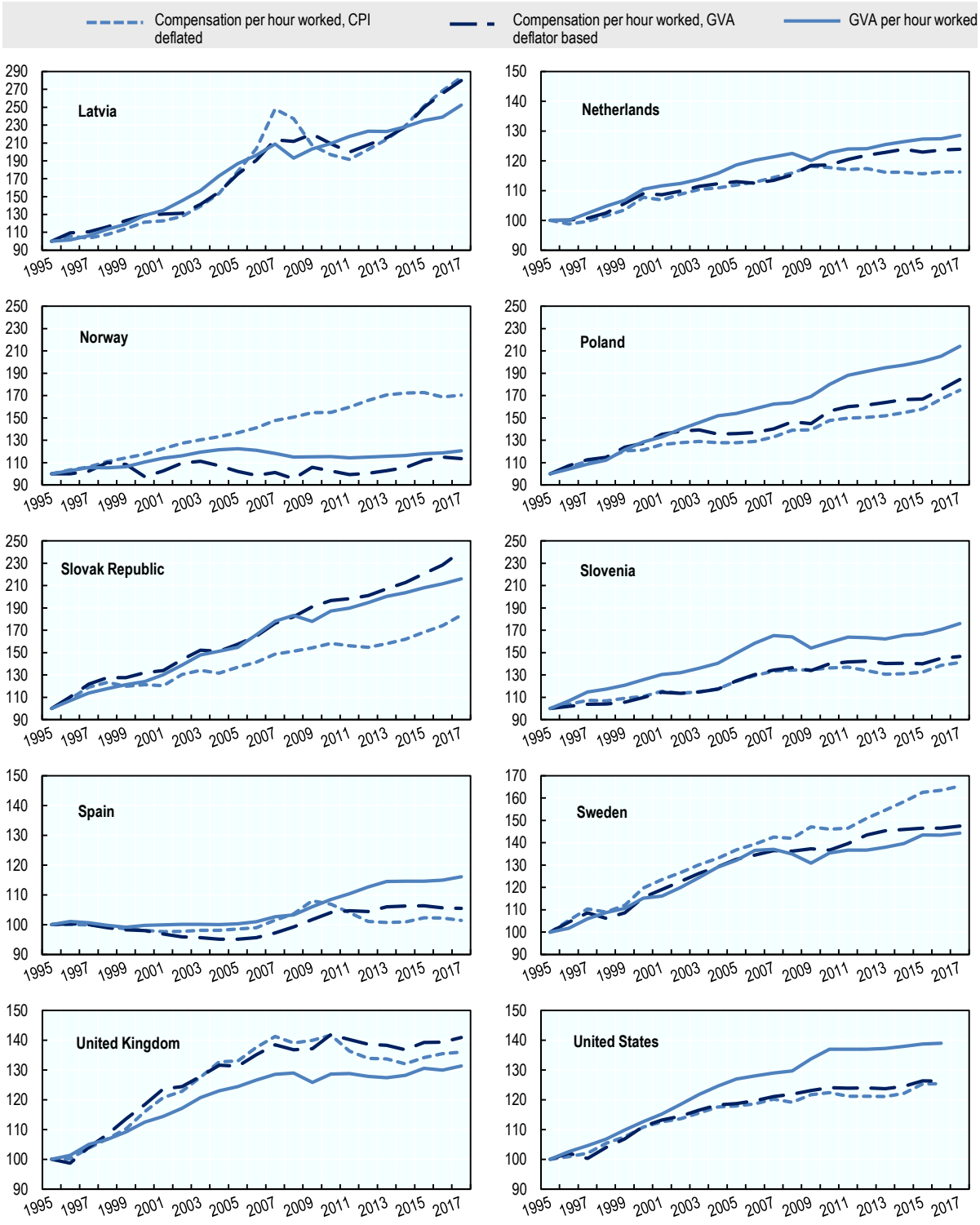
**Figure 6.5. Labour productivity and average labour compensation per hour, total economy (cont.)**

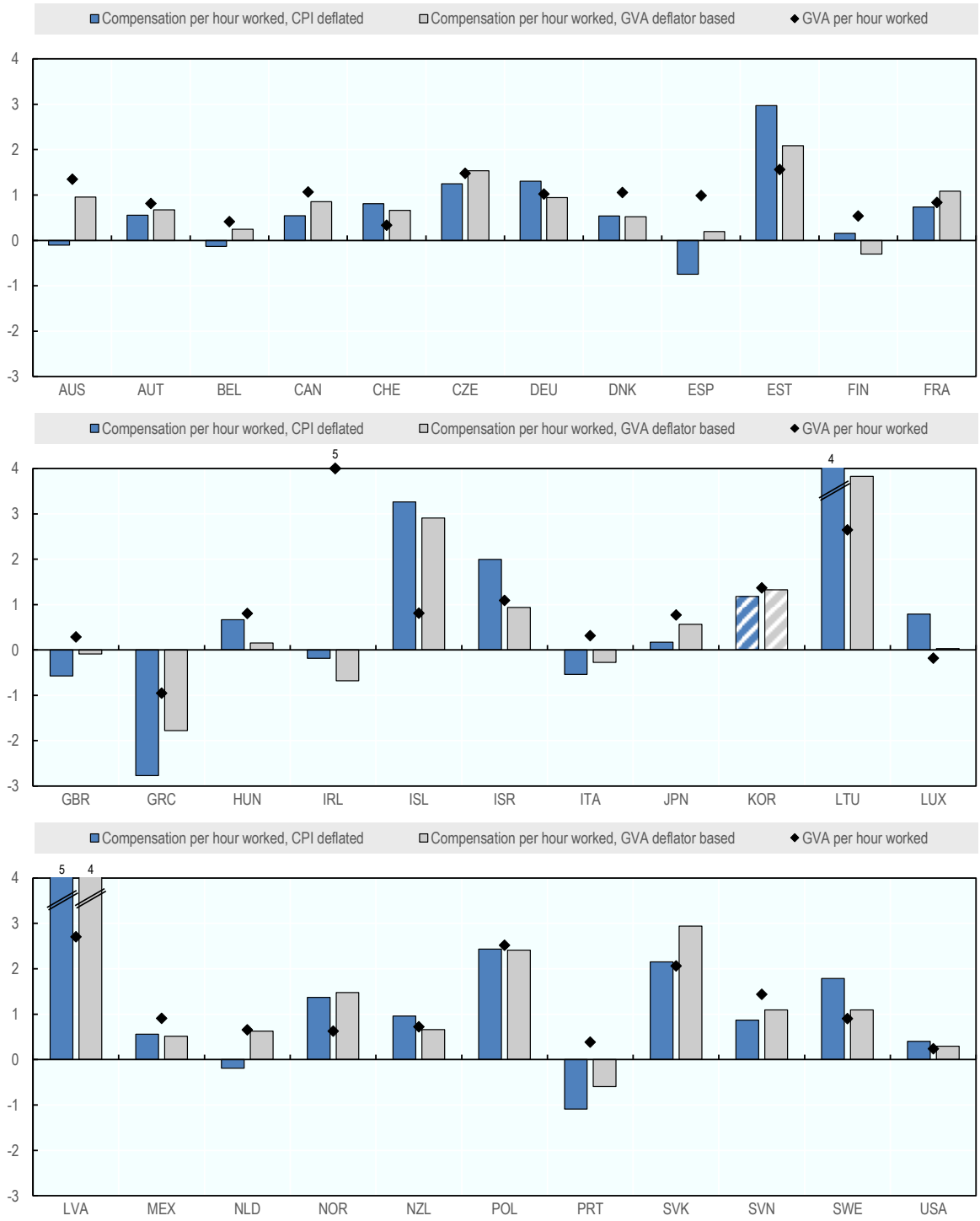
Selected OECD countries, GVA per hour worked and average hourly labour compensation, indices 1995=100




StatLink http://dx.doi.org/10.1787/888933969219

**Figure 6.6. Growth in labour productivity and average labour compensation per hour, total economy, 2010-2017**

Percentage change at annual rate

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# Chapter 7. **Productivity trends in G7 countries**

Trends in labour productivity growth
Trends in multifactor productivity and capital deepening
Multifactor productivity over the cycle

## Trends in labour productivity growth

Labour productivity is a key driver of economic growth and living standards. Understanding whether the slowdown in productivity growth has been driven by structural factors and/or by reactions to the economic cycle is therefore important for policy makers. This requires decomposing the time series of actual annual labour productivity growth into a trend (or structural) component and a cyclical component.

**Key findings**

The slowdown in labour productivity growth is a common feature of all major advanced economies and underlying long-term trends suggest that it was underway prior to the crisis. Indeed, over the 10 years preceding the crisis, trend labour productivity growth declined in all G7 countries, particularly in France, Italy and the United Kingdom. In the case of Canada, the United Kingdom and the United States, the decline since the end of the 1990s marked a reversal of growth that coincided with the IT revolution. In other countries, trend labour productivity growth has shown a gradual decline over the past 45 years from relatively high rates.

### *Definition*

Labour productivity is defined as GDP per hour worked and its growth rate is calculated as its first natural-log difference. The decomposition of labour productivity growth into a trend and a cyclical component is completed by applying the Hodrick-Prescott (HP) filter (Hodrick and Prescott, 1997), where the trend component is meant to capture the long-term growth of the series and the cyclical component is the deviation from that trend. In the HP filter, the smoothness of the trend depends on a parameter usually identified as $\lambda$. The larger the value given to $\lambda$, the smoother is the trend.

### *Comparability*

Like other filters, one limitation of the HP filter is that the estimated trend is more sensitive to transitory shocks or short-term fluctuations at the beginning and at the end of the sample period. This results in a sub-optimal performance of the HP filter at the endpoints of the series (Baxter and King, 1999). In view of this property, trend series are not published for the first and last two years for which data on actual labour productivity growth are available.

An important aspect of the HP filter is the value of the smoothing parameter $\lambda$. While for quarterly data a value of $\lambda$=1600 has typically been assumed (as recommended by Hodrick and Prescott, 1997), there is less agreement on the value which should be used when the filter is applied to other frequencies (e.g. annual, monthly). The value of $\lambda$ selected here is 54.12 and has been determined by calibrating the Hodrick-Prescott filter in such a way that cycles shorter than 9.5 years are attenuated by 90% or more (Chapter 8. ).

Official data for Germany after unification are available only from 1991 onwards. Estimates for Germany as a whole back to 1970 have been derived by applying the relevant growth rates for West Germany to 1991 data.

## References

Baxter, M. and R.G. King (1999), "Measuring business cycles: Approximate band-pass filters for economic time series", *The Review of Economics and Statistics*, Vol. 81, No. 4.

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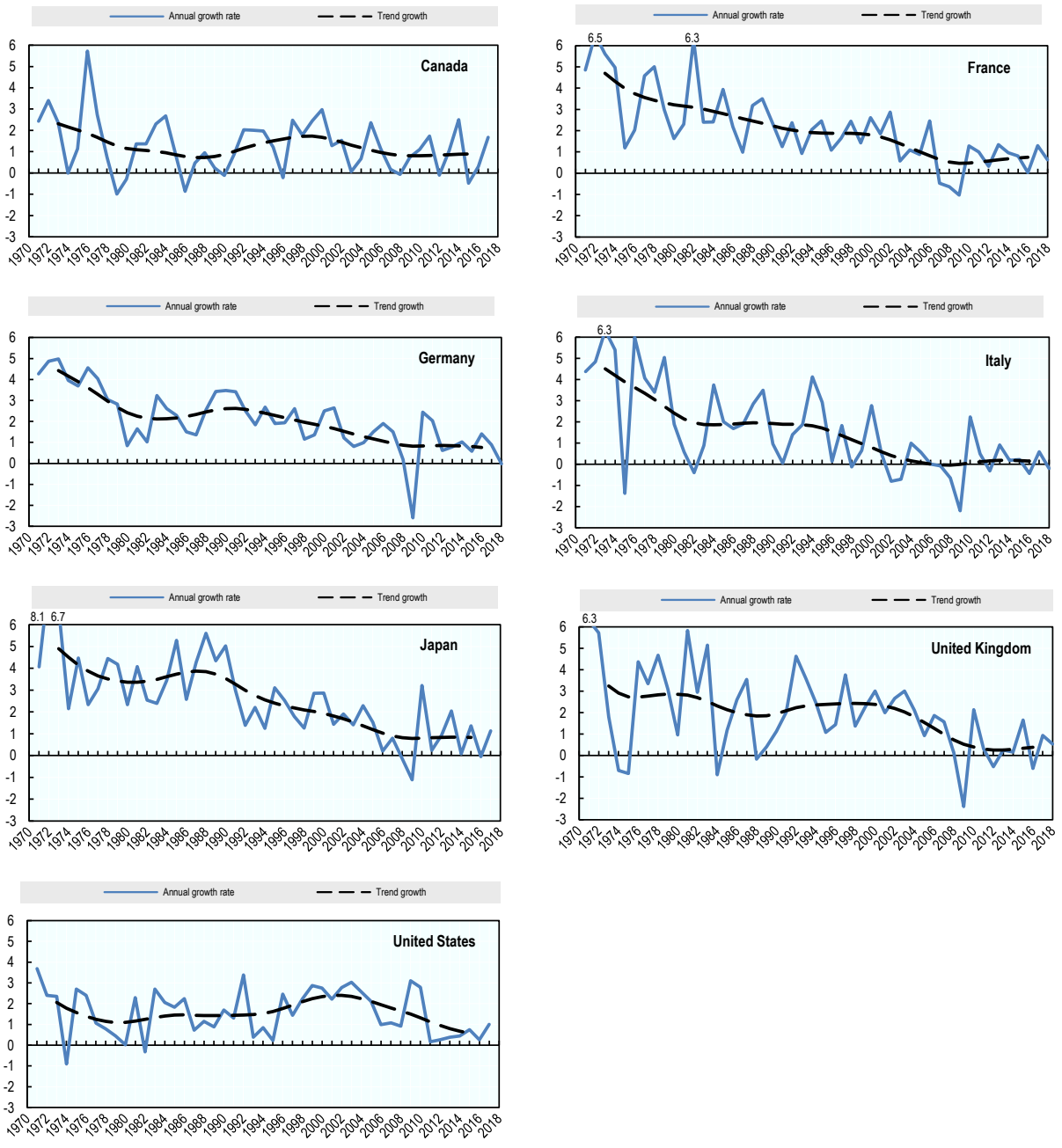
**Figure 7.1. Trend labour productivity growth in G7 countries**

Total economy, percentage change at annual rate

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## Trends in multifactor productivity and capital deepening

Policymakers are interested in the structural factors that may have accentuated the recent slowdown in labour productivity growth. The declining trend labour productivity growth may be driven by declining investment in capital relative to hours worked (capital deepening) or could be indicative of factors that have hampered growth in multifactor productivity (MFP), such as subdued innovative activity, skills mismatches and inefficiencies due to barriers to competition. To shed light on these structural factors, one can decompose the time series of labour productivity growth as well as its drivers, i.e. the contribution of capital deepening and MFP, into a trend and a cyclical component.

**Key findings**

While nearly all G7 countries show a decline in trend labour productivity growth since the end-1990s or before in some cases, the sources for this decline vary. In Canada, the downward trend of MFP growth since the mid-1990s contrasted with the relatively flat trend observed in the contribution of capital deepening. In Germany, trend MFP growth declined continuously since the beginning of the 1990s until the crisis, with tentative signs of an improvement emerging in recent years. In Italy, trend MFP growth has been negative since the early 2000s and has been coupled in recent years with a declining contribution of capital deepening. Japan saw a drastic decline in trend MFP growth over the second half of the 1980s and the 1990s coupled with a downward trend in the contribution of capital deepening. In the United Kingdom, the downward trend in labour productivity growth since the early 2000s was driven by a sharp decline in MFP growth up to the crisis and a flat-lining since then. In the United States, the decline in trend labour productivity growth since the early 2000 has reflected a combination of declining MFP growth and capital deepening.

### *Definition*

Labour productivity is defined as GDP per hour worked and its growth rate is calculated as its first natural-log difference. The contribution of capital deepening is constructed as changes in the volume of capital services per hour worked (i.e. capital deepening) weighted by the cost share of the capital input. Growth in multifactor productivity is measured as a residual, i.e. that part of GDP growth that cannot be explained by growth in labour and capital inputs. The decomposition of these series into a trend and a cyclical component is done by applying the Hodrick-Prescott (HP) filter (Hodrick and Prescott, 1997), where the trend component is meant to capture the long-term growth of the series and the cyclical component is the deviation from that trend (Chapter 8. ).

### *Comparability*

To ensure cross-country comparability of capital services and MFP data, the OECD applies a common computation method to all countries that uses harmonised ICT investment deflators and assumes the same average service lives for any given asset irrespective of the country.

MFP growth is the residual part of GDP growth that cannot be explained by growth in either labour or capital input. Conceptually, it can be seen as technological change. In practice, some part of technological change, including improvements in the design and quality of new vintages of capital, is embodied in physical, notably, ICT capital. Then, MFP only picks up disembodied technical change, e.g., network effects or spillovers from production factors, the effects of better management practices, brand names, organisational change and general knowledge. Moreover, linked to the assumptions of the production function and data constraints hampering a precise measurement of labour and capital inputs, MFP also captures other factors, e.g. adjustment costs, economies of scale, effects from imperfect competition and measurement errors.

Official data for Germany after unification are available only from 1991 onwards. Estimates for Germany as a whole back to 1970 have been derived by applying the relevant growth rates for West Germany to 1991 data.

## References

Hodrick, R. and E. Prescott (1997), "Postwar U.S. business cycles: an empirical investigation", *The Journal of Money, Credit and Banking*, Vol. 29, No. 1.

*OECD Productivity Statistics* (database), http://dx.doi.org/10.1787/pdtvy-data-en.

OECD (2001), *Measuring Productivity – OECD Manual*, http://dx.doi.org/10.1787/9789264194519-en.

**Figure 7.2. Labour productivity growth trend and its components, Canada**

Total economy, percentage change at annual rate

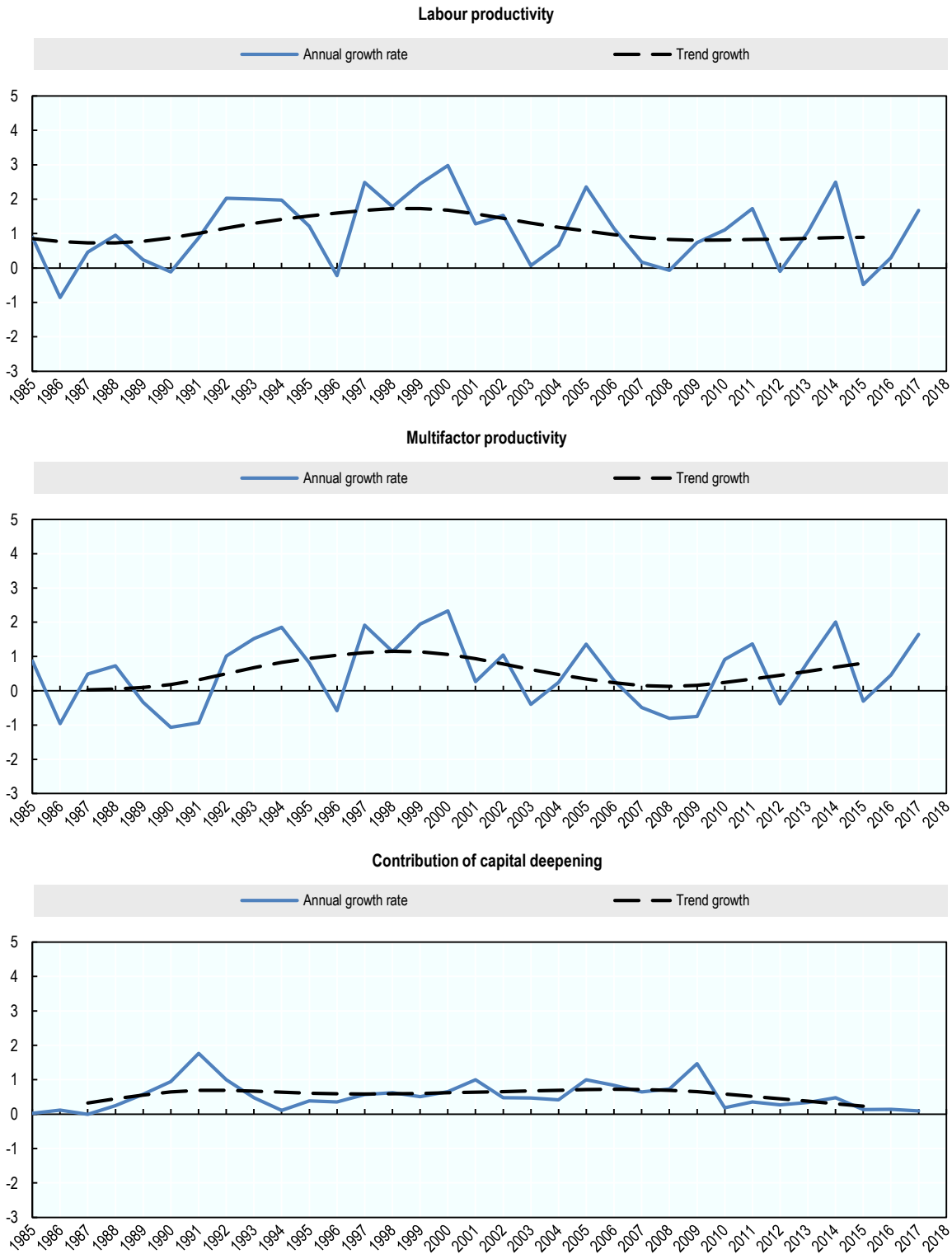


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**Figure 7.3. Labour productivity growth trend and its components, France**

Total economy, percentage change at annual rate

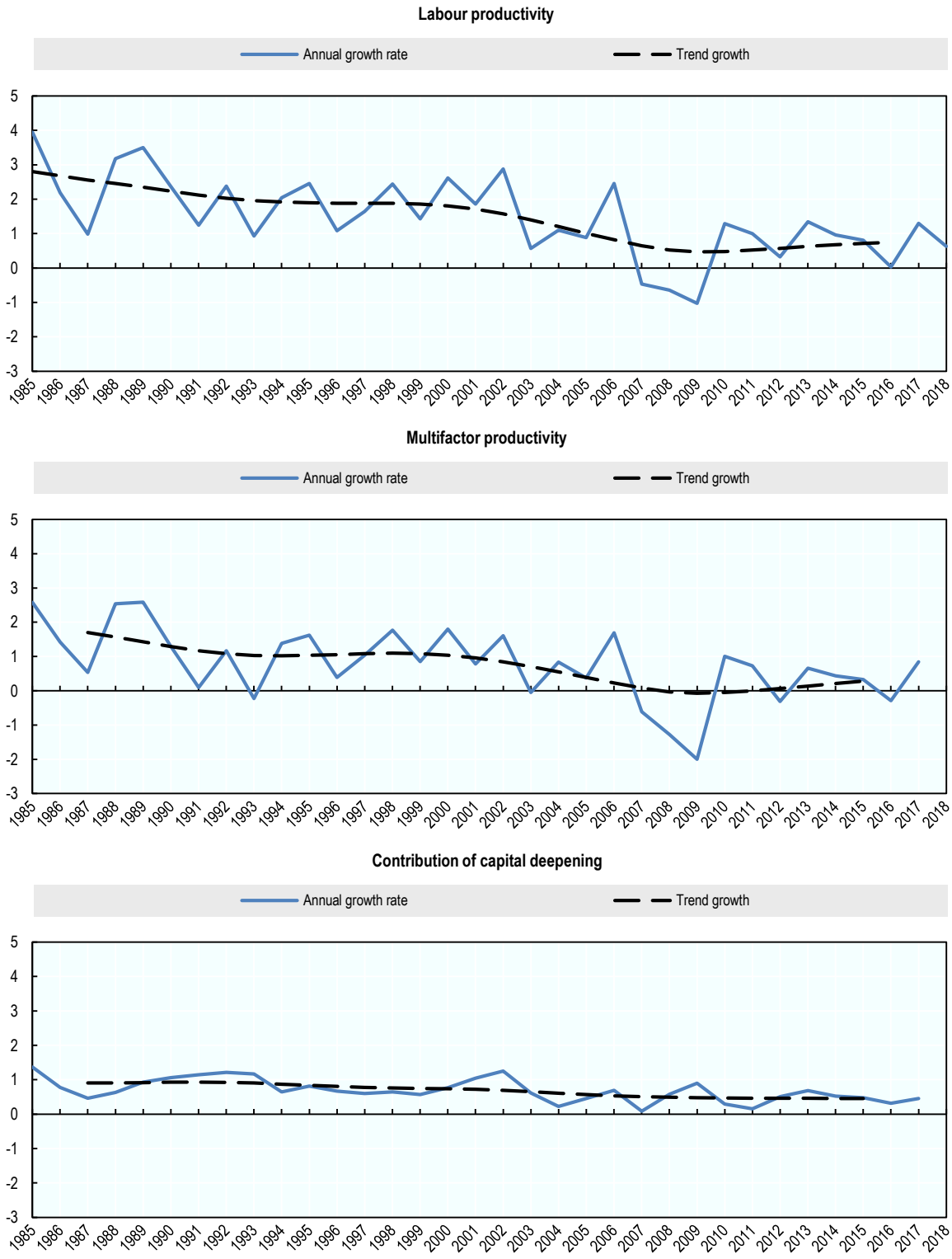


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**Figure 7.4. Labour productivity growth trend and its components, Germany**

Total economy, percentage change at annual rate

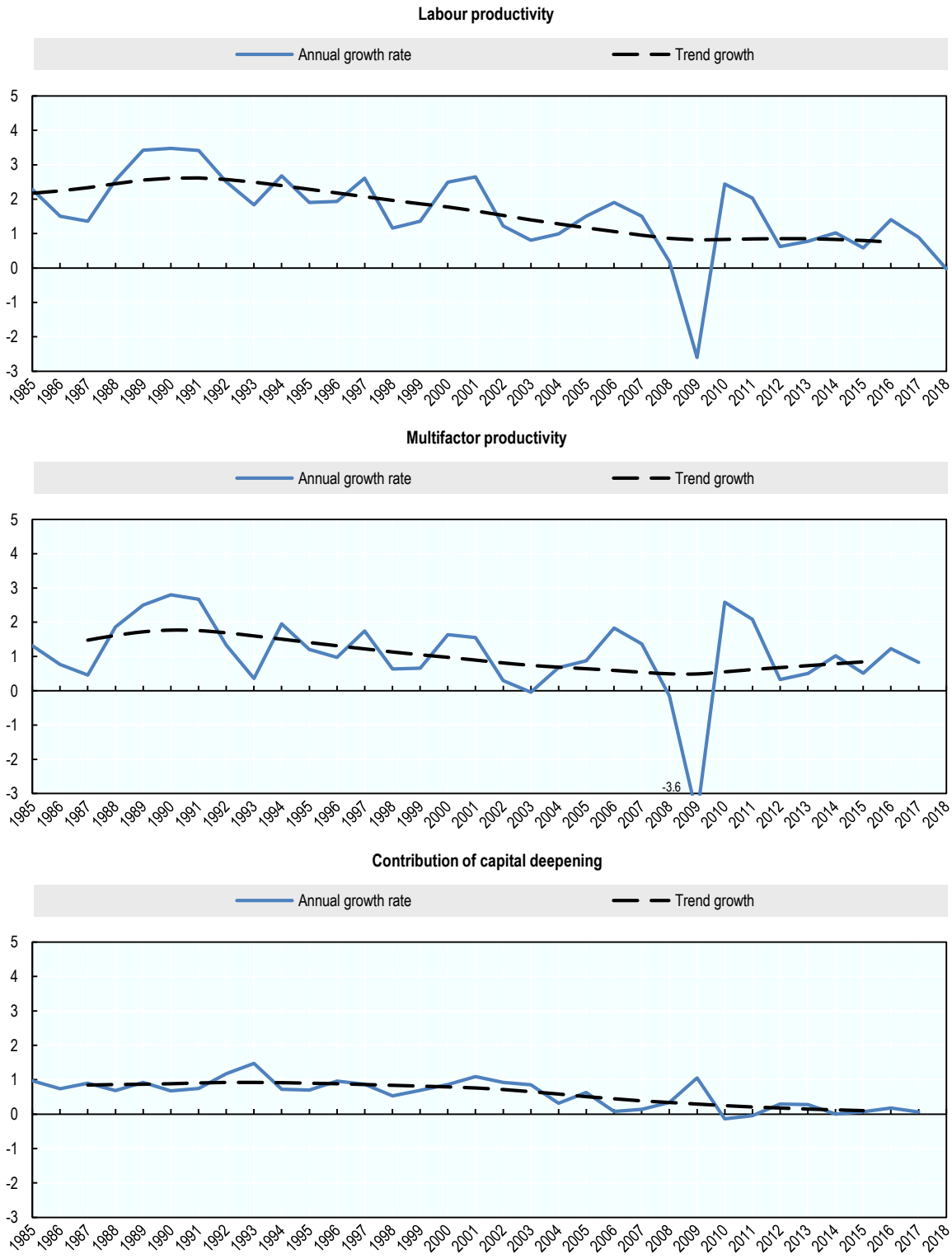


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**Figure 7.5. Labour productivity growth trend and its components, Italy**

Total economy, percentage change at annual rate

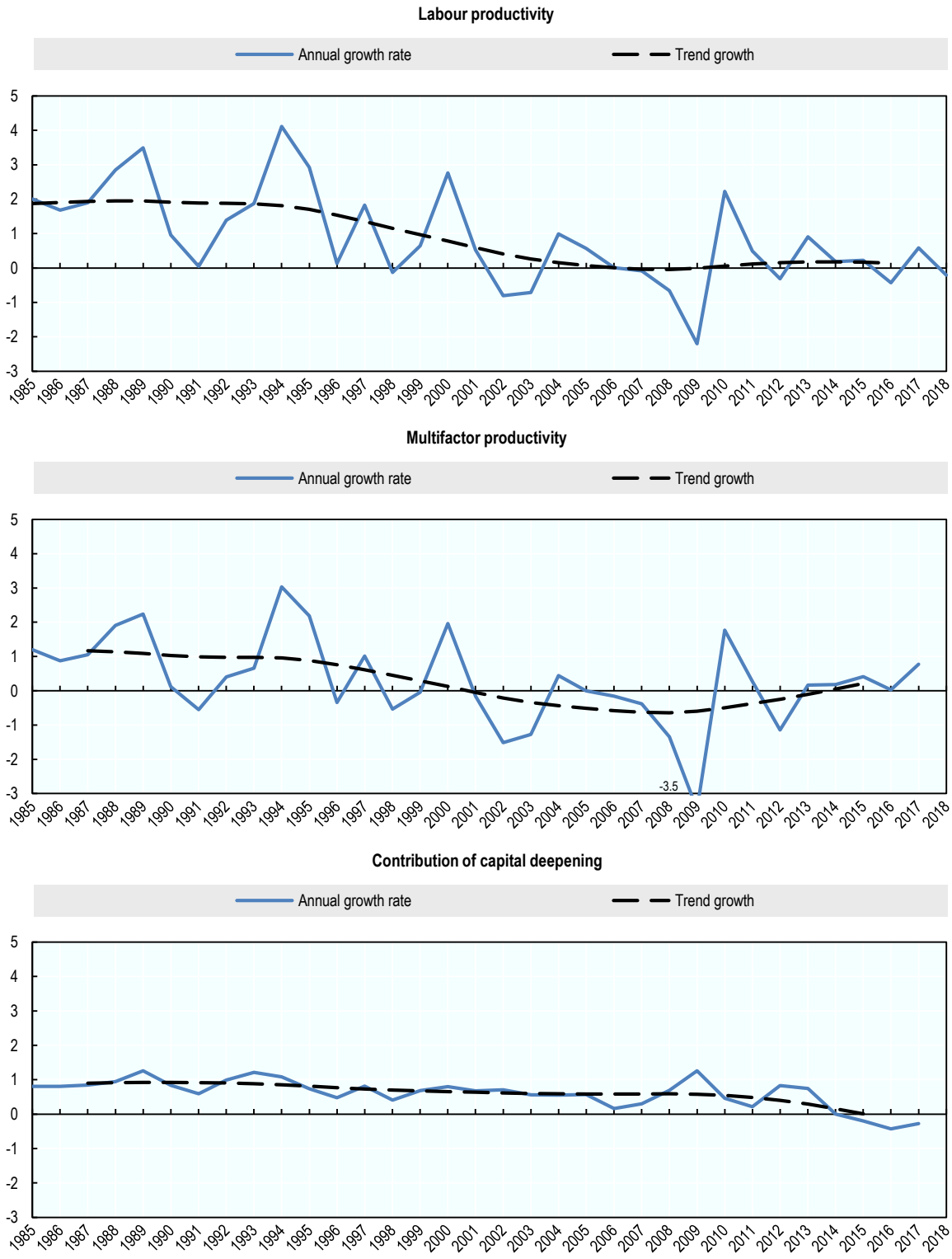


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**Figure 7.6. Labour productivity growth trend and its components, Japan**

Total economy, percentage change at annual rate

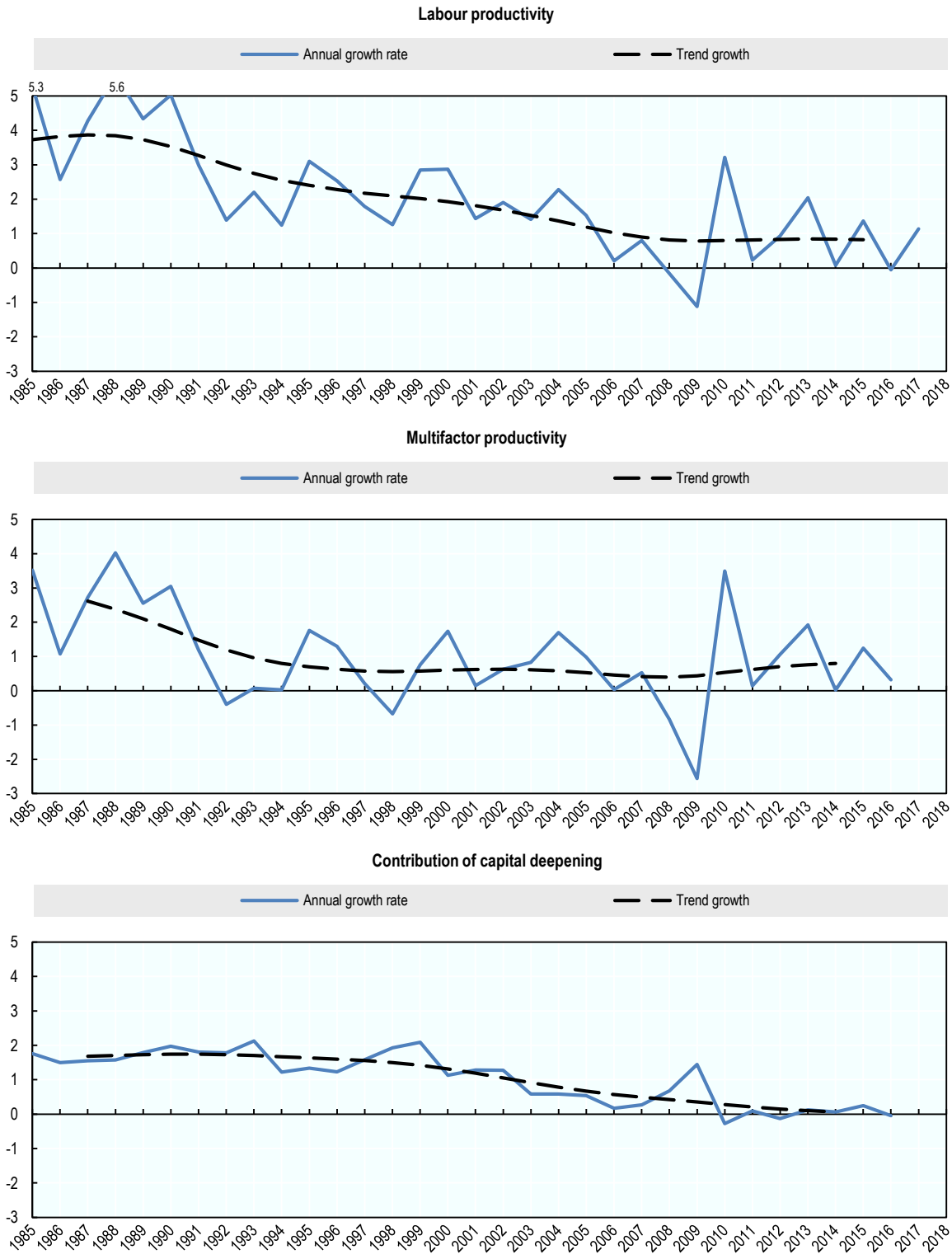


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**Figure 7.7. Labour productivity growth trend and its components, United Kingdom**

Total economy, percentage change at annual rate

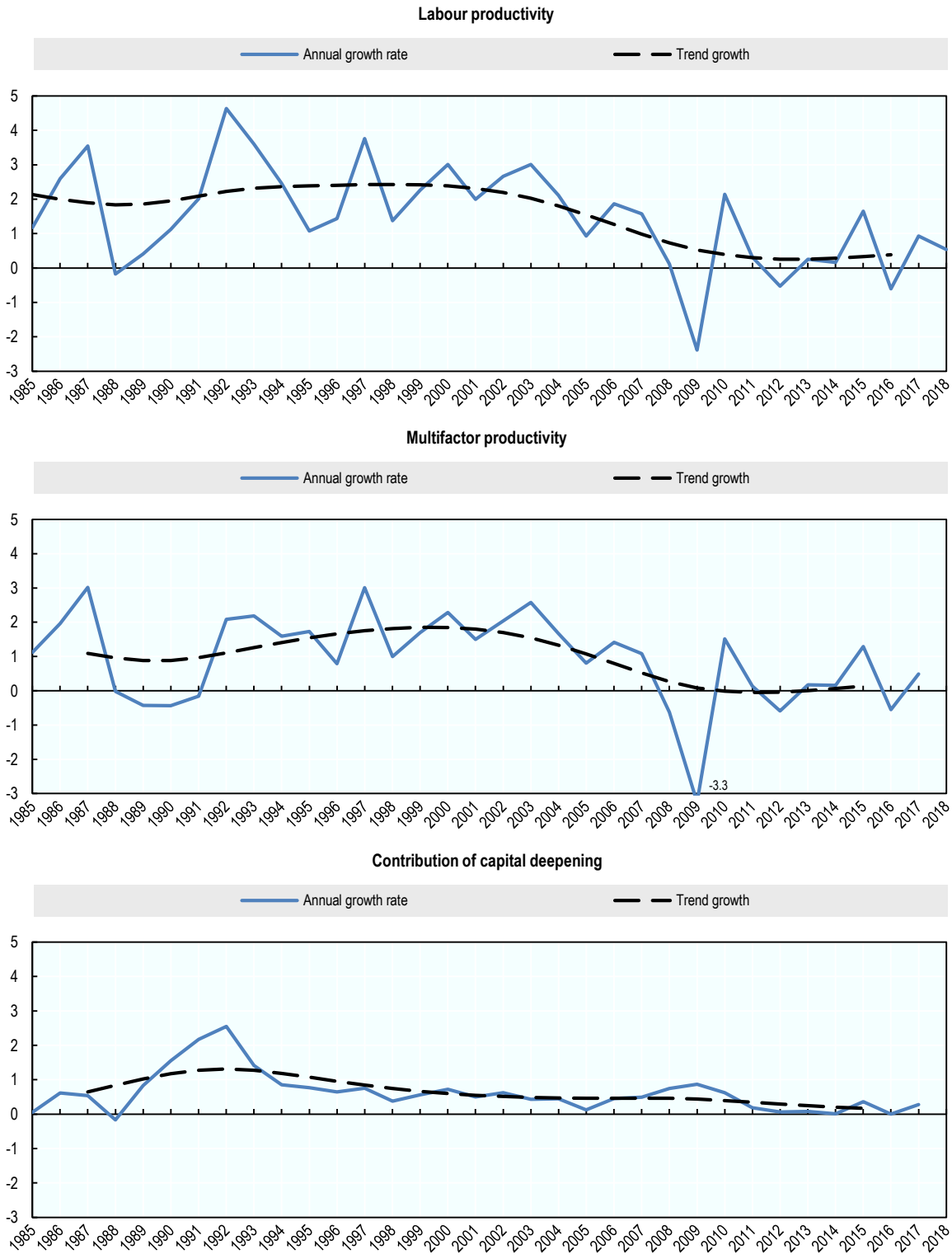


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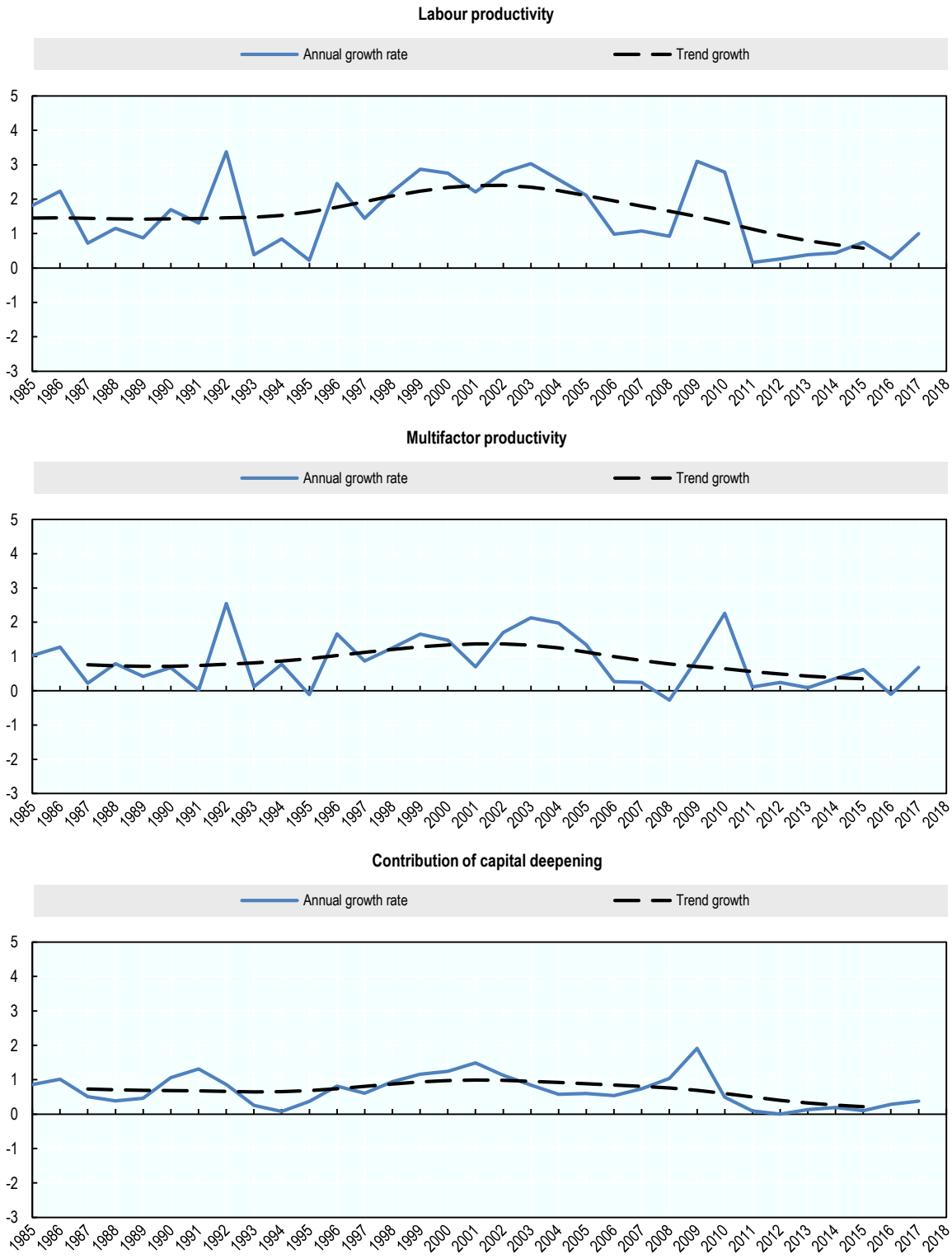
**Figure 7.8. Labour productivity growth trend and its components, United States**

Total economy, percentage change at annual rate

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## Multifactor productivity over the cycle

A number of studies indicate that multifactor productivity growth (MFP) behaves cyclically, i.e., it increases in upturns and declines in downturns. This has sometimes been interpreted as a paradox, as MFP has traditionally been perceived as exogenous technological change, which should typically not behave cyclically.

**Key findings**

The empirical evidence confirms the cyclical pattern of MFP. In fact, MFP follows GDP growth very closely, not only in terms of the direction but also in terms of the size of the change. While the contribution of labour fluctuated relatively strongly for most G7 countries, up to 2007, adjustments in labour input typically lagged. The contribution of capital input changed little over the cycle, possibly reflecting adjustment costs. Capital input reflects the accumulation of past investment of all firms in the economy. Hence, although investment is typically relatively volatile, capital stock and capital services estimates are less so. However, the contribution of capital input to GDP growth declined significantly after the crisis, possibly reflecting the sluggish recovery of investment.

### *Definition*

Four factors help explain this cyclical movement and each of them is related to the definition of MFP as the part of GDP growth that cannot be explained by changes in labour and capital inputs (Chapter 8. ). First, cycles in productivity growth may relate to imperfect competition and the potential to capitalise on increasing returns to scale during upturns. Second, labour input typically adjusts with a lag in downturns, as firms seek to retain workers even if not needed for current production so as to keep the human capital (labour hoarding). Third, adjustment costs prevent an immediate up- or downsizing of production and capital, resulting in lower utilisation of existing capital stock in downturns. Fourth, the reallocation of resources to production of goods and services with higher or lower marginal productivities may be pro or counter cyclical.

### *Comparability*

The appropriate measure of capital input for productivity analysis and within the growth accounting framework is capital services (Chapter 8. ). While these take into account the productivity of the different capital assets, no account is taken of the extent to which the existing capital stock is actually used, i.e. the rate of capital utilisation, which may affect comparability over time and space.

Theoretically, measuring labour input by the total actual hours worked of persons employed should capture the rate of labour utilisation and hence account for the cyclical effects of labour input. Continuous labour force surveys provide a basis for measuring this. However, in practice, total hours worked are often measured based on hours typically worked or actual hours worked during a reference week, which are then extrapolated over the year using additional data sources. These may not capture sufficiently variations in actual hours worked over the cycle (Chapter 8. ).

Official data for Germany after unification are available only from 1991 onwards. Estimates for Germany as a whole back to 1970 have been derived by applying the relevant growth rates for West Germany to 1991 data.

## References

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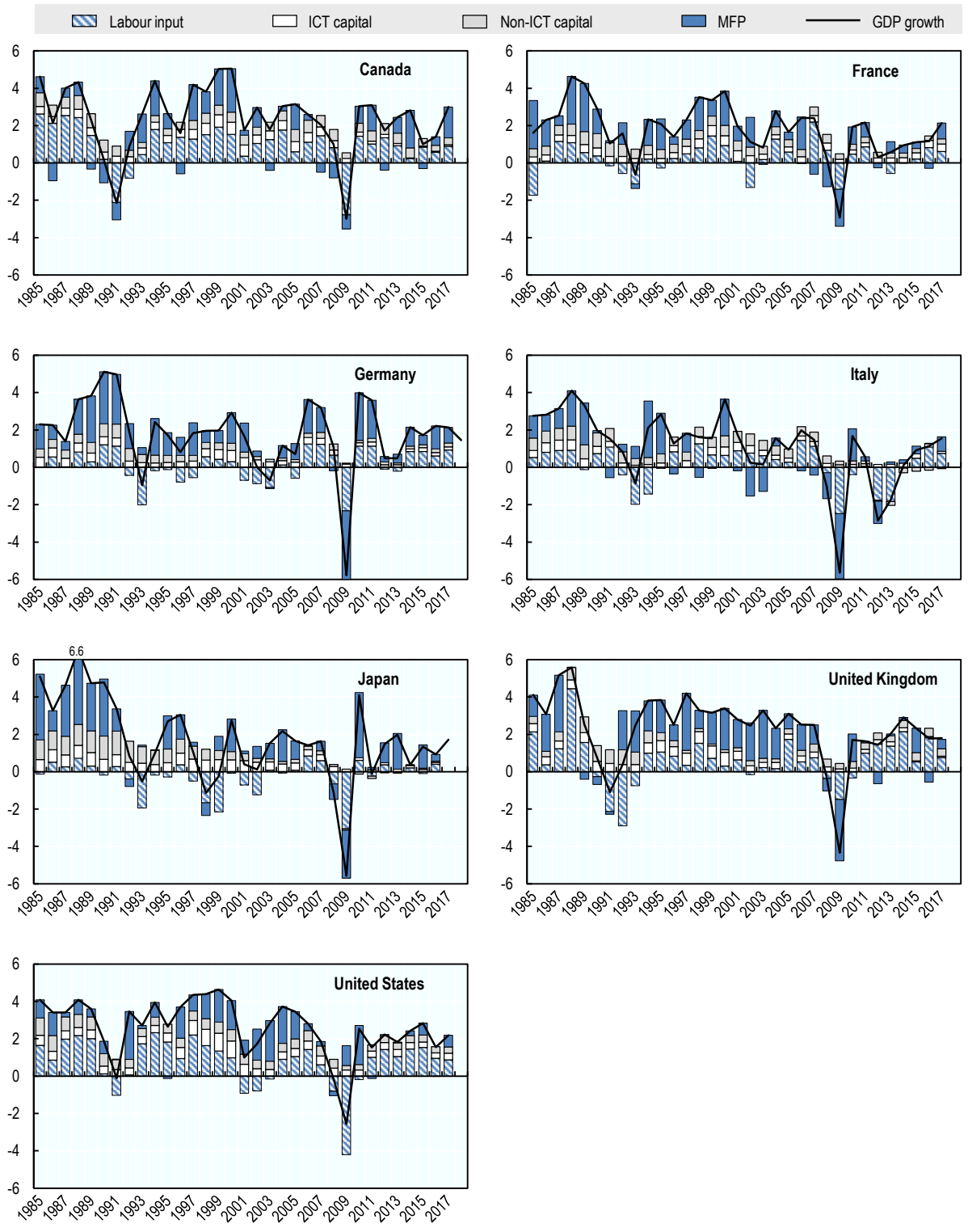
**Figure 7.9. Contributions to GDP growth over time in G7 countries**

Total economy, percentage point contributions at annual rate

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# Chapter 8. **Methodological chapter**

*This chapter presents relevant methodological information on the productivity indicators available in this publication and/or disseminated in the OECD Productivity Statistics (database). It discusses the different existing concepts of hours worked and describes the sources used to measure hours worked for the purposes of productivity analysis. It provides a brief description of capital stocks and capital input measures available at the OECD, highlighting the distinction between two key measures of capital: the productive capital stock and the gross (or net) wealth capital stock. The chapter also provides a summary of the major changes introduced by the System of National Accounts 2008 (2008 SNA), with respect to the 1993 SNA. Further, it describes important measurement issues when tracking price changes in the services sector and the potential significance of price measurement for measured productivity growth in services sectors. It presents the concept of Purchasing Power Parities (PPPs), describing the two different approaches for using PPPs in international comparisons of productivity levels: current PPPs and constant PPPs. The chapter ends with a detailed description of the trend estimation method used to compute productivity trends in this publication.*

## Productivity measures in the *OECD Productivity Database*

The *OECD Productivity Statistics* (database) (PDB) contains a consistent set of productivity measures at the total economy and at the industry levels. This section provides detailed information on the measures included in the database. While the PDB and this publication present value added based productivity indicators by relating value added to the labour and capital inputs used, productivity measures can be computed for different representations of the production process. One typical approach is to relate a volume measure of gross output to primary and intermediate inputs, as used in the KLEMS methodology, which measures the contributions of capital (K), labour (L), energy (E), material inputs (M) and services (S) to output growth. This representation is neither adopted in the PDB nor in this publication.

### *Productivity measures for the total economy*

#### *Labour input*

Within the PDB, the preferred measure of labour input (L) is the total number of hours worked by all persons engaged in production (i.e. employees plus self-employed). Another measure of labour input, albeit less preferred, is the total number of persons employed (i.e. employees plus self-employed). The preferred source for total hours worked and total employment is the *OECD National Accounts Statistics* (database). However, this database does not provide data on hours worked for all countries, and, so, other sources are necessarily used, e.g. the *OECD Employment and Labour Market Statistics* (database). Estimates of average hours actually worked per year per person employed are also provided within the PDB. Section 6.2 presents detailed information on hours worked.

#### *Capital input*

Capital input (K) is measured as the volume of capital services, which is the appropriate measure for capital input within the growth accounting framework (see Schreyer, et al., 2003 for more details on the computation of capital services in PDB). In the PDB, capital services measures are based on productive capital stocks derived using the perpetual inventory method (PIM). The PIM calculations are carried out by the OECD, using an assumption of common service lives for given assets for all countries, and by correcting for differences in the national deflators used for information and communication technology (ICT) assets (see Schreyer, 2002; and Colecchia and Schreyer, 2002, for further information about the calculation of ICT "harmonised" deflators). The investment series by asset type used in the PIM calculations are sourced from national accounts statistics produced by national statistics offices.

From 2015, the classification of assets adopted in the PDB is in line with the 2008 SNA. Capital services are computed separately for eight non-residential fixed assets $k = 1, 2, \ldots, 8$, i.e. computer hardware, telecommunications equipment, transport equipment, other machinery and equipment and weapons systems, non-residential construction, computer software and databases, research and development and other intellectual property products. The volume index of total capital services is computed by aggregating the volume change of capital services of all individual assets using a Törnqvist index that applies asset specific user cost shares as weights:

$$\ln\left(\frac{K^t}{K^{t-1}}\right) = \sum_{k=1}^{8} \frac{1}{2}\left(v_k^t + v_k^{t-1}\right) \ln\left(\frac{K_k^t}{K_k^{t-1}}\right)$$

where:

$$v_k^t = \left(\frac{u_k^t K_k^t}{\sum_{k=1}^{8} u_k^t K_k^t}\right)$$

and $u_k^t$ is the user cost per unit of capital services provided by asset $k$ at time $t$ (see Schreyer et.al., 2003). Thereby, $v_k^t$ is the user cost share of asset $k$, $\frac{1}{2}\left(v_k^t + v_k^{t-1}\right)\ln\left(\frac{K_k^t}{K_k^{t-1}}\right)$ is the contribution of asset $k$, to total capital services in year $t$ and $K_k^t$ is the quantity of capital services provided by asset $k$ in year $t$.

Aggregate volume indices of capital services are also computed for ICT assets (computer hardware, telecommunications equipment and computer software and databases) and non-ICT assets (transport equipment, other machinery and equipment and weapons systems, non-residential construction, research and development and other intellectual property products), using the appropriate user costs shares as weights. The aggregate volume indices of ICT and non-ICT capital services are given by:

$$\ln\left(\frac{K_{ict}^t}{K_{ict}^{t-1}}\right) = \sum_{i=1}^{3} \frac{1}{2}\left(\gamma_i^t + \gamma_i^{t-1}\right)\ln\left(\frac{K_i^t}{K_i^{t-1}}\right)$$

where $i$ represents an ICT asset and

$$\gamma_i^t = \left(\frac{u_i^t K_i^t}{\sum_{i=1}^{3} u_i^t K_i^t}\right)$$

$$\ln\left(\frac{K_{nict}^t}{K_{nict}^{t-1}}\right) = \sum_{j=1}^{5} \frac{1}{2}\left(\gamma_j^t + \gamma_j^{t-1}\right)\ln\left(\frac{K_j^t}{K_j^{t-1}}\right)$$

where j represents a non-ICT asset and

$$\gamma_j^t = \left(\frac{u_j^t K_j^t}{\sum_{j=1}^{5} u_j^t K_j^t}\right)$$

### *Cost shares of inputs*

The total cost of inputs is the sum of the labour input cost and the total cost of capital services. The national accounts record the income of the self-employed as *mixed income*. This measure includes the compensation of both labour and capital to the self-employed but separate estimates of the two components are not generally measurable. As such, in the PDB, total labour input costs for total persons employed (i.e. employees and self-employed) are computed as the average remuneration per employee multiplied by the total number of persons employed. The preferred source for data on compensation of employees and for the number of employees as well as the number of self-employed is the *OECD National Accounts Statistics* (database).

The labour input cost is calculated as follows:

$$w^t L^t = \left(\frac{COMP^t}{EE^t}\right) E^t$$

where $w^t L^t$ reflects the total remuneration for labour input in period $t$, $COMP^t$ is the total compensation of employees in period $t$, $EE^t$ is the number of employees in period $t$, and $E^t$ the total number of employed persons, i.e., employees plus self-employed, in period $t$.

Total capital input cost is computed as the sum of the user costs of each capital asset type $k$ given by $u_k^t K_k^t$, where $u_k^t$ is the user cost per unit of capital services provided by asset type $k$.

The total cost of inputs is then given by

$$C^t = w^t L^t + \sum_{k=1}^{8} u_k^t K_k^t$$

and the corresponding cost shares of labour and capital are

$s_L^t \equiv \frac{w^t L^t}{C^t}$ for labour input,

$s_K^t \equiv \frac{\sum_{k=1}^{8} u_k^t K_k^t}{C^t}$ for total capital input,

$s_{K_{ict}}^t \equiv \frac{\sum_{i=1}^{3} u_i^t K_i^t}{C^t}$ for capital input derived from ICT assets $i$=1,2,3,

$s_{K_{nict}}^t \equiv \frac{\sum_{j=1}^{5} u_j^t K_j^t}{C^t}$ for capital input derived from non-ICT assets $j$=1,…,5.

### *Labour productivity*

At the total economy level, labour productivity is measured as Gross domestic product (GDP) at market prices per hour worked.

### *Multifactor productivity*

The underlying production function assumes "Hicks neutral" technical change, as it is represented as an outward shift of the production function that affects all factors of production proportionately:

$$Q = A\, f(L, K)$$

Differentiating this expression with respect to time and using a logarithmic rate of change, multifactor productivity growth (the rate of change of the variable A) is measured as the rate of change of volume output (Q) minus the weighted rates of change of inputs (X). In simple terms, growth in multifactor productivity (MFP) can be described as the change in output that cannot be explained by changes in the quantity of capital and labour inputs used to generate output. In the PDB MFP growth is then measured as follows:

$$\ln\left(\frac{MFP^t}{MFP^{t-1}}\right) = \ln\left(\frac{Q^t}{Q^{t-1}}\right) - \ln\left(\frac{X^t}{X^{t-1}}\right)$$

where $Q$ is output measured as GDP at market prices and at constant prices; $X$ relates to total inputs used and the rate of change of these inputs is calculated as a weighted average of the rate of change of labour and capital inputs, with the respective cost shares as weights. Aggregation of these inputs is by way of the Törnqvist index:

$$ln\left(\frac{X^t}{X^{t-1}}\right) = \frac{1}{2}\,(s_L^t + s_L^{t-1})\, ln\left(\frac{L^t}{L^{t-1}}\right) + \frac{1}{2}\,(s_K^t + s_K^{t-1})\, ln\left(\frac{K^t}{K^{t-1}}\right)$$

### *Contributions to GDP growth*

In the growth accounting framework, GDP growth can be decomposed into the contributions of each production factor plus multifactor productivity:

$$\ln\left(\frac{Q^t}{Q^{t-1}}\right) = \frac{1}{2}\left(s_L^t + s_L^{t-1}\right)\ln\left(\frac{L^t}{L^{t-1}}\right) + \frac{1}{2}\left(s_{K_{ict}}^t + s_{K_{ict}}^{t-1}\right)\ln\left(\frac{K_{ict}^t}{K_{ict}^{t-1}}\right) + \frac{1}{2}\left(s_{K_{nict}}^t + s_{K_{nict}}^{t-1}\right)\ln\left(\frac{K_{nict}^t}{K_{nict}^{t-1}}\right) + \ln\left(\frac{MFP^t}{MFP^{t-1}}\right)$$

where:

$\frac{1}{2}\left(s_L^t + s_L^{t-1}\right)\ln\left(\frac{L^t}{L^{t-1}}\right)$ is the contribution of labour input to GDP growth,

$\frac{1}{2}\left(s_{K_{ict}}^t + s_{K_{ict}}^{t-1}\right)\ln\left(\frac{K_{ict}^t}{K_{ict}^{t-1}}\right)$ is the contribution of ICT capital input to GDP growth,

$\frac{1}{2}\left(s_{K_{nict}}^t + s_{K_{nict}}^{t-1}\right)\ln\left(\frac{K_{nict}^t}{K_{nict}^{t-1}}\right)$ is the contribution of non-ICT capital input to GDP growth.

### *Contributions to labour productivity growth*

By reformulating the decomposition of output growth presented above, it is possible to decompose labour productivity growth into the contribution of capital deepening and MFP.

$$\ln\left(\frac{LP^t}{LP^{t-1}}\right) = \frac{1}{2}\left(s_K^t + s_K^{t-1}\right)\left[\ln\left(\frac{K^t}{K^{t-1}}\right) - \ln\left(\frac{L^t}{L^{t-1}}\right)\right] + \ln\left(\frac{MFP^t}{MFP^{t-1}}\right)$$

where:

$\ln\left(\frac{LP^t}{LP^{t-1}}\right) = \ln\left(\frac{Q^t}{Q^{t-1}}\right) - \ln\left(\frac{L^t}{L^{t-1}}\right)$ is labour productivity growth,

$\ln\left(\frac{K^t}{K^{t-1}}\right) - \ln\left(\frac{L^t}{L^{t-1}}\right)$ is capital deepening (i.e. growth in capital services per hour worked),

$\frac{1}{2}\left(s_K^t + s_K^{t-1}\right)\left[\ln\left(\frac{K^t}{K^{t-1}}\right) - \ln\left(\frac{L^t}{L^{t-1}}\right)\right]$ is the contribution of capital deepening to labour productivity growth.

It is also possible to reformulate the decomposition of labour productivity growth to show the contributions of ICT capital and non-ICT capital:

$$\ln\left(\frac{LP^t}{LP^{t-1}}\right) = \frac{1}{2}\left(s_{K_{ict}}^t + s_{K_{ict}}^{t-1}\right)\left[\ln\left(\frac{K_{ict}^t}{K_{ict}^{t-1}}\right) - \ln\left(\frac{L^t}{L^{t-1}}\right)\right] + \frac{1}{2}\left(s_{K_{nict}}^t + s_{K_{nict}}^{t-1}\right)\left[\ln\left(\frac{K_{nict}^t}{K_{nict}^{t-1}}\right) - \ln\left(\frac{L^t}{L^{t-1}}\right)\right] + \ln\left(\frac{MFP^t}{MFP^{t-1}}\right)$$

where:

$\frac{1}{2}\left(s_{K_{ict}}^t + s_{K_{ict}}^{t-1}\right)\left[\ln\left(\frac{K_{ict}^t}{K_{ict}^{t-1}}\right) - \ln\left(\frac{L^t}{L^{t-1}}\right)\right]$ is the contribution of ICT capital to labour productivity growth,

$\frac{1}{2}\left(s_{K_{nict}}^t + s_{K_{nict}}^{t-1}\right)\left[\ln\left(\frac{K_{nict}^t}{K_{nict}^{t-1}}\right) - \ln\left(\frac{L^t}{L^{t-1}}\right)\right]$ is the contribution of non-ICT capital to labour productivity growth.

### *Unit labour costs and their components*

Unit labour costs (ULCs) measure the average cost of labour per unit of output produced. They are calculated as the ratio of total labour costs (in national currency, current prices) to real output (in national currency, constant prices). At the total economy level, real output is measured as GDP at market prices and constant prices. Equivalently, ULCs may be expressed as the ratio of total labour costs per hour worked in current prices to real GDP per hour worked in constant prices, i.e., labour productivity.

In principle, the appropriate numerator for ULC calculations is total labour costs of all persons engaged. In practice, however, this information is not readily available for most countries. As such,

OECD total labour cost estimates used in calculating ULCs are based on adjusted estimates of compensation of employees (COE), compiled according to the System of National Accounts (SNA).

Compensation of employees as defined in the SNA excludes labour compensation for the self-employed which is covered in the item *mixed income*. Estimates of the compensation component (per hour worked) of mixed income are set as compensation of employees per hour worked. This assumption may be more or less valid across different countries.

Unit labour costs are therefore compiled as follows:

$$\frac{COMP^t \frac{H^t}{HE^t}}{Q^t}$$

where $COMP^t$ reflects the total compensation of employees in period $t$, $H^t$ is the total number of hours worked by all persons employed in period $t$, $HE^t$ is the total number of hours worked by employees in period $t$ and $Q^t$ is GDP at market prices and constant prices in period $t$.

### *Productivity measures at industry level*

The conceptual approach used to estimate productivity at industry level follows that for the total economy. However the same quantity (and quality) of data that is available for the whole economy estimates is not always available at the detailed industry level. Hence some approximations are necessary and, so, some differences may prevail between the whole economy estimates and those at industry level.

Productivity measures at industry level are computed for 14 economic activities, each defined in accordance with the International Standard Industrial Classification of All Economic Activities (ISIC) Rev.4.

#### *Labour input*

Labour input is measured as total hours worked by all persons engaged in production, i.e. employees plus self-employed, broken down by industry. Another measure of labour input presented in the database is total number of persons employed (i.e. number of employees and numbers of self-employed).

#### *Labour productivity*

At the industry level, labour productivity is measured as gross value added at basic prices per hour worked and growth rates are determined using constant price estimates of gross value added. Comparable measures are also derived per person employed.

#### *Contributions to labour productivity growth*

The contribution of an economic activity to labour productivity growth of a group of economic activities (e.g. total business sector, total services) is compiled using a Törnqvist index as follows:

$$Cont(i,t) = \frac{1}{2}\left[\left(\frac{Q_{cur,i,t}}{Q_{cur,tot,t}} + \frac{Q_{cur,i,t-1}}{Q_{cur,tot,t-1}}\right)\theta_t(Q_{con,i}) - \left(\frac{L_{i,t}}{L_{tot,t}} + \frac{L_{i,t-1}}{L_{tot,t-1}}\right)\theta_t(L_i)\right]$$

where:

$i$ is an economic activity,

$tot$ is an aggregate of economic activities including economic activity i,

$Qcur$ is gross value added at current prices,

$Qcon$ is gross value added at constant prices,

$L$ is the number of hours worked,

$\theta_t(x)$ is the annual growth rate of $x$ between time $t-1$ and $t$.

The database also presents contributions to labour productivity growth by economic activity on an employment (persons) basis.

### *Unit labour costs and their components*

Unit labour costs (ULCs) measure the average cost of labour per unit of output produced. They are calculated as the ratio of total labour costs (in national currency, current prices) to real output (in national currency, constant prices). For main economic activities, real output is measured as gross value added at basic prices and constant prices. Equivalently, ULCs may be expressed as the ratio of total labour costs per hour worked in current prices to real gross value added per hour worked, i.e. labour productivity.

Total labour costs used for the calculations of ULCs by economic activity are computed as described above for the total economy. ULCs by economic activity are compiled as follows:

$$\frac{COMP^{i,t}\,\dfrac{H^{i,t}}{HE^{i,t}}}{Q^{i,t}}$$

where $i$ reflects the economic activity, $COMP^t$ reflects the total compensation of employees in period $t$, $H^t$ is the total number of hours worked by all persons employed in period $t$, $HE^t$ is the total number of hours worked by employees in period $t$ and $Q^t$ is gross value added at basic and constant prices in period $t$. The database presents ULCs by economic activity on an employment (persons) basis.

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## Measuring hours worked

### *Definitions*

In the national accounts framework, for the purposes of productivity measurement, labour input is most appropriately measured as the total number of hours actually worked by all persons engaged in production (2008 SNA, para 19.47). It is instructive to consider the relationship between this concept and related measures of working time (see also Table 8.1):

- *Hours actually worked* – the hours actually spent on productive activities;
- *Hours usually worked* – the typical hours worked during a short reference period such as a week over a longer observation period;
- *Hours paid*– the hours worked for which remuneration is paid;
- *Contractual hours of work* – the number of hours that individuals are expected to work based on work contracts;
- *Overtime hours of work* – the hours actually worked in excess of contractual hours; and
- *Absence from work hours* – the hours that persons are expected to work but do not work.

**Table 8.1. Relationship between different concepts of hours worked**

| Overtime hours of work | | | | | Absences from work | | | |
|---|---|---|---|---|---|---|---|---|
| Irregular overtime | | Regular overtime | | | Irregular absence | | Regular absence | |
| Unpaid | Paid | Paid | Unpaid | | Unpaid | Paid | Paid | Unpaid |
| | | | | **Contractual hours** | | | | |
| | | | | **Hours actually worked** | | | | |
| | | | | **Hours usually worked** | | | | |
| | | | | **Hours paid for** | | | | |

*Note*: Establishing the relationship between normal hours and the five other concepts is not possible, as normal hours are established on a case-by-case basis.
*Source*: ILO (2008), Measurement of working time, 18th ICLS.

Because productivity analysis relates the inputs used in producing a given output, with that output, the underlying concept for labour input should include all hours used in production, whether paid or not, and so should exclude those hours not used in production, even if some compensation is received for those hours. As such the relevant concept for measuring labour input is *hours actually worked*. The productive or non-productive characteristic of an activity is determined by its inclusion in, or exclusion from, the System of National Accounts (SNA) production boundary. *Hours actually worked* are defined as (ILO, 2008):

- the hours spent directly on productive activities or in activities in relation to them (maintenance time, cleaning time, training time, waiting time, time spent on call duty, travelling time between work locations);
- the time spent in between these hours when the person continues to be available for work (for reasons that are either inherent to the job or due to temporary interruptions); and
- short resting time.

Conversely, *hours actually worked* should exclude:

- annual leave and public holidays;
- longer breaks from work (e.g. meal breaks);
- commuting time (when no productive activity is performed); and
- educational activities other than on-the-job training time.

### *Data sources*

The majority of countries use multiple sources to compile estimates of average hours worked per person, in particular for employees, often using *labour force surveys* as a main or secondary source in combination with other main and/or secondary data sources, such as *population census*, *business statistics* and *administrative records* (Ward et al., 2018).

- *Labour force survey*. The labour force survey (LFS) is the most comprehensive and well-established source for information on the composition and characteristics of the labour force. LFS include questions on the number of hours actually and usually worked in the reference period, i.e. questions concerning the differences between the time usually spent working and the time actually worked during the reference week. Additional LFS questions concerning working time components such as hours worked at home, commuting time, short breaks, overtime and absences from work are also often available. International harmonisation is achieved by complying with definitions set out by the International Labour Organisation (ILO, 1982 and 2013), although sample selection, survey techniques, survey responses and the implementation of ILO concepts may vary between countries. An advantage of the LFS is that it covers a broad range of employment situations, including the self-employed, unpaid family workers and informal employment, as well as collecting information on multiple-job holdings, hours usually and actually worked, and paid and unpaid overtime. Its main limitation from the perspective of national accounting, and hence, productivity analysis, is the often limited consistency with output and value-added measures, in particular, by industry, as the LFS is a household survey for which the stratification process may not adequately capture the homogenous strata required in productivity analysis. In addition, in many countries, the LFS does not cover some groups of the population such as persons below or above certain age thresholds (which varies by country), those living and working in communal establishments (such as prisons or long-term care facilities), collective households (such as religious institutions) and the armed forces, all of whose output is included, at least in theory, in estimates of GDP. In addition, the sampling structure of LFS is based on the population usually residing in the country and includes workers in non-resident production units, whereas non-resident cross-border workers working in resident production units are excluded. There may also be biases in LFS responses, reflecting the self-reporting nature of LFS, and these biases, that may also be cultural, appear to be significant with respect to responses on hours actually worked.
- *Population census*. The population census (PC) is a comprehensive source covering the whole population of a country, making it a useful tool to benchmark household surveys, including the LFS. The main disadvantages are the low frequency of data collection, which is typically carried out every five or ten years, and the possibility that unregistered migrants may not be captured.
- *Business statistics*. Business statistics (BS) include establishment and/or enterprise surveys, business census, and dedicated labour cost surveys. Another important data source is the statistical business register (SBR) which is typically sourced from

multiple primary data sources, including business surveys and a variety of administrative data. BS typically provide detailed data on employment and hours worked following a detailed industrial classification of firms that is generally consistent with their classification in national accounts output and value-added data – indeed structural business statistics are an important input to, and building block for, the national accounts. One of the main limitations of BS, however, is that they sometimes exclude establishments or enterprises below a certain employment or turnover threshold and certain categories of firms, such as unincorporated businesses, self-employed persons and informal labour. A further limitation of some business statistics, such as dedicated labour cost surveys, is that they often provide information on hours paid or contractual hours only, and not information on absences from work and unpaid overtime, and, so, do not align with the concept of hours actually worked required to measure labour input in productivity analysis.

- *Administrative data sources* – Administrative data sources (AS) are typically collected by government bodies – but also increasingly by private data providers (e.g. associations for specific groups) – based on some form of statutory or voluntary registration. For example, statistics from social security institutions and tax administrations can provide information on all persons required to pay income tax or social insurance contributions. Social security records, tax registers, compulsory business registration systems, resident permit registers, migration statistics, and statistics on the armed forces, are the administrative sources most commonly used by countries in compiling estimates of labour input. AS may include information on wages, entrepreneurial income, taxes, etc. as well as a series of demographic variables describing age, gender, and family ties. The main advantage of AS is that they are generally comprehensive, at least with regards to the population that they purport to cover, and do not entail additional collection costs to the national statistical offices (NSOs) as compared to surveys. Like BS however, AS often struggle to capture informal labour.
- *Other sources*. Statistical offices may use other complementary sources to estimate labour input that do not fall neatly into any of the above categories. Among others these can include time-use surveys, surveys on households' living conditions, tourism surveys, and surveys of insurance companies.

Table 8.2 summarises the main strengths and limitations of the primary sources typically used to compute hours worked and employment estimates in national accounts.

**Table 8.2. Primary sources used to compute national accounts estimates of hours worked and employment**

| Primary data source | Main strengths | Main limitations |
|---|---|---|
| Labour force survey | • Covers employees, self-employed, unpaid family workers, government and NPISH workers<br>• Includes information on the characteristics of employment: age, gender, education, industry, occupation<br>• Provides information on hours actually worked<br>• Harmonised concepts across countries (ILO concepts)<br>• Typically counts the number of persons | • It is a household survey and so may have limited consistency with output and value added measures collected in business surveys, especially by industry<br>• Concept of employment typically not be in line with the resident (domestic) concept in national accounts<br>• There may be reporting biases in reported hours worked<br>• Excludes people living in collective households, although this is unlikely to significantly affect numbers of persons employed |
| Business statistics (establishment surveys, business census, labour cost surveys) | • Information consistent with output data<br>• Covers production units operating in the territory: domestic concept of employment | • Typically excludes information on agriculture and government sectors - although these are covered in comparable surveys<br>• May exclude small enterprises below a certain employment or turnover threshold and certain categories of firms, such as unincorporated, self-employed and informal.<br>• Information on hours paid or contractual hours, excludes absences and unpaid overtime<br>• Not necessarily harmonised across countries, although when presented as structural business statistics comparability is generally improved |
| Population census | • Can be used as a benchmark | • Low frequency of data collection (typically every 10 years) |
| Administrative sources (e.g. social security registers, tax registers) | • To complement data on employment and labour income/compensation | • There is often restricted access (micro data)<br>• Difficult to capture the informal economy |
| Time use surveys | • To complement and compare data on hours worked | • Low frequency data<br>• Limited international comparability |

For the purposes of productivity analysis, consistency of total hours worked with *national accounts* concepts needs to be ensured (OECD, 2009; Ward et al., 2018)). This implies adjusting the coverage of activities covered by the labour input measures to those covered in GDP, i.e. adapting the geographical and economic boundaries of employment and hours worked to the national accounts production boundary. The notion of economic territory used to compute GDP refers to the domestic concept, so that when compiling labour input measures, resident persons working non-resident units should be excluded while non-resident persons working in resident-units should be included.

### *Methods*

In essence, there are two main approaches to compute estimates of total hours actually worked:

- The *direct method*, which consists of annualising average actual weekly hours worked derived from continuous surveys in all weeks of the calendar year (i.e. multiplying the number of self-reported actual hours worked in the reference week by the number of working weeks in a year). This method often relies on a single source, generally the LFS, and assumes that full- and part-week absences and extra hours worked in the main and/or additional job/s are well captured in self-reported actual hours worked averaged over the year.
- The *component method*, which starts from estimates of contractual, paid or usual hours per week from establishment surveys, administrative sources or, indeed, the

LFS, with adjustments for absences (holidays, sickness, maternity leave, etc.) and (paid and/or unpaid) overtime. This is an indirect approach, as its starting point is not the target concept (hours actually worked) and, rather, requires a series of explicit adjustments (i.e. accounting for each component) to align with the concept, which is why it is often referred to as the component method.

For labour force surveys with fixed monthly reference weeks (i.e. where the survey is not conducted continuously in all weeks of the month or the quarter but in a given week of the month), the direct method consists of averaging hours worked during those 12 reference weeks after applying adjustments for special events, such as holidays, falling outside each reference week. This is the method applied, for example, in Australia and Canada. As discussed in Ward et al. (2018), this is a *direct method with adjustments* that resembles a component approach, as it corrects for annual leave and public holidays, which are the most important reasons for work absences, followed by sickness leave, and the most important reason, after differences in usual hours, to explain cross-country differences in annual working time.

### *Hours worked data in the OECD Productivity Statistics (database)*

In the PDB, the main requirement is that the most internationally comparable hours worked data are used (OECD, 2007). The preferred source for total hours worked is countries national accounts, which are presented in the *OECD National Accounts Statistics* (database), both for the total economy and for aggregate economic activities. However, long time series of hours worked are not available for a number of countries; in which case, the Secretariat estimates hours worked using the *OECD Employment and Labour Market Statistics* (database). Total economy estimates of average hours actually worked per year and per person employed are currently available on an annual basis, for all 36 OECD member countries and some key partner economies as follows:

- Actual hours worked are primarily sourced from the *OECD National Accounts Statistics* (database) for Australia, Belgium, Canada, Costa Rica, the Czech Republic, Denmark, France, Germany, Hungary, Iceland, Ireland, Israel, Italy, Korea, Luxembourg, Mexico, the Netherlands, Norway, the Slovak Republic, Slovenia, South Africa, Spain, Switzerland, and the United States.
- Actual hours worked are sourced from the *OECD Employment and Labour Market Statistics* (database) for Chile, Japan, New Zealand, the Russian Federation and Turkey.
- Since January 2019, actual hours worked for Austria, Estonia, Finland, Greece, Latvia, Lithuania, Poland, Portugal, Sweden and the United Kingdom are estimated by the OECD Secretariat applying a simplified component method on EU LFS data, as described and following the recommendations in Ward et al. (2018).
- For some countries, longer time series and/or more recent estimates of total hours worked are derived using the *OECD Economic Outlook: Statistics and Projections* (database), the *OECD Main Economic Indicators* (database) and national sources.

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## Capital input measures at the OECD

### *Introduction*

Two key measures of capital stock exist. The first is the *productive capital stock*, which looks at capital in its function as a provider of capital services in production. The second is gross (or net) capital stock, which captures the role of capital as a store of wealth (OECD, 2001; Schreyer, 2004; OECD, 2009). This section provides supplementary information on these two measures, on the approaches used to estimate them and on capital measures available at the OECD.

### *Definitions*

#### *Productive capital stock (and capital services)*

When the purpose of capital measurement is to gauge its role in production and productivity, via capital services, it is necessary to construct measures of the *productive capital stock*. The productive capital stock per type of capital asset is constructed by applying an age-efficiency profile and a retirement pattern when past investments of each asset are summed up over time. For example, a 10-year old lorry would be given a lower weight compared with a new lorry when past purchases of lorries are added up to construct a measure of today's productive stock of lorries. Moreover, lorries are scrapped after a certain number of years and investments that date back by say 30 years would not enter today's productive stock. Unlike gross or net capital stock measures, aggregate measures of productive capital stock weigh different types of assets by their relative productivity using the *user costs* of each capital type. The resulting aggregate constitutes a measure for the potential flow of productive services that all fixed assets can deliver in production, i.e. capital services.

#### *Net and gross (wealth) capital stocks*

Perhaps the best known measure of capital stock is that used to value assets on a company, industry or nation's balance sheets, that is, the gross or net capital stock measures described in the System of National Accounts (SNA). These provide measures of wealth but they are not conceptually appropriate for productivity analysis. Unlike the productive capital stock, the purpose of wealth capital stocks measures is not to track the role of capital as a factor of production but to track the role of capital as a set of assets with market value – wealth capital stocks appear on the balance sheets in the SNA. This reflects the fact that the implicit weighting for the different assets used in building up wealth measures of total capital stock is based on the market prices of the different assets. However changes in the relative productivity of the different assets are not necessarily consistent with changes in the relative price of the assets. For productivity analysis it is the former measure (and weighting of different asset types) that is relevant.

### *Measuring capital input*

In general, capital stock series are not directly measured. In common with most measures presented in the national accounts, they are estimated by national statistics institutes using available data on gross fixed capital formation (investment) with local methodology and assumptions – although there is increasing convergence towards international standards. There are heavy data requirements for the estimation of capital stocks which include the following:

- a benchmark level of capital stock for at least one year (preferably by asset type);
- a long-time-series of investment volumes and price deflators (preferably by asset type);
- as much asset type detail as possible;

- depending on the type of capital stock being estimated, estimates of average services lives by asset and/or depreciation rates for each asset;
- industry-by-asset-type investment matrices for capital stock by industry.

### *Capital measures in OECD statistics*

Several OECD databases, described below, contain capital stock data. However some differences exist between them:

- *The origin of the data*. In some of the databases described below only official data made available to the OECD by national statistics institutes are used. In other databases however, particularly those that are considered more analytical databases, such as the *OECD Productivity Statistics* (database), other sources are often used to estimate missing data or to create estimates based on comparable estimation techniques.
- *The coverage of the data*. As shown in Table 8.3 below, some databases are confined to aggregate statistics, such as the *OECD Economic Outlook: Statistics and Projections* (database) or *OECD Productivity Statistics* (database). Others provide a break-down by industry, such as the *OECD Structural Analysis Statistics* (database) and the *OECD National Accounts Statistics* (database).
- *The capital stock variable*. The *OECD Productivity Statistics* (database) measures productive capital stocks (and therefore, capital services) whereas the *OECD Structural Analysis Statistics* (database) and *OECD National Accounts Statistics* (database) contain measures of net and/or gross (wealth) capital stocks.

**Table 8.3. Asset and industry breakdown of capital stock data in OECD databases**

| | | Asset breakdown | |
|---|---|---|---|
| | | Yes | No |
| Industry breakdown | Yes | *OECD National Accounts Statistics* (database) | *OECD Structural Analysis Statistics* (database) |
| | No | *OECD Productivity Statistics* (database) | *OECD Economic Outlook: Statistics and Projections* (database) |

### *Capital services for the total economy, 8-way asset break down*

Estimates of capital services in the *OECD Productivity Statistics* (database) are based on a common computation method for all countries (Schreyer et al., 2003). This approach estimates productive capital stocks for all countries on the assumption that the same service lives are applicable for any given asset irrespective of the country. In the *OECD Productivity Statistics (database)*, the following average service lives are currently assumed for the different assets: 7 years for computer hardware, 15 years for telecommunications equipment, other machinery and equipment and weapons systems and transport equipment, 40 years for non-residential construction, 3 years for computer software and databases, 10 years for research and development and 7 years for other intellectual property products. The approach further uses harmonised deflators for computer hardware, telecommunications equipment and computer software and databases, for all countries, to sort out comparability problems that exist in national practices for deflation for this group of assets (Schreyer, 2002; Colecchia and Schreyer, 2002).

From 2015, the classification of assets adopted in the *OECD Productivity Statistics* (database) is in line with the 2008 SNA asset boundary. Productive capital stocks and the respective flows of capital services are computed separately for eight non-residential fixed assets: computer hardware, telecommunications equipment, transport equipment, other machinery and equipment and weapons

systems, non-residential construction, computer software and databases, research and development and other intellectual property products. By their very nature, capital services flows are presented as rates of change or indices and not as levels of stocks as is the case for measures of net and gross stocks. The aggregate volume of capital services (i.e. capital input) is then computed by aggregating the volume change of capital services of all individual assets applying asset specific *user cost* shares as weights. No conceptual distinction is made between user costs of capital and rental prices of capital. In principle, the rental price is that price that could be directly observed if markets existed for all capital services. In practice, however, rental prices have to be imputed for most assets, using the implicit rent that capital goods' owners 'pay' to themselves: the *user costs of capital*. In other words, the user cost of capital reflects the amount that the owner of a capital good would charge if they rented out the capital good under competitive conditions.

#### *Net and gross capital stocks by broad economic activities, with 9-way asset break-down*

The *OECD National Accounts Statistics* (database) brings together a large number of national accounts series for OECD and non-OECD countries. This includes data on net and gross capital stocks broken down by main economic activity and by nine types of assets: dwellings, other buildings and structures, transport equipment, other machinery and equipment and weapons systems, of which computer hardware and telecommunications equipment; cultivated biological resources; intellectual property products, of which computer software and databases and research and development. The data are transmitted by OECD member countries in reply to an official questionnaire and are provided in current prices and volumes. The level of industry detail and the time period covered varies across countries.

#### *Net and gross capital stocks by detailed industries, no asset break-down*

The *OECD Structural Analysis Statistics* (database) provides data on volume measures of *gross and net capital stock* by industry. The *OECD Structural Analysis Statistics* (database) covers all ISIC Rev.4 aggregations used for national accounts, some additional 2- and 3- digit ISIC Rev.4 detail, as well as specific aggregates. The level of industry detail and the time period covered varies across countries. A detailed overview of available data in the *OECD Structural Analysis Statistics* (database) can be found at http://www.oecd.org/sti/ind/stanstructuralanalysisdatabase.htm.

#### *Alternative capital stocks, for the total economy, no asset break-down*

The *OECD Economic Outlook* is a key twice-yearly publication with economic forecasts and analyses for OECD countries and key partner economies. One of the series available is the volume measure for non-residential capital services for the total economy (productive capital stocks).

### ***How to access OECD capital input measures***

Aggregate capital services series in the *OECD Productivity Statistics* (database), along with methodological information and analytical papers and publications can be found on the *OECD Productivity Statistics* website on http://www.oecd.org/std/productivity-stats/ or on the *OECD Productivity Statistics* (database) on OECD.Stat, within the theme Productivity, then selecting *Growth in GDP per capita, productivity and ULC*, and then *Growth in capital input*;

- Data on gross/net capital stocks by industry can be found in the *OECD Structural Analysis Statistics* (database) on: www.oecd.org/sti/ind/stanstructuralanalysisdatabase.htm;
- Gross/net capital stocks in the *OECD National Accounts Statistics* (database) can be found under the theme of the national accounts via: http://stats.oecd.org/, then

selecting *Annual National Accounts*; *Main Aggregates*; *Detailed Tables and Simplified Accounts*; *Fixed Assets by Activity and by Type of Product*;

- Data used for the *OECD Economic Outlook*, such as the total economy productive capital stock volume series, are published separately and can be found under the item *Supply Block* through the current Economic Outlook theme on OECD.Stat (http://stats.oecd.org/).

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## The System of National Accounts 2008

### *The 2008 SNA – changes from the 1993 SNA*

In 2009, The United Nations Statistical Commission endorsed a revised set of international standards for the compilation of national accounts: the System of National Accounts (SNA) 2008, replacing the 1993 version of the SNA. For Colombia, the indicators presented in this publication are in line with the 1993 SNA. For the Russian Federation, the indicators are in line with the 1993 SNA until 2010 and with the 2008 SNA from 2011 onwards. For all the other countries, the indicators are based on the 2008 SNA. The 2008 SNA includes a number of changes from the 1993 SNA and was adopted by most OECD countries at the end of 2014.

### *Changes affecting whole economy levels of income*

For the United States, the adoption of the 2008 SNA in 2013 raised the level of GDP by 3.6 per cent, mainly due to the recognition of new forms of gross fixed capital formation (GFCF), notably Research and Development (R&D). The revision was also an opportunity for countries to implement some additional changes made in the 1993 SNA, which recognised entertainment originals as fixed assets. In addition changes were also made for the 2008 SNA recommendations on ownership transfer costs (see below). Current consumption expenditures of government in recent years were also revised downwards, reflecting 2008 SNA recommendations on defined benefit pensions plans as well as the net (of depreciation) effects of removing R&D expenditures from current consumption (see also below).

#### *Research and experimental development*

R&D is recognised for the first time as a produced asset. This also means that payments for the acquisition of patents, treated as acquisition or disposal of non-produced, non-financial assets in the 1993 SNA, are treated as transactions in produced assets. This also has implications for sectoral gross value added as the 2008 SNA also recommends that a separate establishment be distinguished for R&D producers when possible. See also the OECD Handbook on Deriving Capital Measures of Intellectual Property Products. Under the 1993 SNA, expenditure on R&D by government already adds to government output (which is estimated on a sum of costs basis) and subsequently as general government final consumption. So, for government the direct impact of the capitalisation mainly involves a reclassification of expenditure from government final consumption to government GFCF. Indirectly however government output and, so GDP, will increase as part of the costs of government is an imputation for depreciation; which now includes a component for the capital stock of R&D by government.

#### *Weapons systems*

Military weapons systems such as vehicles, warships, etc. used continuously in the production of defence (and deterrence) services are recognised as fixed assets in the 2008 SNA (the 1993 SNA recorded these as fixed assets only if they had dual civilian use and as intermediate consumption otherwise). Some single-use items such as certain types of ballistic missiles with a highly destructive capability, but which provide ongoing deterrence services, are also recognised as fixed assets in the 2008 SNA. Because most if not all of these expenditures are carried out by government (whose output is typically valued by summing costs) GDP will only increase by the related new consumption of fixed capital.

### *Financial Intermediation Services Indirectly Measured (FISIM)*

The method recommended in the 2008 SNA for the calculation of FISIM implies several changes from that in the 1993 SNA. For example it explicitly recommends that FISIM only apply to loans and deposits provided by/deposited with financial institutions, and that for financial intermediaries all loans and deposits are included, not just those of intermediated funds. In addition, the 2008 SNA no longer allows countries to record FISIM as a notional industry.

### *Financial services*

The 2008 SNA defines financial services more explicitly to ensure that services such as financial risk management and liquidity transformation, are captured.

### *Output of Central Banks*

The 2008 SNA has provided further clarification on the calculation of FISIM in calculating the output of Centrals Banks. Where Central Banks lend or borrow at rates above or below the effective market lending/borrowing rate, the 2008 SNA recommends the recording of a tax or subsidy from the counterpart lender/borrower to/from government to reflect the difference between the two rates. Correspondingly a current transfer (the counterpart to the tax/subsidy) is recorded between government and the Central Bank. These flows will have an impact on the distribution of income in national income compared with the 1993 SNA treatment.

### *Output of non-life insurance services*

The methodology used to indirectly estimate this activity in the 1993 SNA (premiums plus premium supplements minus claims) could lead to extremely volatile (and negative) series in cases of catastrophic losses. The 2008 SNA recommends a different indirect approach to measurement that better reflects the pricing structures used by insurance companies and the underlying provision of insurance services per se. The approach can be simply described as an ex ante expectation approach. Output is equal to premiums plus expected premium supplements minus expected claims. The 2008 SNA also recommends that exceptionally large claims, following a catastrophe, be recorded as capital, rather than current, transfers which will have an impact on (particularly sectoral) estimates of disposable income.

### *Valuation of output for own final use*

The 2008 SNA recommends that estimates of output for own final use should include a component for the return to capital as part of the sum of costs approach when comparable market prices are not available. However no return to capital should be included for non-market producers.

### *Costs of ownership transfer*

The 1993 SNA recommended that these costs (treated as GFCF in the accounts) should be written off over the life of the related asset. The 2008 SNA instead recommends that these costs be written off over the period the asset is expected to be held by the purchaser. This will impact on measures of net income and only marginally on gross measures, reflecting the calculation of output for own final use and government output (which is calculated as the sum of costs including depreciation).

### *Re-allocating income across categories*

#### *Goods sent abroad for processing*

The 2008 SNA recommends that imports and exports be recorded on a strict ownership basis. This means that the values of a flow of goods moving from one country (that retains ownership of the goods) to another providing processing services should not be recorded. Only the charge for the processing service should be recorded in the trade statistics. The 1993 SNA imputed an effective change of ownership.

#### *Merchanting*

Under the 1993 SNA merchanting - the purchase and subsequent resale of goods abroad without substantial transformation and without the goods entering or exiting the territory of the merchant - was classified as a services transaction. This treatment caused global imbalances in goods and services because while the merchant records an export of a service the country acquiring the good records an import of a good. Therefore, the 2008 SNA recommends classifying merchanting as a component of trade in goods. The acquisition of goods by the merchant are recorded as negative exports of the merchant's economy and the subsequent resale of goods by the merchant are recorded as a positive exports. The difference between sales and purchases of merchanted goods is recorded under a new category "Net exports of goods under merchanting" of the merchant's economy.

#### *Defined benefit pension schemes*

The 1993 SNA stated that actual social contributions by employers and employees should reflect the amounts actually paid. The 2008 SNA differs, recognising that the amounts actually set aside may not match the liability to the employees. As such, the 2008 SNA recommends that the employer's contribution should reflect the increase in the net present value of the pension entitlement plus costs charged by the pension fund minus the employee's own contributions. This change will result in a shift of income between gross operating surplus and compensation of employees and between institutional sectors (corporations/government and households).

In some cases, a defined benefit pension plan may be underfunded implying the pension plan has insufficient financial assets to earn the returns that are necessary to meet promised future benefits. The promised future benefits are assets of the household sector and liabilities of the pension schemes, or the employer if there is no autonomous scheme. According to the 1993 SNA, only the funded component of pension plans should be reflected in liabilities. However, the new 2008 SNA recognises the importance of the liabilities of employers' pension schemes, regardless of whether they are funded or unfunded. For pensions provided by government to their employees, countries have some flexibility in the recording of the unfunded liabilities in the set of core tables. However, the full range of information is required in a new standard table (SNA Table 17.10) that shows the liabilities and associated flows of all private and public pension schemes, whether funded or unfunded, including social security.

#### *Ancillary activities*

The 2008 SNA recommends that if the activity of a unit undertaking purely ancillary activities is statistically observable (separate accounts, separate location) it should be recognised as a separate establishment.

### *Holding companies*

The 2008 SNA recommends that holding companies should always be allocated to the financial corporations sector even if all their subsidiary corporations are non-financial corporations. The 1993 SNA recommended that they be assigned to the institutional sector in which the main group of subsidiaries was concentrated.

### *Exceptional payments from public corporations*

The 2008 SNA recommends that these should be recorded as withdrawals from equity when made from accumulated reserves or sales of assets. The 1993 SNA treated such transactions as dividends.

### *Exceptional payments from governments to quasi-public corporations*

The 2008 SNA recommends that these should be treated as capital transfers to cover accumulated losses and as additions to equity when a valid expectation of a return in the form of property income exists. The 1993 SNA treated all such payments as additions to equity.

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## Measuring producer prices and productivity growth in services

### *The price index-productivity link*

Empirical evidence presented in this publication points to relatively low productivity growth rates over long periods for several service industries. This is true even for some business sector services for which rapid technological change and increasing competitive pressures may argue for an opposite trend. However, for some services, this evidence may reflect an under-estimation of service productivity growth, linked to difficulties measuring price indices, and hence volume series of services value added (Wölfl, 2003). While problems estimating an appropriate price index may arise in several manufacturing industries, there are reasons that measurement problems may be stronger in the service sector than in manufacturing.

Because of the difficulty in measuring services producer price indices (SPPIs), different methods are used in OECD countries to compute volume series of value added. Moreover, even if producer price indices can be computed, different methods are typically used depending on the type of the service under consideration as well as data and availability. Over the past 10 years, much progress has been made by OECD countries in measuring SPPIs, in particular in business sector services. This has significantly increased the availability of SPPIs and has improved their comparability across countries. However, even where SPPIs have been computed, they are based on different pricing methods across industries and countries, potentially affecting comparability of productivity growth estimates.

### *General measurement issues when tracking price changes for services*

Measurement of price changes in services is not trivial, in large part complicated by the way businesses provide and charge for services, by problems identifying quality change, through the provision of bundled services, and by the difficulty identifying separate price indices per end-user.

#### *Pricing methods*

The way businesses provide and charge for services can make it difficult for statisticians to observe prices for a repeated service transaction. As such, standard price measurement methods designed for repeated products can be difficult to apply for services. In practice, price statisticians are then obliged to use a number of methods to track price changes in services, with the methods typically varying across countries, depending on the pricing mechanisms used, and also on the producing industry or product.

However, over the last 10 years, considerable efforts have been made by price statisticians to provide a better understanding of the variety of methods used by countries to facilitate international comparability and hence improve matters. The three main classes of pricing methods are:

1. **Price of final service output:** price observations refer directly to specified service outputs and result in prices of final services output; examples are: direct use of prices of repeated services, contract pricing, unit value, percentage fee, component pricing and model pricing.
2. **Time-based prices:** price observations refer to the time used for the provision of the service rather than to the service itself. Several time-based methods can be distinguished: hourly charge out rate, hourly list rate, wage rates and working days.
3. **Margin prices:** price observations refer to the price that would have to be paid by the service provider for the good or service they provided and the price paid by the final consumer.

It is important to bear in mind that the way firms in a given sector charge for their products can impact considerably on the reliability of measured price indices for the industry. For example, when price indices are either based on a specified service output or are time-based, results of pricing methods can have a different interpretation. In the first case, the volume of output is, in principle, correctly measured (albeit depending on how well price-determining factors are specified). However, this is not necessarily the case for time-based methods, particularly whenever quality changes have occurred, or productivity changes impact on the input (hours spent). Indeed, for pricing based on working time, the price of the service finally provided is not identified. Rather, service provision is assumed to correspond directly or predominantly to different types of chargeable hours, actually worked for a client. The validity of the method depends on how realistic this assumption is, i.e., to what extent the quantity and quality of one chargeable hour's work remains the same in consecutive periods.

#### *Quality changes*

While in principle, the same quality adjustment methods can be used for goods and services, in practice, for services, fewer options are available and much more difficult to implement (Loranger, 2012). First, over time, the way in which a certain service is provided may change (e.g. a service is delivered in less time or by a better qualified employee). Second, the structure of services that are provided in a certain service industry will vary from one period to the next. Third, many service products are unique. In this case, prices cannot be observed over multiple periods requiring assumptions about quality changes that are mostly based on convention rather than reflecting "reality"; typically, constant quality is assumed.

#### *Treatment of bundled services*

Services are frequently (and increasingly) bundled with either another service or a good. This is particularly true in the case of transport and storage and information and communication services. Two main alternatives are commonly used: i) breaking down the bundle into components and price these separately, or ii) pricing bundled services together as a group. Each of these alternatives poses difficulties that are likely to imply biased measure of prices. A particular concern is keeping the bundle constant over time either through quality adjustment or regular updating of the selected bundled services. The ability to reflect the non-monetary benefits of the bundle in the price index may also be a complicated task. Finally, the treatment of bundled services may lead to a heavy calculation and response burden, in particular where bundled components are priced separately.

#### *Decomposition by type of end-users*

Breaking down SPPIs by type of user is an important requirement for the national accounts when price discrimination occurs which feeds through into heterogeneous price changes. Currently, decompositions of SPPI by type of end-users focus mainly on Business to Business (BtoB), Business to Consumers (BtoC) and Business to All (BtoAll) transactions.

### ***The potential role of price measurement for measured productivity growth***

Table 8.4 provides some indication of the potential effects on volume series of value added that may result from using different deflators for two services "telecommunication services", on the one hand, and "legal and accounting services", on the other.[1] These services provide two interesting examples of how price index measurement could impact on measured productivity growth.[2] They are i) characterised by very different factors of service output and the way they are provided, and ii) by different availability of producer price indices and underlying methods.

Table 8.4 provides evidence for France and the United States, for which time series data are available for a large range of input and output variables, such that several different price and volume indices can be derived. The different deflators compared are those that are commonly used in countries either directly for a deflator of value added or as a reference for the computation of producer price indices:

- *Services Producer Price Indices (SPPI)*. From a methodological point of view, using SPPIs, especially in the form of a *price of final service output* as defined above, would represent the most appropriate way to deflate value added if the aim is the computation of productivity growth. Ideally, SPPIs would exist for both, gross output and intermediate inputs used in producing the good or service under consideration, and SPPIs would adjust for quality changes so that the resulting value added volume series reflect productivity growth changes properly.
- *Consumer Price Indices (CPI)*, for goods or services that are close to the services analysed, or the *CPI All items*. Using CPI's for deflation may result in measurement biases vis-à-vis SPPIs as they cover only household consumption and are not valued in basic prices. This may be particularly relevant for those services where the share of final household consumption in total output is low, and where price changes differ significantly between intermediate (business) and final use (consumption) (Eurostat, 2001).
- *Wage rate indices* per employed person or per hour worked (WRIE, WRIH). The latter can be seen as a proxy for a *time-based producer price index* as defined above. Productivity growth rates based on wage rate indices may underestimate true productivity developments.

**Table 8.4. Average annual growth rates in gross value added per person employed using different deflators of value added, in %**

| | | | Base | Wage rate Employment | CPI - All items | CPI - related service | SPPI |
|---|---|---|---|---|---|---|---|
| France | Telecommunications services | 2000-2010 | 6.37 | 0.55 | 2.71 | 6.32 | |
| | | 2005-2010 | 4.73 | -2.01 | 0.22 | 4.92 | 8.60 |
| | Legal and accounting services | 2000-2010 | -0.24 | | 1.17 | 1.02 | |
| | | 2005-2010 | -1.18 | -3.26 | -0.88 | -1.58 | -2.70 |
| United States | Broadcasting & telecommunication | 2000-2010 | 6.82 | 2.28 | 1.88 | 7.41 | 6.00 |
| | | 2005-2010 | 5.64 | 0.40 | 0.85 | 5.67 | 3.12 |
| | Legal services | 2000-2010 | -1.60 | -0.28 | 0.53 | -1.65 | -2.68 |
| | | 2005-2010 | -3.00 | -1.13 | -0.36 | -1.88 | -4.12 |

*Note*: All results based on double deflation. "Base": value added deflator as given in National Accounts.
*Source*: *OECD Structural Analysis Statistics* (database), INSEE, Bureau of Labour Statistics.

StatLink http://dx.doi.org/10.1787/888933969428

Table 8.4 suggests that the choice of the implicit value added deflator, or the pricing method for computing producer price indices, may matter significantly for measured labour productivity growth. For instance, in telecommunication services, average annual labour productivity growth rates over the 2000-2011 period would differ by between 5 percentage points (United States, both periods) and 10 percentage points (France, 2005-2011) using different deflators. In the case of legal services, the overall variation is with 1 to 4 percentage points lower, but still significant, especially given the generally lower level of productivity growth in this services activity.

## Notes

[1] This exercise is of a purely hypothetical nature. Its aim is merely to illustrate the sensitivity of value added volume series and hence productivity growth to price index methods.

[2] In the empirical results presented in Table 8.4, labour productivity growth has been calculated as real value added per employment and not per hour worked. While hours worked is typically the more appropriate measure of labour input, employment has been chosen here for data availability reasons.

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## Purchasing Power Parities for cross-country productivity comparisons

### *Definition*

Purchasing power parities (PPPs) are the rates of currency conversion that equalise the purchasing power of different currencies by eliminating the differences in price levels between countries. In their simplest form, PPPs are price relatives which show the ratio of the prices in national currencies of the same good or service in different countries. In this sense, they are spatial price comparisons.

Levels of GDP in a given year, when converted with PPPs, measure the size of economies in volume terms and so provide a more meaningful measure of the relative size of countries than simple exchange-rate based comparisons. Indeed, exchange rates reflect so many more influences than the direct price comparisons that are required to make volume comparisons. Furthermore, they tend to exhibit large movements over short periods of time, implying rapid changes in living standards which cannot have possibly occurred.

GDP and its components, converted using PPPs, provide a snapshot of relative volumes in a particular year. For many analytical purposes, the interest is in the evolution of GDP volumes between countries and over time. There are at least two ways of setting up such a comparison, each with its specific interpretation and use.

### *Current PPPs and expenditures (comparison at current international prices)*

One approach for combining spatial and temporal observations is to use a sequence of current PPPs, i.e., a new set of price data for every period, compiled, weighted and aggregated to yield rates of currency conversion for total GDP and its expenditure components. With current PPPs, prices and price structures are allowed to vary over time. Volume levels of GDP are then obtained by applying these current PPPs, for every period, to GDP measures at current national prices. *For a given year*, (spatial) comparisons between countries are straightforward – volumes are measured with the same price structure. Comparisons of the resulting series over time, however, incorporate several effects: relative volume changes, changes in relative prices between countries and, possibly, changes in definitions and methodologies. The approach can also be described as comparisons at **current international prices or current PPPs**.

### *Constant PPPs and expenditures (comparison at constant international prices)*

A second approach is to generate time series at constant prices and constant PPPs. With constant PPPs, a single year is chosen for the comparison of GDP levels and all other observations are obtained by applying relative rates of GDP growth, consistent with those derived in national currencies. This procedure ensures transitivity over space and time. The approach can also be described as comparisons at **constant international prices or at constant PPPs**. The key conceptual difference between using current and constant PPPs is that the former capture changes in volume as well as changes in weights, whereas the latter only capture volume changes. Put differently, even if the volumes of goods and services remain identical over time, a GDP comparison based on current PPPs may change over time if prices and price structures shift. Ignoring such shifts over longer periods can generate a biased picture of economic developments. This factor comes into play when some countries are large producers and exporters of products with marked price changes, for example Norway, which is an important oil exporter. Another consequence of fixing price structures to a base year is the sensitivity of results to the choice of the base year.

### *How are PPPs calculated?*

PPPs are calculated in three stages:

- first for individual products,
- then for groups of products or basic headings and,
- finally, for groups of basic headings or aggregates.

The PPPs for basic headings are un-weighted averages of the PPPs for individual products. The PPPs for aggregates are weighted averages of the PPPs for basic headings.

The weights used are the expenditures on the basic headings. PPPs at all stages are price relatives. They show how many units of currency A need to be spent in country A to obtain the same volume of a product or a basic heading or an aggregate that X units of currency B purchases in country B.

In the case of a single product, the "same volume" means "identical volume". But in the case of the complex assortment of goods and services that make up an aggregate such as GDP, the "same volume" does not mean an "identical basket of goods and services".

The composition of the basket will vary between countries according to their economic, social and cultural differences, but each basket will provide equivalent satisfaction or utility.

### *Values at constant international prices of period t0 (at PPPs of period t0)*

Values at constant international prices of period t0 (at PPPs of period t0) are series at current domestic prices converted to a common currency by way of constant PPPs of a given year.

Constant PPPs capture volume changes only.

A value index of this kind corresponds to a weighted average of the value changes in domestic prices, as PPPs are held fixed.

### *Values at constant international prices of period t-1 (at PPPs of period t-1)*

Values at constant international prices of period t-1 (at PPPs of period t-1) are series at current domestic prices converted to a common currency by way of PPPs of year t-1.

A value index of this kind corresponds to a weighted average of the value changes in domestic prices, as PPPs are held fixed at their previous year's value. However, weights are continuously updated.

### *Values at current international prices (at current PPPs)*

Values at current international prices (at current PPPs) are series at current domestic prices converted to a common currency by way of current PPPs. Because PPPs are price relatives of goods and services, this implies substituting the set of domestic prices by a set of international prices.

Current PPPs capture changes in volumes and in relative prices.

PPPs produced at the OECD are intended for whole economy cross-country comparisons of GDP and consumption across countries. They are derived through a collection of prices of final demand components and, as such, while they provide a sound basis for whole economy comparisons, they should not be used for comparisons across industries, especially for sectors whose prices are determined internationally.

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## Trend estimation method

Understanding to which extent productivity growth is driven by structural factors and affected by short-term economic fluctuations is of utmost importance for policy makers. To shed light on this distinction, one can decompose the series into a trend and a cyclical component, where the trend is meant to capture the long-term growth of the series and the cyclical component is the deviation of the series from that trend. In this publication, the method used to extract the trend component is the Hodrick-Prescott (HP) filter (Hodrick and Prescott, 1997).

### *The Hodrick-Prescott filter*

The HP filter is the best known and most widely used method to separate the trend from the cycle (Hodrick and Prescott, 1997). The method has been first presented in a working paper in 1981 (Hodrick and Prescott, 1981). The filter is defined as the solution to the following optimisation problem:

$$y_t = \tau_t + c_t$$

$$min_{\{\tau_t\}}\left\{\sum_{t=1}^{T}(y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1}[(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2\right\}$$

Where $y_t$ is the original series, $\tau_t$ is the trend component and $c_t$ is the cyclical component. The method consists in minimising the deviation of the original series from the trend (the first term of the equation) as well as the curvature of the estimated trend (the second term). The trade-off between the two goals is governed by the smoothing parameter λ. The higher the value of λ, the smoother is the estimated trend.

For quarterly data it has been typically assumed a value of λ=1600, as recommended by Hodrick and Prescott (1997). However, there is less agreement on the value to be used when the filter is applied to other frequencies (e.g. annual, monthly). Backus and Kehoe (1992) used λ=100 for annual data, while Ravn and Uhlig (2002) propose an adjustment of the standard value of 1600 that consists of multiplying that value by the fourth power of the frequency of observations relative to quarterly data. The latter results in a value of λ equal to 6.25 (=1600*$(1/4)^4$) for annual data.[1]

The HP-filter can be interpreted in the frequency domain. In this formulation the λ parameter can be associated with the cut-off frequency of the filter – the frequency at which it halves the impact of the original cyclical component. It can be shown that the Ravn-Uhlig rule for selecting the value of λ corresponds to a cut-off frequency of approximately 10 years, assuming annual data (Maravall and Del Río 2001). Nonetheless, Nilsson and Gyomai (2011) point out that the HP-filter has strong leakages (i.e. letting cyclical components from the stop band appear in the filtered series), and this feature may affect the choice of the filter parameter depending on the goal of the study and sensitivity to filter leakage.

In this publication, the target frequency for trend estimation was no different than in the above studies (10 years and beyond). However an additional objective is to minimize the leakage from shorter business-cycle frequencies into the estimated trend. Accordingly, the value of the smoothing parameter selected here is λ=54.12. This value has been determined by calibrating the Hodrick-Prescott filter in such a way that the frequency response at 9.5 years is equal to 0.10. This means that with λ=54.12, cycles with a wavelength lower than 9.5 years would be attenuated by 90% or more.

In comparison with other ideal filters, the trend estimated with the HP filter is more sensitive to transitory shocks or short-term fluctuations at the end of the sample period. This results in a sub-optimal performance of the HP filter at the endpoints of the series (Baxter and King, 1999). In view of this property, in order to lessen revisions of the published estimates, trend series are not published for the first two years and the last two years for which data on the original series are available. Even though, the choice of the HP filter is based on its interpretability and widespread use in the literature.

## Notes

[1] The frequency of observations relative to quarterly data is 1/4 for annual data and of 3 for monthly data.

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