Chapter 2. Labour share developments over the past two decades: The role of technological progress, globalisation and "winner-takes-most" dynamics

Over the past two decades, real median wage growth in many OECD countries has decoupled from labour productivity growth, partly reflecting declines in labour income shares. This chapter analyses the drivers of aggregate labour share developments using a combination of industry- and firm-level data. Technological change in the investment goods-producing sector and greater global value chain participation have compressed labour shares, but the effect of technological change has been significantly less pronounced for high-skilled workers. Countries with falling labour shares have witnessed both a decline at the technological frontier and reallocation of market shares toward "superstar" firms with low labour shares ("winner-takes-most" dynamics). The decline at the technological frontier mainly reflects the entry of capital-intensive firms with low labour shares into the frontier rather than a decline of labour shares in incumbent frontier firms, suggesting that thus far this process is mainly explained by technological dynamism rather than anti-competitive forces.

Key findings

For the OECD as a whole, real median wages have decoupled from productivity over the past two decades. If real median wages had perfectly tracked productivity growth over 1995-2014, they would have been 13% higher at the end of the period. Developments in the labour share – the share of national income accounted for by labour compensation in the form of wages, salaries and other benefits – explain around one-half of this decoupling, with the other half explained by rising wage inequality, evidenced by declines in the ratio of median to average wages. In the light of this, Chapter 2 analyses the drivers of recent labour share developments. The main findings are as follows:

- The labour share has declined significantly over the past two decades. The aggregate labour share in the 24 OECD countries covered in this chapter fell by around 3.5 percentage points between 1995 and 2013 (from around 71.5% to 68%).
- There have been large differences in labour share developments across countries. While the labour share fell around 8 percentage points in the United States, it remained broadly constant or increased in about half of the covered OECD countries, including France, Italy and the United Kingdom. These differences partly reflect cross-country differences in business cycle developments
- Consistent with the findings in OECD (2012[1]), technological change and globalisation can explain most of the contraction of the labour share. Technology-driven declines in relative investment prices and, to a lesser extent, the expansion of global value chains (in which different stages of production are spread across countries or regions) account for about two-thirds of the aggregate labour share decline in the OECD.
- The substitution of capital for labour in response to declines in relative investment prices is particularly pronounced in industries with a predominance of high routine tasks.
- High shares of high-skilled workers reduce the substitution of capital for labour even in industries with a higher level of routine tasks. High-skilled workers, especially those with high numeracy and problem-solving skills, may be more difficult to replace by machines or may be more easily re-deployed to non-routine tasks than low-skilled workers.
- Declines in relative investment prices affect aggregate labour shares partly by reducing labour shares within firms (labour costs as a proportion of a firm's total value added).
- Global value chain expansion does not affect labour shares within firms, suggesting that such expansion therefore reduces the labour share by reducing the proportion of firms with high labour shares.
- Countries with falling labour shares have witnessed both a decline at the technological frontier and a reallocation of market shares toward capital-intensive "superstar" firms with low labour shares ("winner-takes-most" dynamics).
- The labour share decline at the technological frontier mainly reflects the entry of capital-intensive firms with low labour shares into the frontier rather than a

decline in incumbent frontier firms, suggesting that thus far "winner-takes-most" dynamics are mainly explained by technological dynamism rather than anti-competitive forces.

Looking ahead, ongoing advances in automation and artificial intelligence may not only continue to reduce the relative price of investment goods, but also make capital fundamentally more substitutable for labour. These technological advances may allow some firms to temporarily pull ahead. While product market regulation and competition policies will need to prevent emerging dominant players from engaging in anti-competitive practices, this chapter suggests that skills policies will be key to help workers make the most of ongoing technological advances.

Introduction

Real wage gains are the most direct mechanism through which productivity gains are transmitted to workers, but over the past two decades real median wage growth in most OECD countries has decoupled from labour productivity growth. This reflects declines in labour shares – the decoupling of average wages from productivity – and increases in wage inequality – the decoupling of median wages from average wages. In contrast to previous decades, productivity gains no longer appear to translate into broadly shared wage gains for all workers (Schwellnus, Kappeler and Pionnier, 2017[2]). Since wages are typically the main source of market income for low- and middle-income households, this decoupling also tends to increase inequality in market incomes (total pre-tax incomes excluding income from government sources). Since redistribution through taxes and benefits is constrained by efficiency considerations and has declined in many countries, the decoupling of real median wages from labour productivity is a key public policy issue.

This chapter focuses on the decoupling of real average wages from productivity by analysing labour share developments using a combination of aggregate and disaggregate data.[1] Aggregate data provide descriptive evidence on recent labour share developments, while disaggregate data at the industry and firm levels are used to analyse the role of technology and global value chain (GVC) expansion in aggregate labour share developments. The disaggregate analysis further provides insights into the mechanisms underlying aggregate labour share developments, including the roles of substitution of capital for labour (henceforth capital-labour substitution) and firm-level dynamics.

Apart from extending the sample to the post-crisis period, the main innovations of this chapter with respect to the recent analysis of labour share developments in the OECD Employment Outlook (OECD, 2012[1]) are as follows. First, this chapter focuses on the change in relative investment prices as a specific measure of technological change in the investment goods-producing sector rather than multi-factor productivity as an overall measure of technological change. Over the sample period, technological progress in the investment goods-producing sector is mainly reflected in the falling price of information and communication technology (ICT) goods which are likely to be highly substitutable for some types of labour. Second, the chapter analyses the different effects of this type of technological progress on workers in routine- and non-routine occupations as well as the role of skills in limiting capital-labour substitution. Third, it analyses the extent to which aggregate labour share developments are related to "winner-takes-most" dynamics – the best firms capturing an overwhelming share of the market – and provides suggestive evidence on whether such dynamics reflect technological dynamism or anti-competitive forces.

The remainder of the chapter is organised as follows. Section 2.1 describes the conceptual framework for breaking down the decoupling of median wages from productivity into contributions from labour share and wage inequality developments. It also provides descriptive evidence on labour share developments for the covered OECD countries. Section 2.2 uses a combination of industry- and firm-level data to analyse the effects of technological progress and the expansion of GVCs on labour shares, with a special emphasis on recent firm-level dynamics. Section 2.3 analyses the role of skills in promoting the sharing of productivity gains with workers.

2.1. The link between productivity and wages over the past two decades

Conceptually, macro-level decoupling between the growth rate of real compensation of the typical worker and labour productivity growth can be decomposed into the growth differential between real average compensation and labour productivity and the growth differential between median and average compensation. In this chapter, compensation and value added are deflated by the same value added price index so that decoupling of real average compensation from labour productivity reflects declines in labour shares (Box 2.1).[2] Decoupling of real median compensation from real average compensation reflects declines in the ratio of median to average wages, a partial measure of wage inequality.

For the covered OECD countries as a whole, there has been significant decoupling of real median wages from productivity over the past two decades as real median wages have grown at a lower average rate than labour productivity (Figure 2.1). Based on the total economy measure, median compensation would have been around 13% higher than observed in 2013 if it had perfectly tracked labour productivity since 1995. Based on the measure excluding the primary, housing and the non-market sectors, decoupling implies a 12% loss in compensation for the median worker over the period 1995-2013.

The decoupling of real median wages from labour productivity reflects both declines in labour shares and increases in wage inequality. In line with previous studies on decoupling (Bivens and Mishel, 2015[3]; Sharpe and Uguccioni, 2017[4]) this chapter uses as a starting point compensation and value added in the total economy (Figure 2.1, Panel A). This measure of decoupling suggests similar contributions of declines in labour shares and increases in wage inequality to decoupling. However, the total economy includes sectors for which labour shares are largely determined by fluctuations in commodity and asset prices, such as the primary and housing sectors, or for which labour shares are driven by imputation choices, such as the non-market sector. Labour share fluctuations in these sectors may have different distributional implications from those in the production sector. Once the primary, housing and the non-market sectors – which on average account on for around 30% of value added in OECD countries – are excluded from the analysis, the contribution of the labour share to decoupling becomes smaller (Figure 2.1, Panel B).

Box 2.1. The link between decoupling of median wages from productivity and labour shares

Using the notation $\Delta\% X$ to denote the per cent growth rate of X, decoupling of real median wages from labour productivity in this chapter is defined as follows:

$$Decoupling \equiv \Delta\% \left(\frac{Y/P^Y}{L}\right) - \Delta\% \left(\frac{W^{med}}{P^Y}\right) \quad (1)$$

where Y denotes nominal value added, P^Y denotes the value added price, L denotes number of workers and W^{med} denotes the nominal median hourly wage. The first term on the right-hand-side is labour productivity growth and the second term is real median wage growth in terms of the value added price. By adding and subtracting real average wage growth $\Delta\% \left(\frac{W^{avg}}{P^Y}\right)$ equation (1) can be re-written as follows:

$$Decoupling \equiv \left[\Delta\% \left(\frac{Y/P^Y}{L}\right) - \Delta\% \left(\frac{W^{avg}}{P^Y}\right)\right] + \left[\Delta\% \left(\frac{W^{avg}}{P^Y}\right) - \Delta\% \left(\frac{W^{med}}{P^Y}\right)\right] \quad (2)$$

where the first term in square brackets denotes the growth differential between labour productivity and the real average wage and the second term in square brackets denotes the growth differential between the real average and median wage.

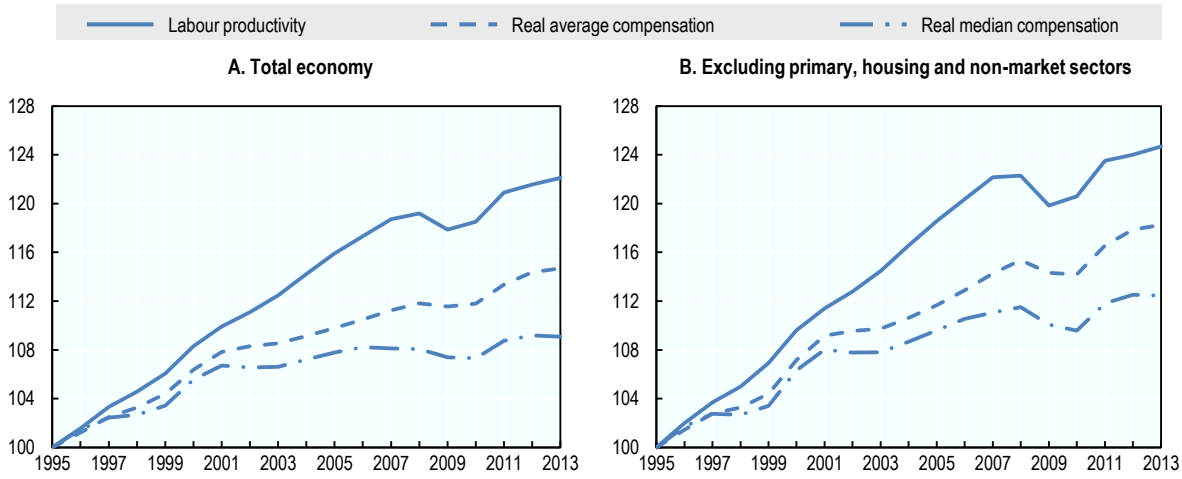
The growth differential between labour productivity and the real average wage can be approximated as $-\Delta\% \left(\frac{w^{avg} \cdot L}{Y}\right)$, i.e. the per cent decline in the labour share. The growth differential between the real average and median wage can be re-written as $\Delta\% \left(\frac{w^{avg}}{w^{med}}\right)$, i.e. the per cent increase in the ratio of the average to the median wage. A high ratio of the average to the median wage typically reflects high compensation at the top of the wage distribution, so that it can be interpreted as a partial measure of wage inequality.

Source: The data underlying the above decomposition at the country level are described in Schwellnus, Kappeler and Pionnier (2017[2]), "Decoupling of wages from productivity: Macro-level facts", http://dx.doi.org/10.1787/18151973.

The aggregate labour share in the countries covered by the analysis declined by around 3.5 percentage points over the past two decades, which coincided with falls in relative investment prices and the expansion of GVCs (Figure 2.2). While the coincidence of these trends does not imply causation, it is consistent with results from previous studies suggesting that relative investment price declines may have triggered capital-labour substitution (Karabarbounis and Neiman, 2014[5]; IMF, 2017[6]) while increased GVC participation may have led to the offshoring of the most labour-intensive tasks (Elsby, Hobijn and Sahin, 2013[7]; IMF, 2017[6]) If capital and labour are highly substitutable, the resulting increase in capital intensity may reduce the labour share.

Figure 2.1. Real median wages have decoupled from labour productivity

Indices, 1995 = 100



Note: Gross domestic product (GDP) weighted average of 24 countries (two-year moving averages ending in the indicated years). 1995-2013 for Finland, Germany, Japan, Korea and the United States; 1995-2012 for France, Italy and Sweden; 1996-2013 for Austria, Belgium and the United Kingdom; 1996-2012 for Australia and Spain; 1997-2013 for the Czech Republic, Denmark and Hungary; 1997-2012 for Poland; 1996-2010 for the Netherlands; 1998-2013 for Norway; 1998-2012 for Canada and New Zealand; 1999-2013 for Ireland; 2002-11 for Israel; 2003-13 for the Slovak Republic. In Panel A, all series are deflated by the total economy value added price index. In Panel B, all series are deflated by the value added price index excluding the primary, housing and non-market industries. The industries excluded in Panel B are the following (International Standard Industry Classification – ISIC – rev. 4 classification): (1) Agriculture, Forestry and Fishing (A), (2) Mining and quarrying (B), (3) Real estate activities (L), (4) Public administration and defence, compulsory social security (O), (5) Education (P), (6) Human health and social work activities (Q), (7) Activities of households as employers (T), and (8) Activities of extraterritorial organisations and bodies (U).
Source: *OECD National Accounts Database*, http://dx.doi.org/10.1787/data-00727-en, *OECD Earnings Distribution Database*, http://dx.doi.org/10.1787/data-00302-en.

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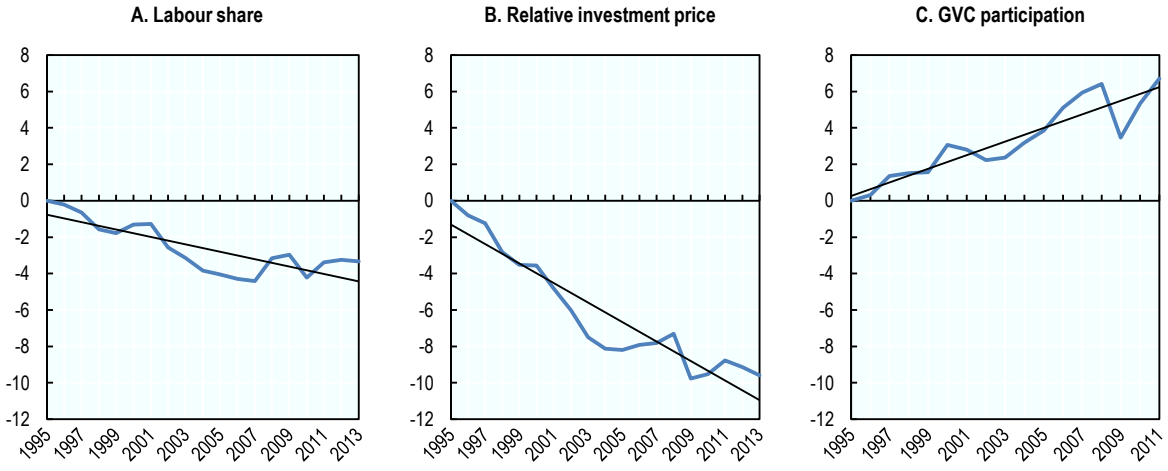
While the aggregate OECD labour share has declined over the past two decades, there have been conflicting cross-country developments (Figure 2.3). OECD countries with significant declines in labour shares include large countries such as Japan and the United States. For instance, in the United States labour shares declined by around 8 percentage points over the sample period, explaining around 0.6 percentage points of the 1.3 percentage annual decoupling of real median wages from productivity. In a number of other OECD countries, labour shares have remained broadly constant or have increased. These include a number of large countries, such as France, Italy and the United Kingdom.

Figure 2.2. Falls in labour shares coincided with falls in relative investment prices and the expansion of global value chains

Percentage point changes, excluding the primary, coke and refined petroleum, housing and non-market industries, 1995 = 0



Note: Gross domestic product (GDP) weighted average of 24 countries (Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Japan, Korea, the Netherlands, New Zealand, Norway, Poland, the Slovak Republic, Spain, Sweden, the United Kingdom and the United States). GVC: global value chain.
Source: Schwellnus et al. (forthcoming[8]), "Labour share developments over the past two decades: The role of technological progress, globalisation and "winner-take-most" dynamics".

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To some extent, large cross-country differences in labour share developments may be explained by differences in business cycle developments as well as policies and institutions. Background analysis conducted for this chapter suggests that an increase in the output gap of 1% – an increase in output relative to potential – reduces the labour share by 0.5 percentage points (Schwellnus et al., forthcoming[8]). Reforms in a number of areas of product and labour market policies as well as changes in collective-bargaining institutions also emerge as significant determinants of labour share developments (Pak and Schwellnus, forthcoming[9]) – see also Chapter 3. But large cross-country differences in labour share developments may also reflect differences in the nature and the pace of technological progress and the integration into GVCs, which may give rise to different firm dynamics across countries.

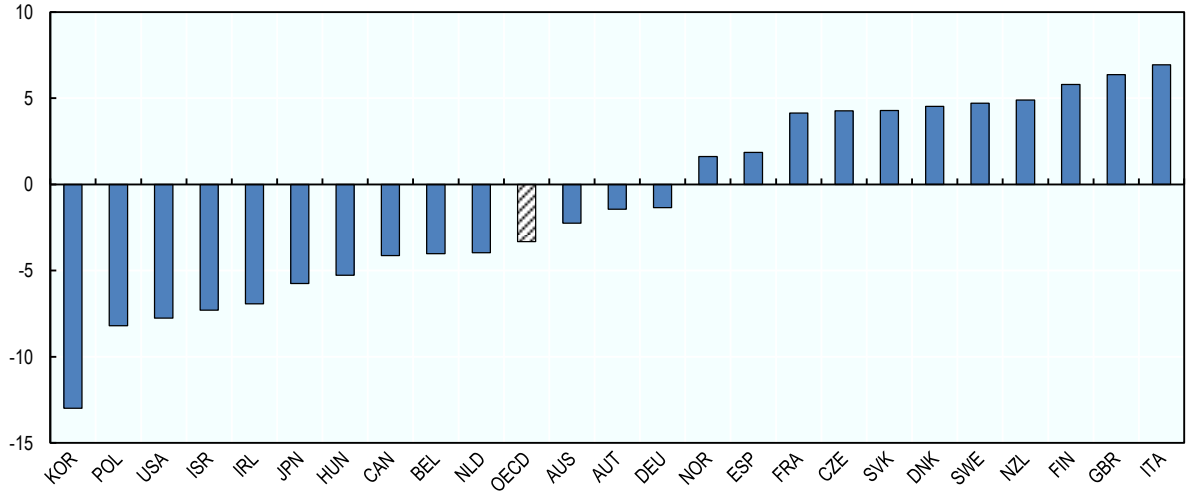
2.2. Technological progress, globalisation and the emergence of "winner-takes-most" dynamics

2.2.1. Technological progress and globalisation

Capital-augmenting technological change or technology-driven declines in relative investment prices may reduce the labour share by raising capital intensity. Even if factor prices are determined competitively, the labour share declines with capital intensity if the elasticity of substitution between capital and labour is above unity.[3]

Figure 2.3. Large cross-country heterogeneity in labour share developments

Percentage point changes over the 1995-2013 period, excluding the primary, housing and non-market industries



Note: Two-year averages ending in indicated years. The OECD average is the GDP-weighted average of changes in labour shares over the 24 countries included in the figure. 1996-2013 for Austria, Belgium, the Czech Republic, Hungary, Israel, the Netherlands, Poland, the Slovak Republic, Spain and the United Kingdom; 1996-2012 for New Zealand; 1998-2012 for Canada; 1999-2013 for Ireland.
Source: *OECD National Accounts Database*, http://dx.doi.org/10.1787/data-00727-en.

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Most estimates of the elasticity of substitution are based on within-country time series variation of factor shares and factor prices. These estimates generally imply an elasticity of substitution below one (Chirinko, 2008[10]). By contrast, Karabarbounis and Neiman (2014[5]) use cross-country and cross-industry variation in labour shares and relative investment prices to obtain an elasticity of substitution in the range of 1.2-1.5. According to their estimations, large declines in investment prices across a broad range of high-income and emerging economies explain around 50% of the global decline of the labour share.

Over time, capital may have become more easily substitutable for labour. On the one hand, new technology extends the range of existing tasks that can be carried out by machines, thereby displacing workers and reducing the labour share (Acemoglu and Restrepo, 2018[11]). On the other hand, new technology also creates new tasks that cannot be carried out by machines. As the nature of technological progress changes, the balance between labour displacement and task creation from new technologies may shift. Evidence for the United Kingdom and the United States, for instance, suggests that the elasticity of substitution between ICT capital and labour is significantly higher than for other capital goods and is well above one (Tevlin and Whelan, 2003[12]; Bakhshi, Oulton and Thompson, 2003[13]). In line with this finding, recent evidence on labour share developments for the United States suggests that technological progress has become more labour displacing over time, with particularly large labour-displacing effects in the 2000s (Autor and Salomons, 2018[14]).

Previous research suggests that capital-labour substitution in response to declines in investment prices is particularly pronounced for low-skilled workers. Krusell et al. (2000[15]) find that in the United States the elasticity of substitution between capital and low-skilled labour is around 1.7, well above the estimated elasticity between capital and high-skilled labour of 0.7. This is consistent with cross-country evidence in IMF (2017[6]) of particularly negative effects of declines in relative investment prices on labour shares in countries with high initial shares of routine jobs. Moreover, using cross-country cross-industry data, IMF (2017[6]) find that the elasticity of substitution between capital and labour increases with industries' routine task exposure and is above unity in about half of the industries covered by their analysis.

Globalisation in the form of increased trade integration may have similar effects on the labour share as it increases in capital intensity (Acemoglu and Autor, 2010[16]). For instance, offshoring of the most labour-intensive stages of production or increased import competition may lead to worker displacement and an increase in capital intensity. If the aggregate elasticity of substitution between capital and labour is above unity, this would reduce the labour share. The cross-country evidence in Harrison (2005[17]) and the cross-industry evidence for the United States in Elsby et al. (2013[7]) are consistent with this hypothesis. In a cross-country, cross-industry study IMF (2017[6]) find that increased participation in GVCs has reduced the labour share in low-income countries but that there is no effect in high-income countries.[4]

The analysis of the roles of technological progress and GVC expansion for labour share developments in this chapter is based on an industry-level approach (Box 2.2). From a conceptual standpoint, the fact that changes in aggregate labour shares overwhelmingly reflect developments within industries rather than cross-industry reallocation justifies focusing on industry-level labour shares to explain aggregate developments (Schwellnus et al., forthcoming[8]).[5] From an econometric standpoint, the industry-level approach has the advantage that country- and industry-specific trends can be controlled for through an appropriate fixed effects structure.

The empirical analysis suggests that declines in relative investment prices and increases in GVC participation reduce the labour share. Both in a model with country fixed effects that allows estimating the effect of the business cycle on the labour share and in a model with a more demanding country-period fixed effects structure, the estimated semi-elasticity of the labour share to the relative investment price is 0.19, which suggests that on average across industries a decline in relative investment prices of 10% (approximately the average decline observed in the OECD over 1995-2013, see Figure 2.2) reduces the labour share by approximately 1.8 percentage point. The estimated semi-elasticity of the labour share to GVC participation is around -0.1, which suggests that an increase of backward and forward linkages of 10 percentage points of value added reduces the labour share by 1 percentage point (the average increase observed in the OECD over 1995-2013 was around 6 percentage points of value added, see Figure 2.2).[6]

Box 2.2. Methodology underlying the industry-level analysis

The baseline empirical specification is motivated by the theoretical model in Schwellnus et al. (forthcoming[8]) linking the cost of capital, offshoring and the labour share. The model introduces capital into the two-factor model of offshoring in Grossman and Rossi-Hansberg (2008[18]) and explicitly models factor shares under the assumption of an elasticity of substitution between capital and routine labour above unity. The main predictions are as follows: i) a decline in the relative investment price reduces the labour share, with the reduction being larger in industries using a larger share of routine labour; and ii) a decline in the cost of offshoring has an ambiguous effect on the labour share.

The estimated baseline empirical specification is as follows:

$$\Delta LS_{ijt} = \beta_1 \Delta P_{ijt}^{Inv} + \beta_2 \Delta T_{ijt} + \beta_3 \left(RTI_{ijt}^{0} \times \Delta P_{ijt}^{Inv} \right) + \beta_4 \left(RTI_{ijt}^{0} \times \Delta T_{ijt} \right) + \\ + \beta_4 X_{ijt} + \alpha_{it} + \alpha_{jt} + \varepsilon_{ijt} \quad (1)$$

where subscripts *i*, *j* and *t* denote, respectively, countries, industries and periods; ΔLS_{ijt} denotes the medium-term (5- or 6-year) change in the labour share; RTI_{ijt}^{0} denotes initial routine task intensity; ΔP_{ijt}^{Inv} denotes the medium-term change in the relative investment price; ΔT_{ijt} denotes the medium-term change in participation in GVCs; X_{ijt} denotes control variables that vary at the country-industry-period level, including the initial routine task intensity RTI_{ijt}^{0}; α_{it} and α_{jt} denote country-by-period and industry-by-period fixed effects. Given that the model is estimated in differences, the fixed effects pick up country-period and industry-period specific trends.

The econometric model is estimated on a sample of 20 OECD countries and 19 industries over the period 1995-2011 for which the dependent and all explanatory variables can be constructed.[1, 2] In order to focus on medium-term changes, the sample is split into three periods of approximately five years (1995-2000, 2000-05 and 2005-11). The analysis of medium-term changes rather than long-term changes over the entire period permits a more precise estimation of the effects of structural and policy drivers of labour shares while allowing labour shares sufficient time to adjust given that the elasticity of substitution between labour and capital is likely to be higher in the medium term than in the short-term. Depending on the specification, business-cycle effects are controlled for by including country-period fixed effects or changes in the output gap as explanatory variables.

Source: The detailed description of the data underlying the industry-level analysis and the detailed regression results can be found in Schwellnus et al. (forthcoming[8]), "Labour share developments over the past two decades: The role of technological progress, globalisation and "winner-take-most" dynamics".

Notes:

1. The countries covered by the industry-level analysis are: Australia, Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Slovak Republic, Spain, Sweden, the United Kingdom and the United States. Canada, Hungary, Israel, New Zealand and Poland are covered in the aggregate analysis in Section 2.1 of this chapter, but data on labour shares, relative investment prices or routine-task intensity are not available at the level of disaggregation required for the industry-level analysis.

Estonia is not covered in the aggregate analysis in Section 2.1 of this chapter because data on the aggregate wage distribution are not available, but industry-level data on labour shares, relative investment prices and routine-task intensity are available so that it can be included in the industry-level analysis.

2. The industries covered by the industry-level analysis are the following (International Standard Industry Classification – ISIC – rev. 4): manufacture of food (CA), of textile (CB), of wood and paper (CC), of chemicals and chemical and pharmaceuticals (CE+CF), of non-metals (CG), of metals (CH), of electrical equipment (CI+CJ), of machinery (CK), of transport equipment (CL), other manufacturing (CM), utilities (D+E), construction (F), trade (G), transportation (H), accommodation (I), ICT services (J), finance (K), professional services (M+N) and other services (R+S). The primary, coke and refined petroleum, housing and non-market industries are not covered because labour shares in these industries are largely determined by fluctuations in commodity and asset prices or imputation choices rather than structural developments such as technological progress and globalisation.

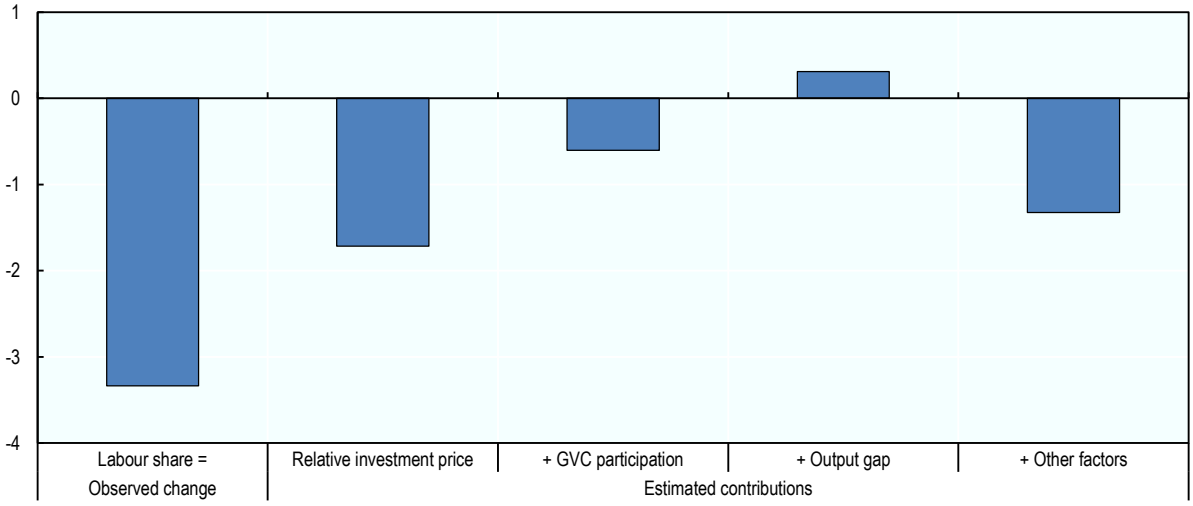
The econometric results are consistent with macro-level evidence that the labour share is counter-cyclical. The coefficient on changes in the output gap – i.e. the difference in business cycle conditions in the initial year and the final year of each five-year period – is negative and statistically significant at the 1% level, with the estimated semi-elasticity suggesting that a 1 percentage point increase in the output gap (observed GDP growth exceeding potential GDP growth by 1 percentage point) reduces the labour share by 0.5 percentage point.

Taking the estimated elasticities of the baseline model at face value, the observable variables included in the model can account for most of the aggregate labour share decline in the covered OECD countries over the sample period. The observed average decline in the relative investment price across countries and industries over the sample period was around 10% and the average increase in GVC participation around 7 percentage points (see Figure 2.2). Assuming that the elasticities estimated at the industry level are similar to those at the aggregate level, over the period 1995-2013 the baseline results suggest that investment price declines reduced the labour share by around 1.8 percentage points and increased GVC participation by around 0.7 percentage point.[7] Over the same period, business cycle effects raised the labour share by around 0.3 percentage point as the average output gap fell by around 0.7 percentage point. The net effect of changes in the relative investment price, GVC participation and business cycle conditions was around -2%, about 65% of the observed decline in the labour share (Figure 2.4).

Firm-level analysis conducted for this chapter suggests that declines in the relative investment price affect industry-level labour shares at least partly through changes within firms (Box 2.3). The average estimated firm-level semi-elasticity of firm-level labour shares to relative investment prices is around 0.15, remarkably similar to the estimated industry-level semi-elasticity of around 0.19. The estimated semi-elasticity is significantly larger in highly productive firms (around 0.3) that may be better able to adopt new technologies embodied in capital goods if adoption requires complementary know how. However, the firm- and industry-level results are not directly comparable as high-productivity firms are over-represented in the firm-level dataset used in this chapter and the firm-level analysis is based on a more limited country and year sample.[8] Consequently, the similarity in estimated semi-elasticities across the firm- and industry-level analyses cannot be interpreted as ruling out composition effects.

Figure 2.4. Estimated contributions to aggregate OECD labour share decline

1995-2013, percentage points



Note: GDP-weighted average of 24 OECD countries (Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Japan, Korea, the Netherlands, New Zealand, Norway, Poland, the Slovak Republic, Spain, Sweden, the United Kingdom and the United States). GVC: global value chain.
Source: Schwellnus et al. (forthcoming[8]) "Labour share developments over the past two decades: The role of technological progress, globalisation and "winner-take-most" dynamics".

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In contrast to the effects of relative investment prices on industry-level labour shares, the effects of increased GVC participation appear to mainly operate through the reallocation of production from high-labour share to low-labour share firms. The insignificance of the estimated coefficient on GVC participation at the firm-level is consistent with the theoretical model in Schwellnus et al. (forthcoming[8]) that shows that GVC expansion has offsetting effects on firm-level labour shares. On the one hand, the decline in the cost of offshoring leads to the substitution of imported intermediate goods for domestic routine labour and thereby to a reduction in the domestic wage bill as a share of gross output. On the other hand, offshoring of previously domestically produced output leads to a reduction in domestic value added as a share of gross output.

In sum, the econometric analysis suggests that technological progress and – to a lesser extent – the expansion of GVCs tends to reduce labour shares. This is broadly in line with the findings in OECD (2012[1]) of negative effects of technological change and intra-industry offshoring on labour shares in high-wage countries.[9] The effects of technological progress appear to operate partly by reducing firm-level labour shares, with large differences across low- and high-productivity firms. By contrast, the effect of GVC expansion appears to operate exclusively by shifting the composition of firms to those with the lowest labour shares.

Box 2.3. Methodology and data underlying the firm-level analysis

In order to assess whether within-firm labour shares respond to changes in industry-level relative investment prices and GVC participation, the following baseline equation is estimated:

$$\Delta LS_{cjit} = \beta_1 \Delta P_{ijt}^{Inv} + \beta_2 \Delta T_{ijt} + \gamma' X_{cji0} + \alpha_{cj} + \alpha_t + \varepsilon_{cji}$$

where subscripts *c, j, i, t* denote, respectively, countries, industries, firms and time; ΔLS_{cji} denotes the annualised long difference in the firm-level labour share, with long differences computed over the longest period a firm is observed and the sample is constrained to firms that are observed for at least eight years over the period 2001-13; ΔP_{cjt}^{Inv} denotes the annualised long difference of the log relative investment price; ΔT_{ijt} is the annualised change in GVC participation; X_{cji} is a set of firm-level controls that include: initial values of the firm's age, size (as measured by employment) and the initial labour share;[1] α_{cj} denotes country-industry fixed effects and α_t are period-fixed effects that cover all permutations of possible start and end years over the period 2001-13.

The model is estimated using firm-level data from Orbis – a dataset provided by Bureau van Dijk – and industry-level relative investment price indices for nine countries for which long differences in labour shares can be computed for a sufficient number of firms.[2] The Orbis dataset contains information from firms' income statements and balance sheets, including on revenues, value added, employment and compensation. In order to limit the influence of erratic or implausible firm-behaviour, the dataset is cleaned by removing extreme outliers using the procedure described in Andrews et al. (2016[19]). For the purpose of the labour share analysis in this chapter the dataset is additionally cleaned by removing observations with extreme values for labour shares. High-productivity firms are defined as the top 5% of firms within an industry with the highest labour productivity across the countries covered by the analysis.

Source: The detailed description of the data underlying the firm-level analysis and the detailed regression results can be found in (Schwellnus et al., forthcoming[8]), "Labour share developments over the past two decades: The role of technological progress, globalisation and "winner-take-most" dynamics".

Notes:

1. Given that the above specification of the firm-level regressions considers only one long difference per firm, firm fixed effects cannot be included. Including the initial values of the dependent variable allows controlling for unobserved firm characteristics in the absence of firm fixed effects (Angrist and Pischke, 2009[20]).

2. The analysis is limited to the same industries as the industry-level analysis. The included countries are Belgium, Finland, France, Germany, Italy, Korea, Spain, Sweden and the United Kingdom. In order to ensure that results are not driven by firms with extreme values in long differences in labour shares, firms with long differences outside the [-40,+40] percentage point interval are removed from the analysis in this section. The analysis is further restricted to country-industry cells with more than 30 firms in order to ensure that the industry-level variables are identified by a sufficient number of firms. The results are robust to alternative sample restrictions.

Overall, these results are consistent with "winner-takes-most" dynamics in the sense that only a subset of highly productive firms ("superstars") with low labour shares may be fully able to reap the benefits of new technologies and globalisation.

2.2.2. Firm-level dynamics: Does the winner take it all?

Technology and globalisation strengthen supply- and demand-side economies of scale, which may in turn give rise to "winner-takes-most" dynamics – the process through which the most productive firms capture an overwhelming share of the market, see Rosen (1981[21]); Frank and Cook (1995[22]); and Autor et al. (2017[23]). While the relevant market for the best manufacturing firms used to be primarily national or regional, the fall in transport costs and tariffs implies that these firms can now serve significant shares of the global market, strengthening supply side economies of scale. The trend toward larger market size has been reinforced by rapid progress in information and communication technologies (ICT) that allow matching sellers and buyers across geographically distant locations.[10] Rapid progress in ICT has also facilitated the emergence of markets with a global scale in a number of traditional service industries, such as retail and transport, as well as new ICT services with near zero marginal cost of scaling up operations.[11] In some of these industries, including ICT services, retail and transport, network externalities (demand side economies of scale) that favour the emergence of a dominant player have become more important.[12]

Standard economic theory suggests that "winner-takes-most" dynamics imply both falling labour shares in the technologically most advanced firms and reallocation of market shares toward these firms. In a standard model with heterogeneous firms, the best firms have low labour shares because the fixed overhead labour cost needed for production is distributed over a larger output and/or because large market shares allow these firms to charge higher markups (Autor et al., 2017[23]). "Winner-takes-most" dynamics implies that as technology and globalisation raise the relevant market size the best firms become larger, which implies that: i) the labour share in these firms declines as the value added share of fixed overhead labour cost declines and/or their markup increases; and ii) production is reallocated toward low labour share firms as the market share of the best firms increases.

The analysis below provides descriptive evidence on these hypotheses using the Orbis dataset. The sample underlying the analysis covers firms in the non-primary and non-financial business sector of 17 OECD countries with satisfactory firm coverage. To minimise issues related to the under-representation of small firms in the dataset, the analysis in this section is restricted to firms with more than 20 employees.

Decoupling of wages from productivity: Superstar firms or the rest?

In countries that experienced declines in labour shares over the period 2001-13, wages in technologically leading firms decoupled from productivity but closely tracked productivity in the remaining firms (Figure 2.5). This implies that in these countries labour shares within the group of leading firms declined while they remained constant in the remaining firms, which is consistent with "winner-takes-most" dynamics.[13] The best firms in these countries diverged from the remaining firms in terms of both productivity and wages, but wage divergence was much less pronounced than productivity divergence.[14]

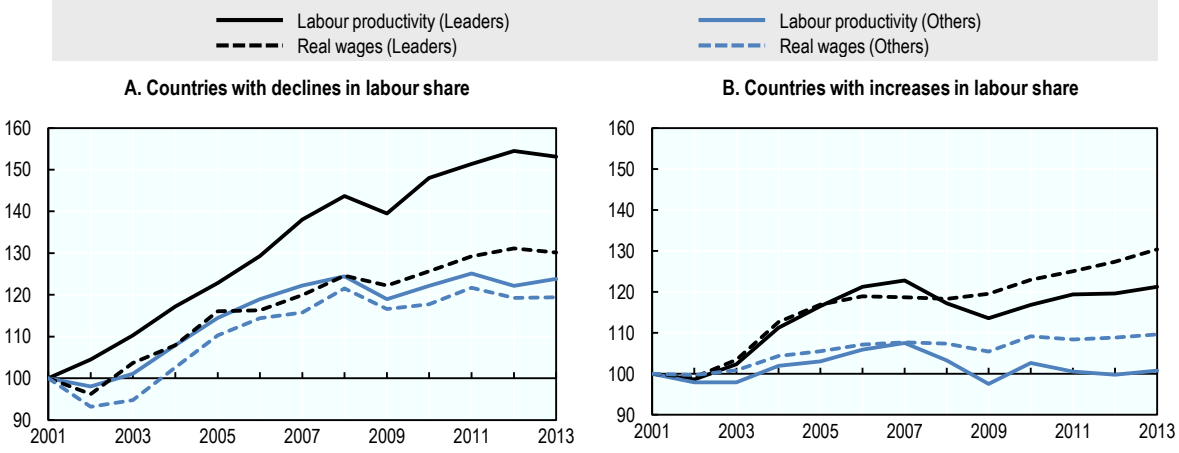
In countries that did not experience declines in labour shares, real wage growth outpaced labour productivity growth in both leading firms and the remaining firms. Productivity and wages in leading firms diverged from those of the remaining firms, but labour shares were broadly constant before the crisis of 2008-09 and increased in both groups thereafter. This suggests that in countries with increases in labour shares over the period 2001-13 cross-firm heterogeneity in labour share trends was less pronounced. One

possible explanation could be that there was less technological dynamism in countries with increases in labour shares, which is consistent with the fact that productivity growth of the leading firms in these countries was similar to that of the non-leading firms in countries that experienced labour share declines.

The decoupling of wages from productivity in technologically leading firms is overwhelmingly explained by the entry of capital-intensive firms with low labour shares into the technological frontier (Figure 2.6). The decoupling of wages from productivity in leading firms can be decomposed into contributions from firms staying at the technological frontier ("incumbent leaders") and firms entering and exiting it ("net entry"). While productivity and wages remained closely linked in incumbent technological leaders, net entry into the frontier drove a large wedge between wage and productivity growth, implying that labour shares of firms entering the technological frontier were significantly lower than those exiting it. Thus, the decline of labour shares at the technological frontier was not driven by increasing markups or capital intensity in firms remaining at the technological frontier but rather by the entry of firms with higher markups or higher capital intensity into the technological frontier. Empirical analysis suggests that firms entering the technological frontier were about 60% more capital intensive than those exiting it (Schwellnus et al., forthcoming[8]).

Figure 2.5. Average wages and productivity in the best firms and the rest

Indices, 2001 = 100



Note: Labour productivity and real wages are computed as the unweighted mean across firms of real value added per worker and real labour compensation per worker. Leaders are defined as the top 5% of firms in terms of labour productivity within each country group in each industry and year. The countries with a decline in the labour share excluding the primary, housing, financial and non-market industries over the period 2001-13 are: Belgium, Denmark, Germany, Ireland, Japan, Korea, Sweden, the United Kingdom and the United States. The countries with an increase are: Austria, the Czech Republic, Estonia, Finland, France, Italy, the Netherlands and Spain.
Source: Schwellnus et al. (forthcoming[8]), "Labour share developments over the past two decades: The role of technological progress, globalisation and "winner-take-most" dynamics".

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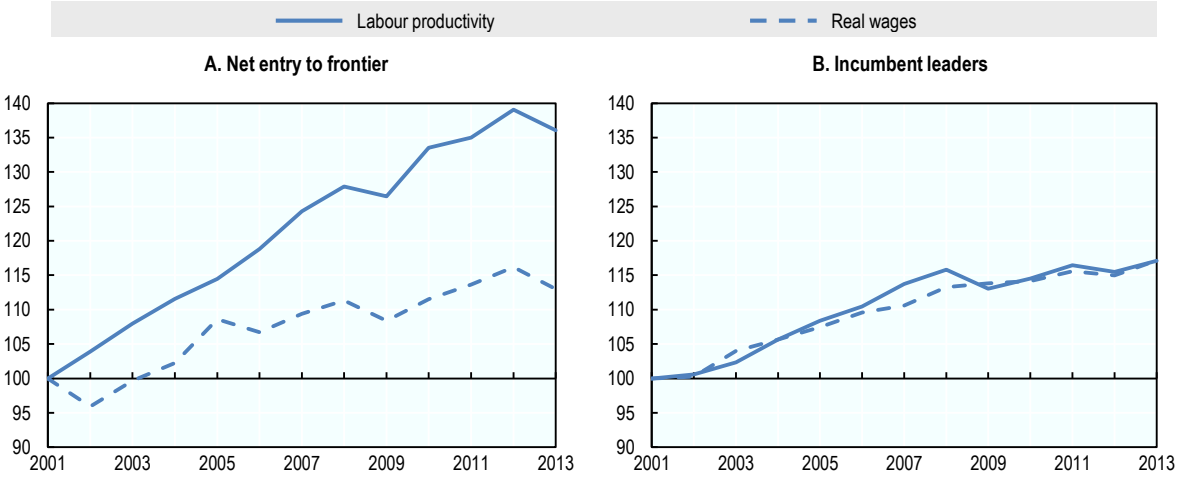
Figure 2.6. Net entry fully explains the decoupling of wages from productivity in leading firms

Contributions to labour productivity and real wage growth at the frontier, countries with declines in labour shares, indices, 2001 = 100



Note: Contributions to real wage growth and labour productivity growth are based on the decomposition $\Delta X = \left[s_2^{stay} X_2^{stay} - s_1^{stay} X_1^{stay}\right] + \left[s_2^{entry} X_2^{entry} - s_1^{exit} X_1^{exit}\right]$, X denotes the logarithm of labour productivity or real wages; s denotes the share of each group of firms in the total number of leading firms; superscripts denote groups of firms; and subscripts denote the period (Baily et al., 1992[24]). The countries with a decline in the labour share excluding the primary, housing, financial and non-market industries over the period 2001-13 are: Belgium, Denmark, Germany, Ireland, Japan, Korea, Sweden, the United Kingdom and the United States.
Source: Schwellnus et al. (forthcoming[8]), "Labour share developments over the past two decades: The role of technological progress, globalisation and "winner-take-most" dynamics".

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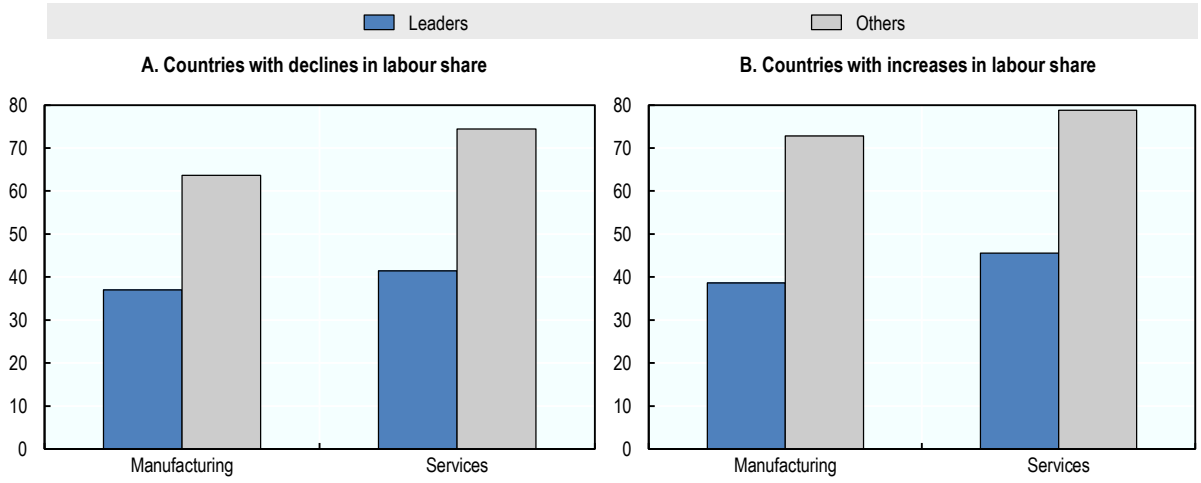
Labour shares and reallocation: Are superstar firms gaining market shares?

Across countries and industries, labour shares in leading firms are lower than in the remaining firms (Figure 2.7). While labour share developments in leading firms have differed across countries with declining labour shares and those where they increased, labour shares in leading firms are consistently lower than those in the other firms across both country groups. This stylised fact also holds across manufacturing and services, with limited differences across industries at a higher level of disaggregation (Schwellnus et al., forthcoming[8]). Therefore, reallocation of production to firms at the technological frontier tends to reduce the labour share.

Figure 2.7. Labour shares in leading and other firms, 2001-13



Note: The labour share is computed as the unweighted mean across firms of the percentage ratio of total labour compensation to value added over the period 2001-13. Leaders are defined as the top 5% of firms in terms of labour productivity within each country group in each industry and year. The countries with a decline in the labour share excluding the primary, housing, financial and non-market industries over the period 2001-13 are: Belgium, Denmark, Germany, Ireland, Japan, Korea, Sweden, the United Kingdom and the United States. The countries with an increase are: Austria, the Czech Republic, Estonia, Finland, France, Italy, the Netherlands and Spain.
Source: Schwellnus et al. (forthcoming[8]), "Labour share developments over the past two decades: The role of technological progress, globalisation and "winner-take-most" dynamics".

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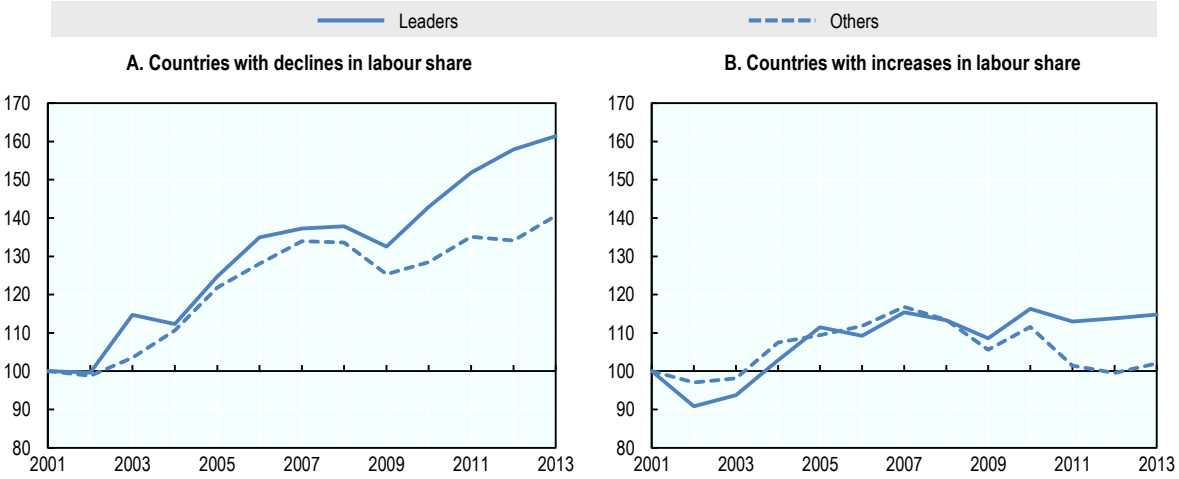
In countries with declines in labour shares, value added in leading firms strongly diverged from the remaining firms, implying increasing market shares of firms at the technological frontier (Figure 2.8). Given that labour shares in leading firms are well below those in other firms, in these countries reallocation of value added put further downward pressure on labour shares. This is consistent with "winner-takes-most" dynamics but it does not necessarily indicate an increase in anti-competitive forces, such as higher entry barriers. The emergence of new technologies may allow innovating firms to temporarily pull ahead. Autor et al. (2017[23]) find evidence that growing market concentration in the United States occurs predominantly in industries with rapid technological change, consistent with the conjecture that "winner-takes-most" dynamics reflect technological dynamism rather than anti-competitive forces. Nevertheless, there is a risk that over time incumbent technological leaders attempt to reduce the threat of market entry through anti-competitive practices, e.g. through predatory pricing or mergers and acquisitions of competing firms.

In countries with increases in labour shares the pattern of increasing market shares of firms at the technological frontier was more muted. This is consistent with the above conjecture that in these countries "winner-takes-most" dynamics were less prevalent.

Figure 2.8. Real value added in leading and other firms

Indices, 2001 = 100



Note: Real value added is computed as the unweighted mean across firms of nominal value added deflated by the industry value added deflator over the period 2001-13. Leaders are defined as the top 5% of firms in terms of labour productivity within each country group in each industry and year. The countries with a decline in the labour share excluding the primary, housing, financial and non-market industries over the period 2001-13 are: Belgium, Denmark, Germany, Ireland, Japan, Korea, Sweden, the United Kingdom and the United States. The countries with an increase are: Austria, the Czech Republic, Estonia, Finland, France, Italy, the Netherlands and Spain.
Source: Schwellnus et al. (forthcoming[8]), "Labour share developments over the past two decades: The role of technological progress, globalisation and "winner-take-most" dynamics".

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Summing up, the firm-level analysis suggests that "winner-takes-most" dynamics have contributed to labour share declines, both through a decline in labour shares within the group of technologically leading firms and the reallocation of market shares toward these firms. The results further suggest that thus far the decoupling of wages from productivity at the technological frontier is not primarily driven by the entrenchment of a small number of superstar firms that raise their markups, but instead by firms with lower labour shares leapfrogging incumbent frontier firms. While low labour shares in firms entering the technological frontier may to some extent reflect high markups, the fact that these firms leapfrog incumbents suggests that high markups likely reflect innovation rents rather than a lack of entry barriers. This interpretation is also consistent with the fact that the share of young and small firms is significantly higher for entrants into the technological frontier than for firms staying at or exiting the frontier.[15] A key challenge for product market regulation and competition policy going forward will be to prevent emerging dominant players from engaging in anti-competitive practices so that markets remain contestable.

2.3. The central role of skills for broadly shared productivity gains

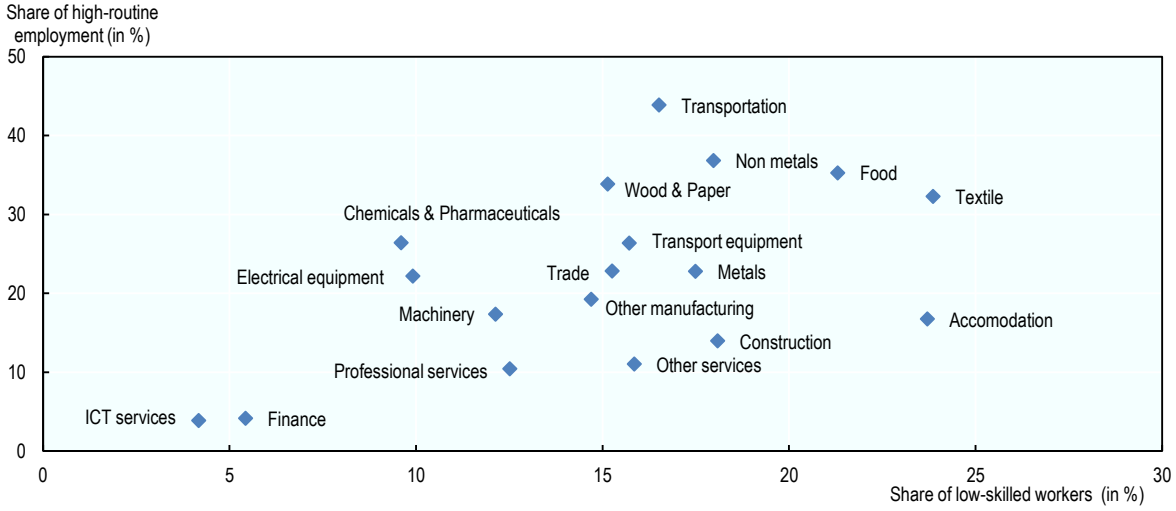
A large body of evidence suggests that routine task and skill intensity are key determinants of the substitutability of capital for labour. For instance, existing

cross-country studies show that declines in labour shares in response to declines in relative investment prices have been more pronounced in countries with higher shares of routine employment (IMF, 2017[6]). The elasticity of substitution between capital and labour is typically estimated to be significantly higher for low-skilled than for high-skilled workers (Duffy, Papageorgiou and Perez-Sebastian, 2004[25]; Krusell et al., 2000[15]). These results suggest that equipping workers with the right skills to carry out non-routine tasks would make them less substitutable with capital and allow them to make the most of ongoing technological advances.

To assess the role of routine-task intensity and skill intensity for capital labour substitution in response to technological progress, the background analysis for this chapter reported in Schwellnus et al. (forthcoming[8]) constructs industry-level measures based on the OECD Survey of Adult Skills - Programme for the International Assessment of Adult Competencies (PIAAC). These measures suggest that the share of high-routine jobs – defined as jobs with limited independence and freedom in planning and organising the tasks to be performed – is particularly high in industries such as transportation and non-metal manufacturing, and particularly low in ICT services and finance (Figure 2.9). While routine and skill intensity are correlated across industries, a high employment share of low-skilled workers does not necessarily imply a high share of high-routine workers, which allows to empirically distinguish between the effects of routine tasks and skills. The accommodation and construction industries, for instance, employ high shares of low-skilled workers but low shares of high-routine workers.

Figure 2.9. High routine intensity does not imply low skill intensity

OECD average, 2012



Note: The share of low-skilled workers is defined as the share of workers with numeracy skills below level 2 in the Programme for the International Assessment of Adult Competencies (PIAAC). The share of high-routine employment is defined as the share of workers in an occupation above the 75th percentile of the routine-task distribution.
Source: Schwellnus et al. (forthcoming[8]), "Labour share developments over the past two decades: The role of technological progress, globalisation and "winner-take-most" dynamics".

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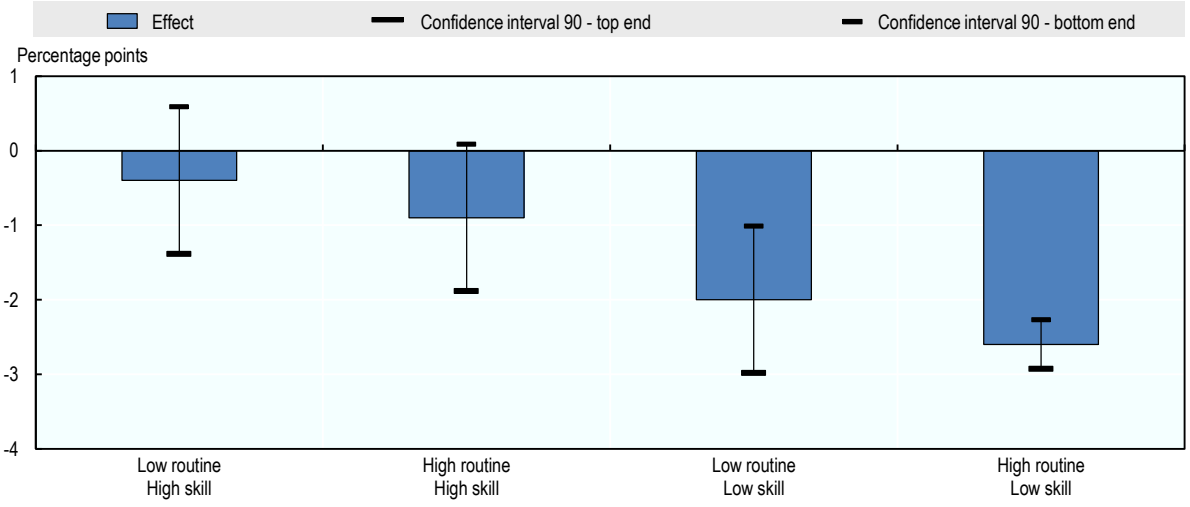
The industry-level empirical analysis suggests that a decline in relative investment prices has a lower impact on the labour share in industries with low initial routine intensity. The estimated semi-elasticity is 0.1 for low-routine industries – defined as those industries with initial routine intensity below the median industry – whereas it is around 0.22 for high-routine industries (Schwellnus et al., forthcoming[8]). Similarly, the estimated semi-elasticity is typically significantly lower in industries with high skill intensity, especially problem-solving and numeracy skills.

Even at a given level of routine task intensity, labour share declines in response to relative investment price declines are lower in countries and industries with a high share of high-skilled workers. While high literacy skills do not appear to significantly reduce capital-labour substitution in response to relative investment price declines, numeracy and problem-solving skills are statistically significant when added to the baseline specification separately. The estimated coefficients suggest that even in a high-routine industry a decline in the relative investment price results in an only modest decline in the labour share if the industry employs a high share of workers with high numeracy- or problem-solving skills (Figure 2.10). When all skill indicators are added to the baseline specification simultaneously, only numeracy skills turn out to be statistically significant.[16]

Figure 2.10. High skills reduce capital-labour substitution

Change in the labour share in response to a 10% decrease in the relative investment price, percentage points



Note: Based on the industry-level results for numeracy skills reported in Schwellnus et al. (forthcoming[8]).
Source: Schwellnus et al. (forthcoming[8]), "Labour share developments over the past two decades: The role of technological progress, globalisation and "winner-take-most" dynamics".

StatLink http://dx.doi.org/10.1787/888933777965

Overall these results suggest that high-skilled workers, especially those with high numeracy skills, may be more difficult to replace by machines or may be more easily re-deployed to non-routine tasks than low-skilled workers (see Chapter 4). Basic literacy, numeracy and problem-solving skills remain in high demand in OECD countries and are key to allowing workers to make the most of the opportunities and challenges afforded by technological change and globalisation (Vignoles, 2016[26]; OECD, 2017[27]). The challenge for skill policies is to develop strong skill foundations in youth while also

supporting life-long learning, including through strong systems of skills validation and certification (OECD, forthcoming[28]).

2.4. Concluding remarks

This chapter provides evidence suggesting that technological change and greater participation in global value chains have reduced labour shares, including by strengthening "winner-takes-most" dynamics: countries with falling labour shares have witnessed both a decline at the technological frontier and a reallocation of market shares toward capital-intensive "superstar" firms with low labour shares. But technology-induced capital-labour substitution has been significantly less pronounced for high-skilled workers, suggesting that raising skills will be key to reconnecting real median wages to productivity.

Continued technological change is likely to put further downward pressure on labour shares and create new challenges for the broad sharing of productivity gains. Advances in ICT will continue to raise production efficiency for investment goods, further reducing their relative prices and raising capital-labour substitution. But technological progress may also fundamentally change the substitutability of capital and labour. For instance, technological advances in artificial intelligence and robotics could make more human tasks – including cognitive tasks – replaceable by capital in the future. Even though the evidence suggests that the expansion of global value chains stalled in the wake of the global crisis of 2008-09 (Haugh et al., 2016[29]), technological advances may lead to further offshoring of labour-intensive services.

These technological advances may further strengthen "winner-takes-most" dynamics, with wages decoupling further from productivity at the technological frontier and market shares being reallocated to a small number of "superstar" firms with low labour shares. This chapter finds no evidence that the emergence of "superstar" firms indicates the rise of anti-competitive forces rather than technological dynamism. Nonetheless, competition policy will need to find the right balance between preventing anti-competitive practices by incumbent technological leaders and encouraging innovation by allowing entrants into the technological frontier to reap the rewards for their innovations. Irrespective of the source of emerging "winner-takes-most" dynamics, policies that raise human capital through education and training will play a crucial role to broaden the sharing of productivity gains by ensuring that workers can make the most of ongoing technological advances.

Notes

[1] The empirical results reported in this chapter are based on Schwellnus et al. (2017[2]; 2017[32]; forthcoming[8])

[2] Note that the value added price index is different from the GDP price index. GDP includes taxes less subsidies on products whereas value added does not. Value added is thus a more relevant concept to study the relation between labour productivity and wages.

[3] If factor prices are determined competitively real wages are equal to *marginal* labour productivity, but this does not imply equality between real wages and *average* labour productivity. Real wages can decouple from *average* labour productivity even with factor prices that are determined competitively if the elasticity of substitution between capital and labour is non-unitary.

[4] Participation in global value chains is measured by the sum of the share of foreign value added in gross exports (backward participation) and the share of exports consisting of intermediate inputs used by trading partners for the production of their exports to third countries (forward participation).

[5] At the level of industry disaggregation used in this chapter, labour share developments within industries explain around 80% of aggregate labour share developments, which is broadly in line with previous studies (Bassanini and Manfredi, 2012[31]; Karabarbounis and Neiman, 2014[5]; IMF, 2017[6]) . Given that reallocation across industries explains only a small fraction of aggregate labour share developments, weighting industries with shares in aggregate value added in the regression analysis allows making direct statements on aggregate effects.

[6] The value added deflator implicitly enters both the denominator of the labour share and the denominator of the relative investment price. A range of robustness checks reported in Schwellnus et al. (forthcoming[8]) suggest that potential endogeneity of the relative investment price does not bias the results reported here. Changes in GVC participation may partly be driven by labour share developments, e.g. if labour share increases induce offshoring of intermediate goods production. If anything, this could bias the coefficient on GVC participation upwards, but does not call into question the significant negative coefficient on GVC participation.

[7] Industry-level elasticities can plausibly be assumed to be similar to aggregate elasticities because within-industry labour share developments explain aggregate developments (Schwellnus et al., forthcoming[8]) and in the regression analysis industry shares in value added are used as weights.

[8] Moreover, in order to cover a maximum number of firms, the firm-level analysis is based on a single eight-year or longer difference as compared to three non-overlapping five- or six-year differences in the industry-level analysis.

[9] It is also in broadly in line with more recent cross-country studies such as De Serres and Schwellnus (2018[30]), IMF (2017[6]) and Karabarbounis and Neiman (2014[5]).

[10] For instance, the internet has created international marketplaces on which sellers offer a large variety of products and buyers can compare prices globally.

[11] For instance, the marginal cost of replicating and supplying the informational goods provided by digital platforms is near zero.

[12] Network externalities are relevant for digital platforms (e.g. through better matching of suppliers and buyers) but also for retail (e.g. through better access to network of suppliers) and transport (e.g. through more efficient logistics). In some industries, network externalities operate through more subtle channels. For instance, the use of private airlines' computerised reservation systems among travel agents can lead to the emergence of dominant players (Frank and Cook, 1995[22]).

[13] Leaders are defined as the top 5% of firms in terms of labour productivity within each country group in each industry and year, implying that the composition of firms at the technological frontier is allowed to vary over time.

[14] The decoupling of wages from productivity in leading firms does not appear to reflect an increase in stock option compensation. Stock option compensation is typically found to be particularly prevalent in finance and ICT services (Elsby, Hobijn and Sahin, 2013[7]). The finance industry is not covered by Orbis so that the role of increasing stock option compensation can be assessed by removing the ICT industry from the analysis in Figure 2.5. Since the figure remains qualitatively and quantitatively unchanged, increasing non-cash compensation is unlikely to be the main driver of decoupling of wages from productivity in leading firms in countries with declining labour shares (Schwellnus et al., forthcoming[8]).

[15] The share of firms that employ less than 100 workers and have been in existence no more than 5 years is 14% for entrants into the technological frontier, whereas it is 8% for firms staying at the frontier or exiting it (Schwellnus et al., forthcoming[8]).

[16] Although the empirical suggest that numeracy skills are more robustly related to capital-labour substitution in response to relative investment price declines, the insignificance of the literacy and problem solving indicators may to some extent also reflect high collinearity between the three skill indicators. The coefficients on the three skill indicators are jointly significant at the 5% level.

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