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By Chiara Chriscuolo, Alexander Hijzen, Cyrille Schwellnus, Erling Barth, Wen-Hao Chen, Richard Fabling, Priscilla Fialho, Katarzyna Grabska, Ryo Kambayashi, Timo Leidecker, Oskar Nordström Skans, Capucine Riom, Duncan Roth, Balazs Stadler, Richard Upward and Wouter Zwysen.

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ABSTRACT /RESUME

Workforce composition, productivity and pay: the role of firms in wage inequality

In many OECD countries, low productivity growth has coincided with rising inequality. Widening wage and productivity gaps between firms may have contributed to both developments. This paper uses a new harmonised cross-country linked employer-employee dataset for 14 OECD countries to analyse the role of firms in wage inequality. The main finding is that, on average across countries, changes in the dispersion of average wages between firms explain about half of the changes in overall wage inequality. Two thirds of these changes in between-firm wage inequality are accounted for by changes in productivity-related premia that firms pay their workers above common market wages. The remaining third can be attributed to changes in workforce composition, including the sorting of high-skilled workers into high-paying firms. Over all, these results suggest that firms play an important role in explaining wage inequality as wages are driven to a significant extent by firm performance rather than being exclusively determined by workers' earnings characteristics.

JEL codes: D2, J31, J38.

Keywords: Wage inequality, firm wage premium, productivity.

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Composition de la main-d'œuvre, productivité et rémunération: le rôle des entreprises dans les inégalités salariales

Nombreux sont les pays de l'OCDE où l'on a vu une faible croissance de la productivité coïncider avec un creusement des inégalités. L'accentuation des écarts de rémunération et de productivité entre les entreprises n'est sans doute pas étrangère à ces deux tendances. Grâce à un nouvel ensemble harmonisé de données appariées employeurs-salariés couvrant 14 pays de l'OCDE, ce document analyse quel rôle les entreprises jouent dans l'évolution des inégalités salariales. Il ressort de cette analyse que, dans l'ensemble des pays étudiés, les changements de la répartition des salaires moyens entre les entreprises comptent pour la moitié environ des changements globaux des inégalités salariales. Les deux tiers environ des changements observés entre les entreprises tiennent à la variation de la prime liée à la productivité que ces mêmes entreprises accordent à l'ensemble de leurs employés en supplément du salaire de marché. Le dernier tiers peut être attribué aux modifications de la composition de la main-d'œuvre, et en particulier au tri qui s'opère parmi les actifs avec la concentration des plus qualifiés dans les entreprises qui rétribuent le mieux. En somme, ces observations donnent à penser que les entreprises jouent un rôle majeur dans les inégalités salariales en ce sens que le niveau de rémunération dépend dans une large mesure de la tenue de ces entreprises et non pas exclusivement des qualifications des travailleurs.

Codes JEL : D2, J31, J38

Mots-clés : inégalités salariales, prime salariale offerte par les entreprises, productivité.

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Workforce composition, productivity and pay: the role of firms in wage inequality

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1. Introduction

1. At a time when many OECD countries are grappling with low productivity growth and rising inequality, gaps in business performance have also widened. While a small fraction of high-performing businesses continue to achieve high productivity and wage growth, the remaining ones are increasingly falling behind (Andrews, Criscuolo and Gal, 2016[1]; Berlingieri, Blanchenay and Criscuolo, 2017[2]). This raises the question whether growing performance gaps across businesses can at least partly account for aggregate productivity and inequality developments.

2. Designing better public policies for broadly shared productivity growth requires an understanding of the mechanisms through which firms affect both aggregate productivity and inequality. Firms may not only determine the distribution of market income between capital and labour, but also drive the distribution of labour income between workers, i.e. wage inequality.[2] In particular, addressing concerns about rising inequality may not only require policies to support workers, such as in the areas of skills and wage-setting, but also business-focused initiatives that allow lagging firms to catch up or exit the market.

3. Uncovering the mechanisms linking growing performance gaps between businesses and wage inequality requires granular information on the characteristics of both workers and their employers. Such information allows quantifying the contribution to increasing wage inequality of changes in wage dispersion *(i)* between different workers within their firm and *(ii)* between similar workers across different firms. It also

[1] This paper was produced by the OECD Economics Department (ECO), the OECD Science, Technology and Innovation Directorate (STI), and the OECD Department for Employment, Labour and Social Affairs (ELS), as well as partners from participating countries who contributed with analysis. The paper was written by Cyrille Schwellnus (OECD, ECO), Chiara Criscuolo (OECD, STI), Alexander Hijzen (OECD, ELS), Balazs Stadler (OECD, ECO), Timo Leidecker (OECD, STI) and Wouter Zwysen (OECD, ELS). Erling Barth (Norway. Institute for Social Research Oslo), Wen-Hao Chen (Canada, Statcan), Richard Fabling (New Zealand), Priscilla Fialho (Portugal, OECD), Katarzyna Grabska (Netherlands, Maastricht University), Ryo Kambayashi (Japan, Hitotsubashi University), Oskar Nordström Skans (Sweden, Uppsala University), Capucine Riom (France, LSE), Duncan Roth (Germany, IAB Nuremberg), and Richard Upward (United Kingdom, University of Nottingham) contributed with analysis. Sarah Michelson (OECD, ECO) provided excellent editorial support. Contact: linkeed@oecd.org

[2] The role of firms in determining the labour share has, for instance, been the subject of Autor et al. (2019[52]), Kehrig and Vincent (2019[51]) and Schwellnus et al. (2018[50]). The role of firms in determining wage inequality has, for instance, been the subject of Barth et al. (2016[11]; 2018[16]) and Song et al. (2019[18]).

helps understanding the extent to which such differences are explained by changes in workforce composition, differential technology adoption, or shifts in market power between firms, which may in turn be driven by changes in technology, domestic and international value chains, as well as policy.

4. The OECD Economics Department, the Directorate for Science, Technology and Innovation and the Department for Employment, Labour and Social Affairs have set up a joint project to provide evidence-based policy advice on these issues. As part of this project, this paper provides a conceptual framework and a descriptive analysis of the role of firms in wage inequality drawing on a new dataset of linked employer-employee data across 14 OECD countries from the early 1990s to around 2013-18.[3] Based on these findings, the paper raises a number of hypotheses on the structural and policy drivers of between-firm wage inequality that will be empirically tested in the next stage of the project.

5. The paper first provides new stylised facts based on a decomposition of aggregate wage inequality into within- and between-firm components. It further analyses channels underlying changes in both between and within-firm wage dispersion. Using measures of worker skills within the firm, it disentangles the role of increased worker sorting from the role of increased dispersion of firm wage premia, which may be related to increased revenue productivity dispersion (i.e. increased dispersion of price-cost margins and/or increased dispersion of physical productivity). This analysis is only possible thanks to the novel use of employer-employee data in a cross-country context.

6. The main finding of this paper is that firms play a important role in explaining aggregate wage inequality. Rather than being exclusively determined by workers' earnings characteristics, wages are driven to a significant extent by firm performance as workers and firms bargain over the sharing of productivity-related rents. On average across countries, changes in between-firm wage inequality (differences in average pay between firms) explain about half of the changes in overall wage inequality. Two thirds (65%) of changes in between-firm wage inequality is accounted for by changes in firm wage premia. The remaining third (35%) of changes in between-firm wage inequality can be attributed to changes in the sorting of workers.

7. The challenge for policy makers is to simultaneously promote productivity gains from the adoption of new and possibly skill-biased technologies and the corresponding efficiency-enhancing sorting of workers across firms, while ensuring a broader sharing of these gains. Policies that promote the adoption of productivity-enhancing technologies in low-wage firms are likely to be key, as they promote increased access to adequate skill upgrading for all workers, providing them with pathways to climb the job ladder. More generally, worker-centred policies, such as education and training, may need to be complemented by firm-centred policies that promote productivity in low-wage firms to effectively address concerns around high inequality and low productivity growth.

8. The remainder of the paper is organised as follows. Section 2 describes the analytical framework that links technological change, globalisation and public policies to within and between-firm wage inequality. Section 3 outlines the construction of a harmonised cross-country linked employer-employee dataset and compares the resulting measures of wage inequality with other available data sources. Section 4 uses this dataset to provide a statistical decomposition of wage inequality into within- and between-firm components for a range of OECD countries. Section 5 provides evidence on the role of worker sorting across firms and differences in firm wage premia in between-firm wage inequality. Section 6 discusses follow-up research and possible implications for public policies, while Section 7 concludes.

[3] The dataset provides rich information on employees and their employers based on administrative records collected for social security or tax purposes. Country-specific confidentiality requirements and data idiosyncrasies – e.g. due to sampling, measurement and available information – are addressed by aggregating the individual-level data to the country-industry level and imposing a number of basic harmonisation requirements. The analysis currently covers the following countries: Canada, Estonia, France, Germany, Italy, Japan, Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, United Kingdom and the United States.

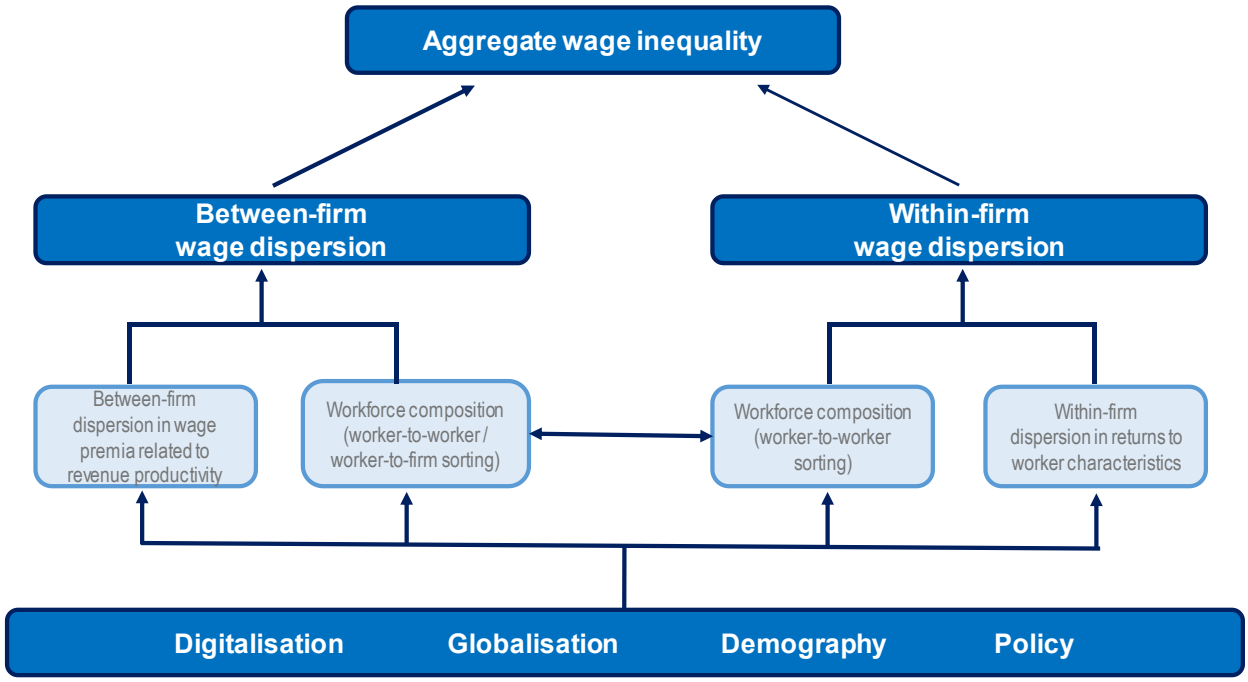
2. A framework for dissecting the role of firms in wage inequality

2.1. Conceptual framework

9. Aggregate wage inequality can be decomposed into wage dispersion between firms and within firms (Figure 1). Wage dispersion between firms may reflect differences in workforce composition or differences in revenue-based productivity at given workforce composition due to technology or market power, and the extent to which market rents are shared with workers. Wage dispersion within firms reflects worker heterogeneity in terms of a range of earnings characteristics – including education, experience and gender – and returns to these characteristics. The digital transformation, trade integration and demographic change, as well as public policies affect aggregate wage inequality through these channels.

10. In a perfectly-competitive labour market without frictions, where firms pay workers according to their marginal productivity (e.g. skills, unobserved ability, motivation etc.), pay differences between firms entirely reflect differences in workforce composition. For instance, one firm may mainly employ high-skilled workers at high wage rates, whereas another one may mainly employ low-skilled workers at low wage rates, because they perform different economic activities or use technologies with different skill requirements. Put differently, in a perfectly-competitive labour market, such worker-to-worker sorting fully explains wage differences between firms. However, since workers' wages are fully determined by their own skills worker-to-worker sorting has no impact on aggregate wage inequality: higher between-firm wage inequality due to higher skill dispersion between firms is fully offset by lower within-firm wage inequality due to more homogeneous workforces within firms.

Figure 1. Conceptual framework



Source: OECD

11. In an imperfectly-competitive labour market with frictions, firms and workers bargain over market rents (Pissarides, 2000[3]; Mortensen, 2003[4]). In this case, average pay between firms may differ even when they employ identically-skilled workers because of differences in firm wage premia due to differences in firms' revenue productivity and/or in the sharing of market rents with workers. For instance, one firm may

adopt more advanced technologies than another one employing identically-skilled workers, because it benefits from better access to finance or has reached the minimum scale to cover the fixed cost of adopting advanced technologies. Revenue productivity may also differ between firms with identically-skilled workers because of differences in product market power, which allows some firms to charge higher prices at given technology and may partly reflect product innovation but also barriers to competition due to sunk costs or the policy environment.

12. In reality, pay differences between firms are likely to be explained by both differences in workforce composition and differences in firm wage premia, with worker sorting across firms not only reflecting the clustering of similarly-skilled workers in the same firms (worker-to-worker sorting), but also the concentration of high-skilled workers in the best-performing firms (and of low-skilled workers in low-productivity firms, i.e. worker-to-firm sorting). Worker-to-worker sorting represents specialisation based on the preferences and skills of workers or the technology-based skill requirements of firms. This type of sorting is not driven by differences in pay between firms and does not generate changes in the distribution of productivity-related rents across workers. By contrast, worker-to-firm sorting may result from the presence of firm wage premia, based on complementarities between workers' skills and firms' production technology or labour market frictions. Firms may also aim at limiting the sharing of productivity-related rents with low-skilled workers, for instance by outsourcing the least skill-intensive production stages.

13. Evidence for Germany and the United States suggests that domestic outsourcing of supporting service activities, such as cleaning, security and catering, has contributed to increased worker-to-worker and worker-to-firm sorting (Dorn, Schmieder and Spletzer, 2018[5]; Goldschmidt and Schmieder, 2017[6]). Moreover, improved access to imported inputs and services offshoring have allowed firms to replace tasks previously conducted in-house by imports, making worker skills within firms more homogeneous (Autor, Dorn and Hanson, 2015[7]; Bloom, Draca and Van Reenen, 2016[8]; Carluccio, Fougère and Gautier, 2015[9]; Weil, 2014[10]).

14. This framework allows for the possibility that rather than being fully determined by workers' marginal productivity, wages may at least partly be driven by firms' productivity-related rents. Such rents may affect wage inequality both directly by affecting the dispersion of average wages between firms and indirectly by affecting workers' incentives to sort across firms with different wage premia. Therefore, worker-centred policies that have traditionally focused on addressing the gap between skill demand and supply may fall short of fully addressing the drivers of wage inequality. Instead, worker-centred policies may need to be complemented with firm-centred policies that address differences in productivity-related rents between firms while supporting overall productivity growth.

2.2. Empirical implementation

15. The analysis of the separate channels underlying aggregate wage inequality is implemented empirically as follows. Wage inequality is measured as the total variance of logarithmic wages, which is additively decomposable, scale independent and provides a more comprehensive measure of inequality compared to partial measures, such as the $90^{th}/10^{th}$ percentile ratio. In a first step, the total variance of wages is decomposed into the variance of average wages between firms and the variance of individual wages within firms. The results from this analysis are presented in Section 4 below.

16. In a second step, the estimation of a traditional human-capital earnings equation augmented with firm-fixed effects allows further decomposing between- and within-firm wage inequality into the four parts highlighted by the analytical framework in Figure 1 (Box 1):[4]

[4] As a robustness check, Box 4 further augments the human capital earnings equation by including worker in addition to firm fixed effects (Abowd, Kramarz and Margolis, 1999[12]).

- *(i)* the variance of wages at given observable workforce composition (dispersion of firm wage premia);
- *(ii)* the covariance between the predicted wages of workers based on their observable earnings characteristics and firm-specific wage premia (worker-to-firm sorting);
- *(iii)* the covariance between the predicted wages of workers based on their observable earnings characteristics and the firm-level average of predicted wages (worker-to-worker sorting);
- *(iv)* the variance of wages related to workers' observed and unobserved earnings characteristics and the returns to these characteristics.

17. The results from this analysis are presented in Section 5 below, with the full variance decomposition reported in Table B.3.

Box 1. Using a traditional human capital earnings equation to decompose wage inequality

Isolating the contribution of sorting of workers across firms to between- and within-firm wage inequality involves estimating a traditional human capital earnings equation augmented with firm fixed effects (Barth et al., 2016[11]):

$$\ln w_{ij} = x_i\beta + \gamma_j + \varepsilon_{ij} \quad (1)$$

where w_{ij} denotes the wage of worker *i* in firm *j*; x_i denotes a vector of observable worker characteristics; β denotes the estimated return to these characteristics; γ_j denotes estimated firm fixed effects; and ε_{ij} denotes the error term. The observable earnings characteristics included in the empirical model generally include education and/or occupation, age, gender, indicators for part-time work and interaction terms between these variables (see Table B.2 for the list of variables included in the empirical model by country).

Based on equation (1), denoting estimated coefficients and variables with superscript ^ and defining $\hat{s} \equiv x_i\hat{\beta}$ (workers' predicted wages based on observable earnings characteristics) the total variance of $\ln w_{ij}$ can be written as follows:

$$V^{total} = V(\hat{s}) + V(\hat{\gamma}) + 2cov(\hat{s},\hat{\gamma}) + V(\hat{\varepsilon}) \quad (2)$$

where $V(\hat{s})$ is the variance of predicted wages based on observable earnings characteristics; $V(\hat{\gamma})$ is the variance of firm-specific wage premia; $cov(\hat{s},\hat{\gamma})$ is the covariance of predicted wages with firm-specific wage premia and $V(\hat{\varepsilon})$ is the variance of residual wages.

Defining $\rho_\gamma \equiv \frac{cov(\hat{s},\hat{\gamma})}{V(\hat{s})}$ and $\rho \equiv \frac{cov(\hat{s},\hat{S})}{V(\hat{s})}$, where $\hat{S}$ is the average of all individual workers' $\hat{s}$ in the firm, the total variance of $\ln w_{ij}$ can be re-written as:

$$\begin{aligned} V^{total} &= \left[V(\hat{s})\rho + 2V(\hat{s})\rho_\gamma + V(\hat{\gamma})\right] + \left[V(\hat{s}) + V(\hat{\varepsilon}) - V(\hat{s})\rho\right] \\ &= V^{between} + V^{within} \end{aligned} \quad (3)$$

where ρ_γ is the correlation of workers' predicted wages based on observable earnings characteristics with the estimated firm-fixed effects (a measure of worker-to-firm sorting) and ρ is the correlation of workers' predicted wages with the average predicted wage in their firm (a measure of worker-to-worker sorting).

The between-firm variance can thus be decomposed into contributions from worker-to-worker sorting $V(\hat{s})\rho$, worker-to-firm sorting $2V(\hat{s})\rho_{\gamma}$ and the variance of firm-specific wage premia $V(\hat{\gamma})$. The within-firm variance can be decomposed into contributions from the returns to observed and unobserved earnings characteristics $V(\hat{s}) + V(\hat{\varepsilon})$ and worker-to-worker sorting $-V(\hat{s})\rho$.

The positive contribution of worker-to-worker sorting to overall wage inequality through between-firm wage inequality $V(\hat{s})\rho$ is exactly offset by the negative contribution through within-firm wage inequality $-V(\hat{s})\rho$. This reflects the fact that increased worker-to-worker sorting raises the dispersion of workforce composition between firms but makes workforce composition within firms more homogeneous, with no net effect on overall wage inequality.

The variance of firm-wage premia to overall wage inequality in the above framework represents an upper-bound estimate of its true contribution due to the role of unobservable worker characteristics (as shown in Box 4 following Abowd et al (1999[12])), while it represents a lower bound estimate of the contribution of worker-to-firm sorting due to the presence of sorting on unobservable ability (as shown in Annex B3 by applying Borovičková and Shimer (2017[13])). This issue is particularly pronounced in countries where information on neither occupation nor education are available (Canada, Estonia and New Zealand).

3. Constructing a cross-country dataset based on employer-employee data

18. In order to empirically quantify the contributions of each of the elements of the above framework to levels and changes in wage inequality and the scope for firm-centred policies, data are needed that map workers to the firms that employ them. The linked employer-employee data used in this project are drawn from administrative records designed for tax or social security purposes or, in a few cases, mandatory employer surveys.[5] In most countries, the project takes a distributed micro-data approach that relies on partners based in participating countries to provide relevant aggregations of individual-level data using a harmonised statistical code. In order to develop and test the statistical code, as well as to develop an in-house data infrastructure, the project has also gained direct access to a number of anonymised individual-level data sets.[6]

19. Linked employer-employee data have the major advantage of being very comprehensive and, in some cases, covering the entire population of workers and firms in a country. The information is generally also of very high quality, given the potentially important financial or legal implications of reporting errors and extensive administrative procedures for quality control. However, since tax and social security systems differ considerably across countries, they often have different administrative requirements, with potentially important implications for their comparability across countries.

20. While it is impossible to fully address all comparability issues, the following measures provide a minimum degree of harmonisation (see Table A.1 in the Annex for on overview of the data used for each country):

- **Differences in worker coverage:** Differences in administrative systems can lead to significant differences across countries in the types of workers covered by linked employer-employee data. For instance, public sector workers are excluded from some datasets, as they are covered by separate administrative systems, but are included in others. Similarly, the self-employed are not systematically included in all datasets and, when they are, they cannot always be separately

[5] This is, for instance, the case in the United Kingdom.

[6] The project currently has direct access to linked employer-employee data for Estonia, France, Italy and Spain.

identified.[7] To deal with these issues, the analysis is restricted to the private sector, excludes the self-employed where possible and own-account workers everywhere by focusing on firms with two employees or more (Table 1).[8]

- **Sampling design:** While the administrative data typically cover the universe of workers and their employers, the data made available for analytical purposes are in some countries based on a representative sample of workers or firms. Worker-based samples only cover a fraction of workers in a firm, introducing measurement error in average firm wages. This tends to bias within-firm wage dispersion down relative to between-firm wage dispersion (Håkanson, Lindqvist and Vlachos, 2015[14]). Such bias is not an issue if all workers in a firm are included, as is the case when the population of workers is available or in firm-based samples.[9] The analysis corrects for sampling error in worker-based samples through the procedure described in Annex B.[10]
- **Employer definition:** The definition of an employer differs across countries. While some datasets link workers to their establishments, others link them to their firms (which may encompass several establishments) or to an administrative reporting unit somewhere between the firm and the establishment (Vilhuber, 2009[15]). Although this could matter for decomposing wage dispersion into between and within-employer components, empirical work suggests that in practice the unit of observation may only have a limited impact on such decompositions. This w may partly reflect the fact that most firms have only a single establishment. Barth et al. (2018[16]) based on US data and Skans, Edin, and Holmlund (2009[17]) based on Swedish data show that the within-firm between-establishment variance in earnings is very small.[11] Similarly, Song et al. (2019[18]) show that almost all of the increase in earnings inequality occurred between firms rather than between establishments within firms. A minimum level of harmonisation in terms of employer definition is achieved by focusing on firms rather than establishments where both are available, which is typically the level at which wages are set (Alvarez et al., 2018[19]; Helpman et al., 2017[20]; Song et al., 2019[18]).
- **Wage definitions, working time and top coding:** All linked employer-employee data used here provide information on wages in gross terms, i.e. total labour cost minus employer social security contributions (take-home-pay plus employee social security contributions plus personal income taxes minus benefits). These are generally based on all taxable earnings, including overtime and other bonuses. Tax data generally include only limited information on working time, thereby conflating variation in hourly earnings with differences in hours worked. This issue is addressed by

[7] This problem tends to be less pronounced in tax data since these generally distinguish between capital and labour income.

[8] These restrictions are particularly appropriate from the perspective of the decomposition of overall wage inequality into between- and within-firm components. Including the self-employed and public sector firms would artificially inflate between-firm wage inequality at the expense of the within component, since the self-employed constitute overwhelmingly single-worker firms and the distribution of public sector wages is typically highly compressed. When information on public employment status is unavailable the “public government and defence” and “education” sectors are excluded. Information on self-employment is not always available, but a large fraction of self-employed workers is excluded by restricting the analysis to firms with at least 2 employees.

[9] The main downside of firm-based samples is that it is more difficult to follow workers across firms, which is crucial for the construction of measures of worker and firm quality through the estimation of panel fixed effect models.

[10] This procedure requires dropping firms with only one observed worker.

[11] This could be explained by technologies and pay practices being shared across establishments of the same firm. As a result, wages are effectively set at the level of the firm.

focusing on full-time monthly earnings or full-time equivalent earnings where possible.[12] Social security data are often censored at the bottom and top contribution thresholds.[13] This issue is addressed by imputing censored wages based on regression analysis using the predicted wage and the distribution of estimated error terms based on methods developed by Dustmann et al. (2009[21]) and Card et al. (2013[22]).[14]

Table 1. Summary of data harmonisation

	Comparability issue	Harmonisation
Covered workers	Public sector coverage	Restrict to private sector
	Self-employed coverage	Restrict to dependent employees / minimum firm size threshold
Sampling design	Small within-firm sample	Minimum firm size threshold + bias correction
Employer definition	Establishment vs firm	Firm where possible
Wage definitions	Coverage of cash bonuses	Gross monthly earnings including bonuses
	Censored earnings	Imputation procedure
	Part-time worker coverage	Full-time equivalent earnings
	Working time not available	Restrict to full-time workers

Note: Detailed information on the country-level datasets is provided in Table A.1 in the Annex.
Source: OECD.

[12] As some datasets contain no information on hours worked (e.g. Canada and New Zealand) or only days worked (e.g. Germany and Italy) full-time equivalent earnings cannot always be calculated. New Zealand and Canada do not report whether people work full-time or part-time, but this can be approximated by using a minimum threshold for wages based on the minimum wage.

[13] Up to 15% of earnings data in Germany are above the social security contribution threshold. Around 10% at the top and the bottom of the wage distribution of earnings are censored in the Spanish social security data, with exact thresholds differing by occupation, sector and year. Italian social security data is also censored, but at a very high level affecting only a limited number of workers (around 750 euros per day).

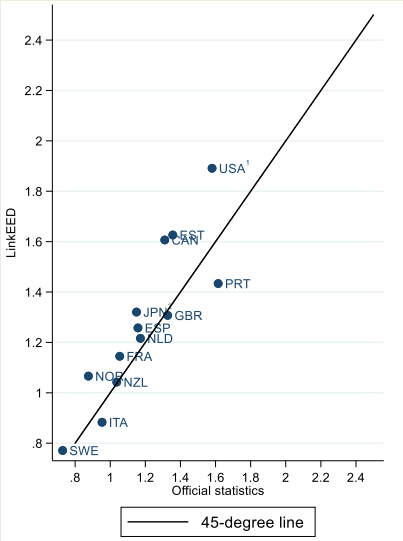
[14] More specifically, censored wages are imputed by estimating Tobit regressions separately by year and categories of key socio-demographic variables such as gender and occupation, controlling for relevant information on the worker's career and firm characteristics. The imputed wage is the sum of the predicted wage and a random component based on the distribution of the estimated error terms. This method performs well when compared to uncensored distributions regarding estimates of the overall variance, it trends over time and decompositions into within and between-firm components (De la Roca, 2017[55]).

Box 2. Comparison of wage inequality measures based on LinkEED and official sources

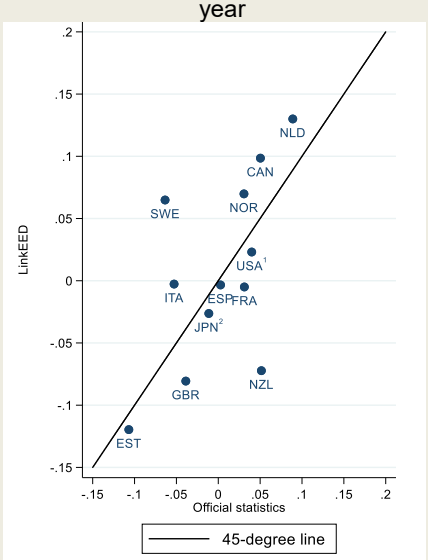
This box assesses the extent to which the patterns in overall wage inequality based on the new linked employer-employee dataset (LinkEED) correspond to those reported by official sources from national agencies or international organisations. Since the variance of wages – the preferred measure of wage inequality used in this paper – is generally not available from official sources, this is done by comparing the 90th/10th percentile ratio for the latest available year and the change in this ratio between the first and the last available year in both sources (Figure 2). Deviations in terms of levels of wage inequality are generally very small, with the correlation between the two data sources being around 0.9. The correlation is somewhat lower in terms of changes (around 0.6), which mainly reflects significant deviations for New Zealand and Sweden. Such deviations could signal differences in samples or wage definitions between the two data sources rather than fundamental disagreement on wage inequality developments. For instance, the European Union Structure of Earnings Survey that underlies the official statistics for European countries in Figure 2 only covers a relatively small sample of workers (generally around 5-10%) as opposed to the universe of workers for most countries covered by LinkEED. Moreover, the European Union Structure of Earnings Survey excludes firms with less than 10 employees as opposed to firms with less than 2 employees in LinkEED.

Figure 2. Comparison of LinkEED with official statistics

Panel A: Level of log(P90/P10), latest year



Panel B: Change in log(P90/P10), from first to latest year



Note: The sample period for the data comparison between LinkEED and official data sources does not necessarily match the sample period in the remainder of the paper, since official data on the 90th/10th percentile ratio are often only available for a shorter sample period. The data comparison could not be conducted for Germany since the 90th/10th percentile ratio was not computed by the German partners of the LinkEED project. The data comparison in changes is not conducted for Portugal, because 2006 is the only common year in the LinkEED and official data. First available year is 1997 for Canada; 2002 for Netherlands, Spain, Sweden, United Kingdom and the United States; 2006 for Estonia, France, Italy, Germany and Norway; and 2008 for Japan. Latest available year is 2006 for Portugal; 2007 for the United States; 2014 for the Estonia, France, Germany, Italy, Japan, Netherlands, Norway, Sweden, and United Kingdom; 2016 for Canada and Spain; 2017 for New Zealand.

[1] For the United States, LinkEED is based on Barth et al (2016[11]).

[2] For Japan, both LinkEED and official statistics are based on full-time workers only.

Source: OECD calculations and official statistics: Federal Reserve Bank of St. Louis (2019[23]; 2019[24]); Statistics Bureau of Japan (2019[25]); OECD Earnings Distribution Database (2019[26]) for Canada and New Zealand; Eurostat Structure of Earnings Survey (2017[27]) for all remaining countries.

21. The resulting dataset (henceforth LinkEED) generally covers the past two decades and is broadly consistent with other national and cross-country data sources in terms of levels and changes in overall wage inequality (Box 2).[15] Deviations in terms of levels of the 90th/10th percentile ratio are generally very small, but there are significant deviations in terms of changes for a number of countries, which may reflect differences in samples or definitions of wages across the two data sources.

4. Key stylised facts on wage inequality between and within firms

22. A number of stylised facts emerge by decomposing aggregate wage inequality developments according to the analytical framework in Figure 1 based on the LinkEED dataset.

4.1. Inequality between firms accounts for a sizeable share of the levels and changes in overall wage inequality

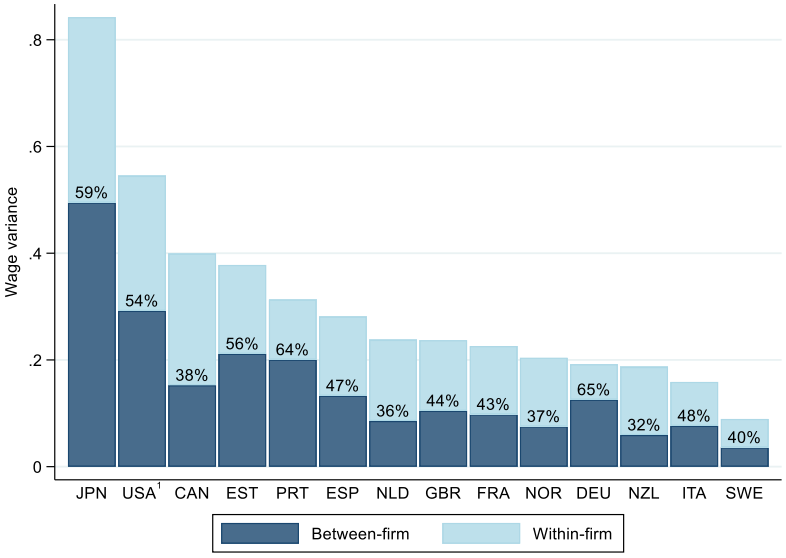
23. On average across countries, the dispersion of average wages between firms accounts for about half of the overall dispersion of wages (Figure 3). While cross-country differences in the *share* of between-firm inequality in overall wage inequality are fairly limited (between 40-60% in most countries), there are large cross-country differences in its overall *extent* (ranging from a variance of 0.05 in Sweden to 0.5 in Japan), suggesting that there may be large cross-country differences in terms of worker sorting and the dispersion of firm wage premia.[16] These may partly reflect cross-country differences in productivity dispersion between firms, but also the extent to which labour market institutions such as collective bargaining influence the sharing of productivity-related rents with workers.

[15] In a number of countries, including Japan and Norway, the sample period is significantly shorter than two decades, implying that overall changes in wage inequality may not be directly comparable across all countries.

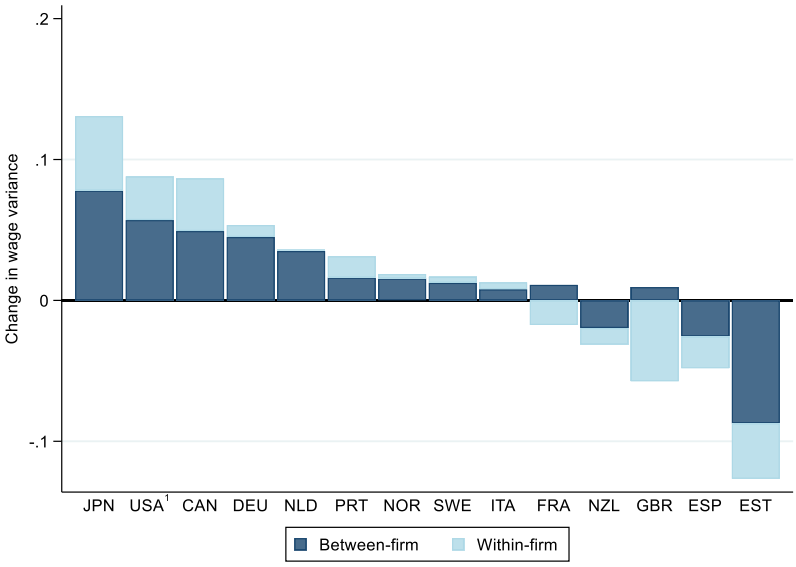
[16] The measurement of wage inequality in Japan is particularly sensitive to the inclusion of part-time workers because their average hourly wages are lower than those of full-time workers. When including all workers, wage inequality is among the highest in the OECD (OECD, 2015[54]; Garnero, Hijzen and Martin, 2019[53]). However, when focusing on full-time workers only, wage inequality in Japan is around the OECD average (Figure B.1).

Figure 3. A significant share of overall wage inequality is between firms

Panel A. *Level* of (log) wage variance, latest available year



Panel B. Change in (log) wage variance, latest year – first year



Note: The total height of the bars in Panel A shows the total variance of log wages, with the percentages on top of the dark-shaded bars denoting the ratio of the between-firm component to the total variance. The net height of the bars in Panel B shows the change in the total variance of log wages, with the dark-shaded component showing the change in the between-firm variance and the light-shaded bar showing the change in the within-firm variance. First year: 1991 for Canada, Italy, Portugal; 1992 for the United States; 1996 for Germany and Spain; 1998 for the United Kingdom; 1999 for Sweden; 2000 for New Zealand; 2001 for Netherlands; 2002 for Estonia and France; 2004 for Norway; 2005 for Japan. Latest available year: 2007 for the United States; 2009 for Portugal; 2013 for Japan; 2014 for Norway; 2015 for France, Italy and Sweden; 2016 for Canada, Germany, Netherlands and Spain; 2017 for New Zealand; 2018 for Estonia and the United Kingdom.
1. Values for the United States are based on Barth et al. (2016[11]).
Source: OECD calculations.

24. The orders of magnitude are broadly in line with those of previous studies, which found that wage dispersion between firms accounts for up to 60% of overall wage inequality. Recent research using cross-country data for European countries estimates that wage dispersion between establishments explains around 60% of aggregate wage inequality (International Labour Organization, 2016[28]). A previous cross-country study covering European countries and the United States found that wage dispersion between firms accounts for around 20-40% of aggregate wage inequality (Lazear and Shaw, 2009[29]).[17]

25. *Changes* in the dispersion of average wages between firms also account for around half of *changes* in overall wage inequality (Figure 3, Panel B).[18] Except for the United Kingdom, where between-firm inequality has increased despite declining overall wage inequality, in most countries changes in between-firm wage inequality have contributed significantly to overall wage inequality developments, highlighting the crucial of role of firms in aggregate wage inequality developments. Large cross-country differences in absolute changes in wage inequality partly reflect large differences in initial levels, with overall wage inequality typically changing by 10-20% over the sample period (Table B.3). However, the fact that the direction of changes differs across countries suggests that changes in between-firm wage inequality most likely also reflect differences in the extent to which policies and institutions shape the impact of global trends, such as globalisation and technological change, on worker sorting and inequality in firm-level productivity and wages.

4.2. Between-firm inequality partly reflects differences in workforce composition

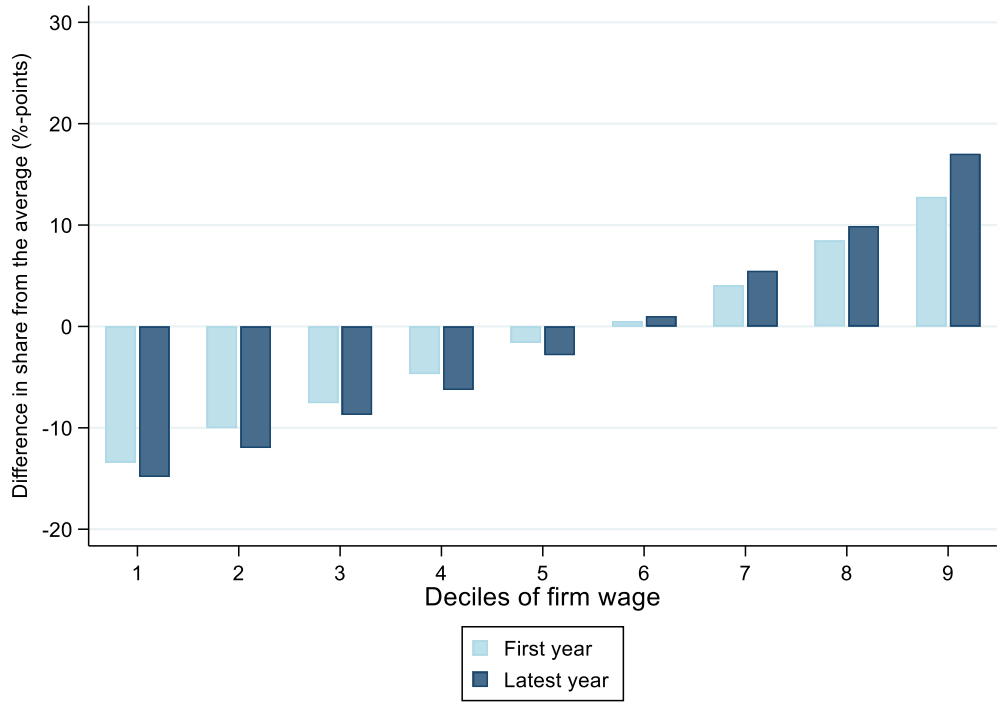
26. Dispersion in average wages between firms partly reflects differences in workforce composition. For instance, high-skilled workers earning high wages may predominantly work in firms that employ other high-skilled workers or pay high wage premia. Defining high-skilled workers based on education or occupation, the evidence suggests that the share of high-skilled workers in high-wage firms is higher than in firms at the bottom of the firm wage distribution (Figure 4). On average across countries, in the last year of the sample, the share of high-skilled workers in firms at the top decile of the firm wage distribution was about 32 percentage points higher than in firms at the bottom decile. Moreover, the difference between the top and the bottom decile was about 8 percentage points higher than in the first year of the sample, suggesting that high-skilled workers increasingly cluster in the same firms as firms get more specialised or better-performing firms pay higher wages to attract better workers. Dispersion in average wages between firms partly also reflects the fact that women tend to work in low-wage firms, although this is less the case than about two decades ago (Box 3).

[17] International Labour Organization (2016[28]) covers a limited sample period (2002-2010) using the European Structure of Earnings Survey data that consists of repeated cross sections of random samples of workers and their establishments. Lazear and Shaw (2009[29]) use national administrative data but do not cover the past two decades (their sample period typically covers 1980-2000).

[18] Consistent with these results, most of the available evidence suggests that changes in wage dispersion between firms account for at least 60-70% of changes in overall wage dispersion (Lazear and Shaw, 2009[29]).

Figure 4. Skill dispersion across firms is large and increasing

Deviations of shares of high skilled employees from average across firm-wage deciles, in %-points



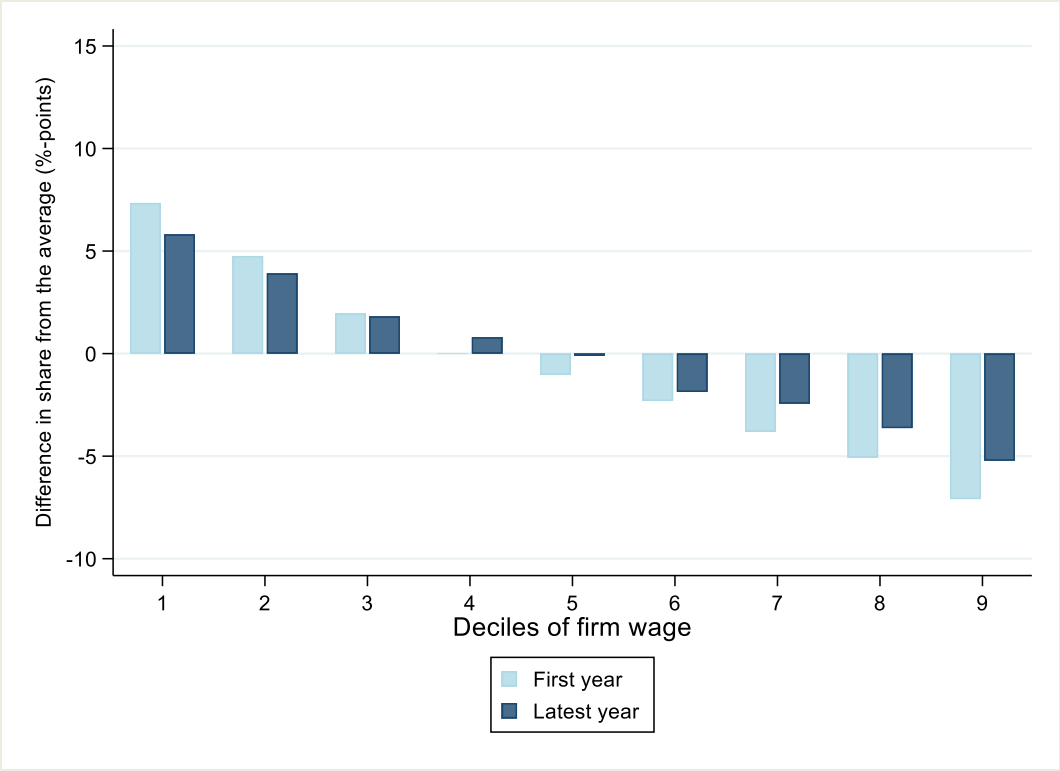
Note: The figure shows the deviations of the share of high-skilled workers from the average share over all deciles in the first and last available years, with high-skilled workers defined based on occupational category or education. For instance, in the last available year, the share of high-skilled workers in the top decile was 17 percentage points above the average, while in the bottom decile it was 15 percentage points below the average. First year: 1991 for Italy; 1995 for Portugal; 1996 for Spain; 1998 for the United Kingdom; 1999 for Sweden; 2001 for Netherlands; 2002 for France, 2004 for Norway; 2005 for Japan. Latest available year: 2009 for Portugal; 2013 for Japan; 2014 for Norway; 2015 for France, Italy and Sweden; 2016 for Netherlands and Spain; 2018 for the United Kingdom.
Source: OECD calculations.

Box 3. Women are increasingly working in high-wage firms

Traditionally, women are much more likely to work in low-wage firms than men (Figure 5). About two decades ago, the share of women in the highest-paying firms (top decile of average wages) was about 15 percentage points lower than in the lowest-paying firms (bottom decile), but the difference has shrunk to about 11 percentage points. This likely reflects rising labour market skills among women, the changing nature of high-pay occupations (e.g. manufacturing versus services), a more supportive institutional environment (e.g. working time flexibility, childcare) and reduced gender discrimination as a result of changing social norms, which has increasingly allowed women to find jobs in higher-paying firms.

Figure 5. Women increasingly work in high-wage firms

Deviations of shares of women from average across firm-wage deciles, in %-points



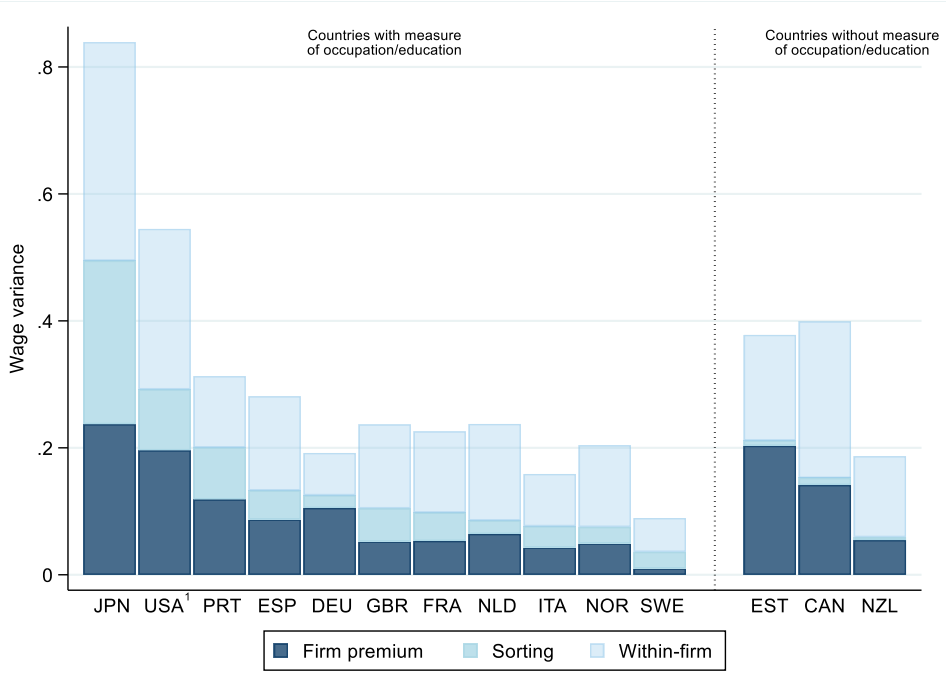
Note: The figure shows the deviations of the share of women from the average share over all deciles in the first and last available years. For instance, in the last available year, the share of women in the top decile was 5 percentage points below the average while in the bottom decile it was 6 percentage points above. First year: 1991 for Italy; 1995 for Portugal; 1996 for Spain; 1998 for the United Kingdom; 1999 for Sweden; 2001 for Netherlands; 2002 for France; 2004 for Norway; 2005 for Japan. Latest available year: 2009 for Portugal; 2013 for Japan; 2014 for Norway; 2015 for France, Italy and Sweden; 2016 for Netherlands and Spain; 2018 for the United Kingdom.
Source: OECD calculations.

5. Distinguishing between firm-wage premia and worker sorting

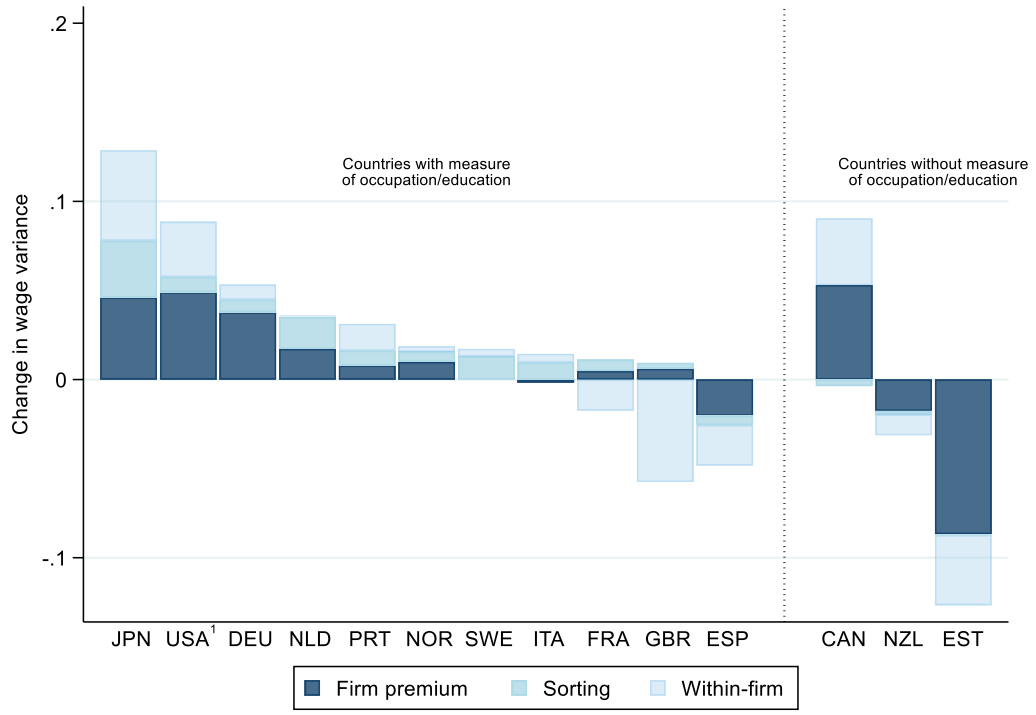
27. The between-firm component of wage inequality can be further decomposed into differences in firm-specific wage premia (due to productivity-related rents) and the sorting of workers into firms paying different average wages. On average across countries, the dispersion of firm wage premia accounts for around two thirds of between-firm wage inequality, both in levels and changes, with worker sorting across firms accounting for around one third (Figure 6). The contribution of firm wage premia to between-firm wage inequality is fairly similar across countries where information on workers' age, gender, occupation and/or education are available. In Canada, Estonia and New Zealand, where only information on age and gender is available, their estimated contribution tends to be larger. In these countries, differences in occupational or educational composition of workers are incorporated into the estimated firm wage premia. Accounting for differences in workforce composition between firms related to unobservable earnings characteristics slightly reduces the contribution of firm-wage premia to the overall *level* of wage dispersion, but has no systematic impact on their contribution to *changes* in overall wage dispersion (Box 4). These results strongly suggest that inequality in average wages between firms does not just reflect differences in workforce composition, but mainly differences in productivity-related rents or the extent to which such rents are shared with workers.

Figure 6. Distinguishing between firm-wage premia and worker sorting

Panel A: Contributions to *levels* of wage dispersion, latest year



Panel B: Contributions to changes in wage dispersion, latest year – first year



Note: The height of the bars in Panel A denotes the level of overall wage inequality in the latest available year, with the shaded parts denoting the contributions of firm premia, sorting and within firm inequality. Panel B shows the changes in overall wage inequality and its components from the first to the latest available year. First available year: 1991 for Canada, Italy, Portugal; 1992 for the United States; 1996 for Germany and Spain; 1998 for the United Kingdom; 1999 for Sweden; 2000 for New Zealand; 2001 for Netherlands; 2002 for Estonia and France; 2004 for Norway; 2005 for Japan. Latest available year: 2007 for the United States; 2009 for Portugal; 2013 for Japan; 2014 for Norway; 2015 for France, Italy and Sweden; 2016 for Canada, Germany, Netherlands and Spain; 2017 for New Zealand; 2018 for Estonia and the United Kingdom.
1. Figures for the United States are based on Barth et al. (2016[11]).
Source: OECD calculations.

Box 4. Accounting for unobservable earnings characteristics

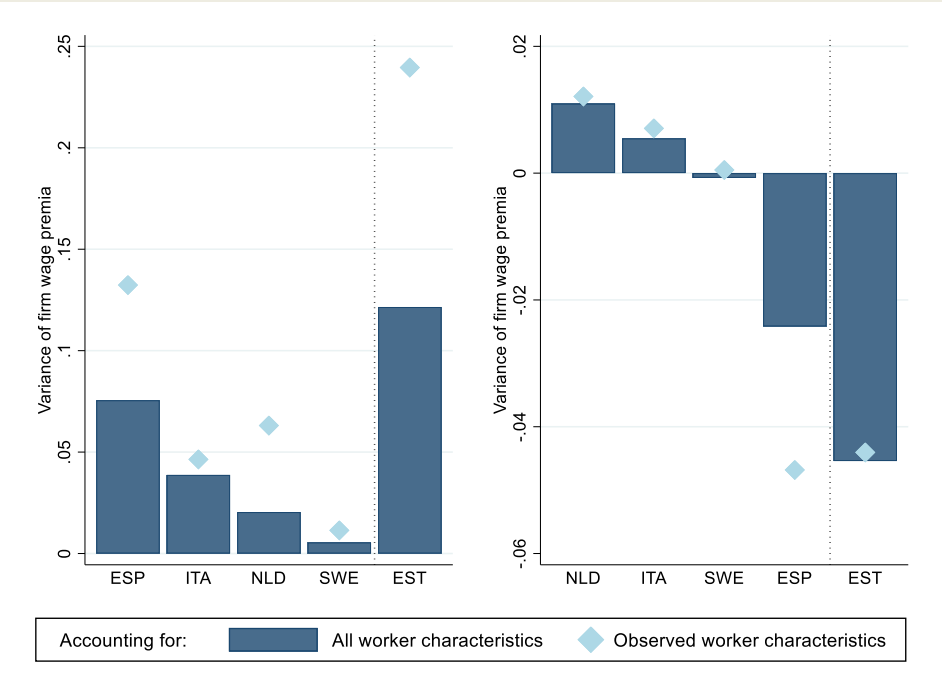
Compositional differences between firms may not only relate to workers' observable earnings characteristics (e.g. age, gender, education and/or occupation) but also unobservable ones (e.g. innate ability or motivation). As a result, the component of wage dispersion associated with firm fixed effects may not just reflect differences in firm wage premia, but also unobservable differences in workforce composition. This box analyses the extent to which accounting for unobserved earnings characteristics affects the estimated contribution of firm-wage premia to the level and change in wage inequality in selected countries.

Accounting for the role of unobservable earnings characteristics for the variance of wages, involves augmenting the human capital earnings equation in Box 1 with a person fixed effect using the method developed by Abowd, Kramarz and Margolis (1999[12]) (henceforth AKM):

$$\ln w_{ijt} = x_{it}\beta + \pi_i + \varphi_j + \theta_t + \varepsilon_{ijt} \qquad (4)$$

where w_{ijt} denotes the wage of worker i in firm j at time t; x_{it} is a vector of observable worker characteristics and β the estimated return to these characteristics; π_i, φ_j and θ_t are person-, firm- and year-fixed effects, respectively; and ε_{ij} is the error term. Since the person fixed effects are identified from worker mobility across firms, equation (4) is estimated over periods of at least five years. The decomposition of the between-firm variance into the components associated with firm-wage premia and sorting is analogous to that described in Box 1.

Figure 7. Contribution of firm-wage premia to variance of wages



Note: The figure shows the contribution of firm-wage premia to overall wage dispersion controlling for observed worker characteristics (baseline) and unobserved worker characteristics (AKM). The left panel focuses on wage

dispersion in levels using data for the entire period (1990- 2017 for Spain; 2001-2018 for Estonia; 1990-2017 for Italy; 2001-2017 for the Netherlands; 2000-2017 for Sweden), whereas the right panel focuses on changes in wage dispersion between the first and the latest period (1990-1994 and 2011-2017 for Spain; 2001-2005 and 2011-2018 for Estonia; 2001-1990-1995 and 2011-2017 for Italy; 2001-2005 and 2011-2017 for the Netherlands; 2000-2005 and 2011-2017 for Sweden).

Accounting for unobservable workforce differences between firms typically reduces the contribution of firm-wage premia to the overall *level* of wage dispersion, but has no systematic impact on the contribution to *changes* in overall wage dispersion (Figure 7). On average, across the countries covered by the analysis, the contribution of firm-wage premia to the level of between-firm wage variance declines by about one third relative to the baseline model. However, the contribution of changes in firm-wage premia dispersion to changes in overall wage dispersion is typically similar when accounting for unobservable workforce differences between firms, even in countries with very limited information on observable worker characteristics such as Estonia. Overall these results suggest that sorting of workers across firms based on unobservable characteristics contributes significantly to the *level* of between-firm wage inequality but only marginally to *changes* in between-firm wage inequality.

5.1. The link between firm-wage premia and productivity

28. Changes in between-firm wage inequality that cannot be accounted for by changes in worker sorting across firms may reflect changes in revenue productivity dispersion or changes in the extent to which productivity-related rents are shared with workers. Changes in revenue productivity dispersion may partly reflect the strengthening of technology and globalisation-related "winner-takes-most" dynamics as network externalities and fixed and quasi-fixed spending on intangible assets increases (Autor et al., 2017[30]; Van Reenen, 2018[31]). They may also reflect changes in the competitive environment that are unrelated to technology and globalisation, such as higher regulatory entry barriers or a weaker enforcement of antitrust policy, or barriers to technology adoption for technologically lagging firms (Berlingieri, Blanchenay and Criscuolo, 2017[2]; Gal et al., 2018[32]).

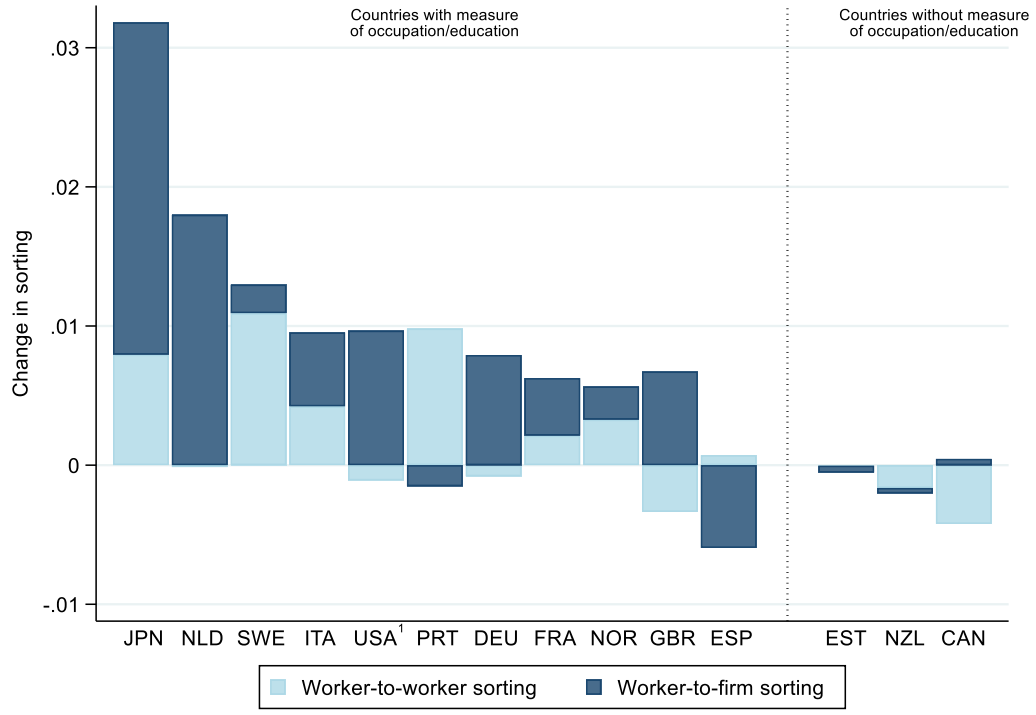
29. Changes in the extent to which rents are shared with workers may amplify between-firm differences in wages originating from revenue productivity if, for instance, firms that make intensive use of skilled and highly specialised workers share a larger part of productivity-related rents with workers in order to attract and retain them than firms that do not require specific skills. In other words, such firms compete more intensively for skilled workers, which strengthens the workers' bargaining position. Indeed, the bargaining position of low-skilled workers has tended to weaken as they tend to be most exposed to the threat of automation, the decentralisation of collective bargaining, weaker employment protection or reduced generosity of unemployment benefits (Alvarez et al., 2018[19]; Coudin, Maillard and To, 2018[33]; Guertzgen, 2009[34]; Ramos, Sanromá and Simón, 2018[35]).

30. Preliminary evidence for a limited subset of countries for which revenue productivity is available in the LinkEED database, suggests that there is a strong link between firm-level productivity and wages, even accounting for the composition of the workforce within the firm. Regressing estimates of firm-wage premia (obtained by estimating equation 1 in Box 1) on measures of firm-level productivity (Table B.4), delivers a simple cross-sectional estimate of the "rent-sharing elasticity", i.e. the extent to which differences in productivity-related rents across firms are shared with workers. On average across the covered countries, the estimated rent-sharing elasticity is around 0.1, suggesting that around 10% of productivity-related rents are shared with workers. This is broadly in line with the central estimate in the literature (Card et al., 2018[36]). These estimates do not take account of common productivity shocks across firms, which tend to be shared more broadly with workers. Indeed, at the country level the rent-sharing elasticity approaches one (Lazear, 2019[37]).

5.2. Dissecting the contribution of sorting to between-firm wage inequality

31. Turning to the role of worker sorting, the evidence suggests that in many countries sorting has also tended to exacerbate between-firm wage inequality and, to a lesser extent, overall wage inequality developments. Moreover, within countries, worker-to-worker sorting and worker-to-firm sorting have often moved in the same direction (Figure 8). Thus, from the perspective of firms, specialisation in tasks with different skill requirements – be it to take advantage of pure gains of specialisation or to limit rent-sharing with low-skilled workers – has increased over time. From the perspective of workers, increases in the dispersion of firm-wage premia may also have raised incentives for sorting into higher-paying firms. Consistent with this hypothesis, Spain, which is the only country that experienced declines in the dispersion of firm-wage premia (in the group of countries with measures of occupation and/or education), experienced a decline in worker-to-firm sorting.

Figure 8. Worker-to-worker and worker-to-firm sorting have often moved together



Note: Start year: 1991 for Canada, Italy, Portugal; 1992 for the United States; 1996 for Germany and Spain; 1998 for the United Kingdom; 1999 for Sweden; 2000 for New Zealand; 2001 for Netherlands; 2002 for France and Estonia; 2004 for Norway; 2005 for Japan. Latest available year: 2007 for the United States; 2009 for Portugal; 2013 for Japan; 2014 for Norway; 2015 for France, Italy and Sweden; 2016 for Canada, Germany, Netherlands and Spain; 2017 for New Zealand; 2018 for Estonia and the United Kingdom.
1. Figures for the United States are based on Barth et al. (2016[11]).
Source: OECD calculations.

32. With increased sorting of workers and more homogenous workforces (in terms of observable earnings characteristics), one would expect a declining contribution of within-firm wage differences to inequality. However, many countries have also experienced widening wage gaps within firms. This is because, on average across the countries covered in this paper, returns to worker skills, which represent

the main part of within-firm difference in wages, have increased by around 6 percentage points.[19] This points to skill shortages due the failure of education systems to keep pace with developments in demand for certain skills by firms (OECD, 2018[38]; OECD, 2019[39]). For instance, digitalisation may have raised the demand for highly skilled engineers by more than the education system can rapidly supply.

6. Next steps and possible implications for public policies

33. The research presented in this paper will be extended in two directions. A first strand of follow-up research will analyse the determinants of the dispersion of firm wage premia, with a particular focus on possible synergies and trade-offs between containing wage inequality and supporting overall productivity growth. A second strand will analyse the determinants of worker sorting across firms, including the role of domestic and international outsourcing.

6.1. Determinants of firm wage premia

34. Gaining a better understanding of the determinants of firm wage premia is crucial to identify public policies that may limit wage inequality, while at the same time supporting productivity growth. An analysis of the LinkEED dataset by country, industry and year allows estimating the role of technological change, globalisation and policies in a standard cross-country-industry panel regression framework, with a particular focus on the role of public policies in shaping the effects of such megatrends. For countries where firm-level productivity is available, the analysis could distinguish between changes originating from productivity dispersion between firms or from changes in the sharing of productivity-related rents between different types of workers (e.g. low-skilled workers versus high-skilled workers) and different types of firms (e.g. high-productivity versus low-productivity firms). Extending the range of countries for which information on firm wage premia can be linked to productivity will therefore be a key priority of the next stages of the project.

35. A number of policies may limit the dispersion of productivity-related wage premia between firms while at the same time supporting aggregate productivity growth. The productivity gap between lagging and leading firms could be reduced by improving the conditions for technology adoption, including by supporting investments in intangible assets and skills that are complementary to new technologies, as well as by allowing for the orderly exit of underperforming firms (Andrews, Nicoletti and Timiliotis, 2018[40]; McGowan and Andrews, 2016[41]; Berlingieri et al., 2019[42]; Bajgar et al., 2019[43]; Bajgar, Criscuolo and Timmis, 2019[44]; Andrews and Saia, 2017[45]; Andrews, Criscuolo and Gal, 2016[1]). Public investment in training and public support to innovation, for instance through public procurement, grants, loans and loan guarantees, also appear to be related to faster catch-up of lagging firms (Berlingieri et al., 2019[42]).

36. At the other end of the productivity distribution, reducing market entry barriers and strengthening the enforcement of competition policy could support productivity growth and limit between-firm wage inequality by containing rents in “superstar” firms that are unrelated to innovation (Bajgar et al., 2019[43]; Gutierrez and Philippon, 2019[46]). Such rents may also be contained by levelling the playing field in terms of tax policies, as the evidence suggests that multinational firms are typically better able to reduce their tax burden through tax optimisation measures than domestic firms (Johansson et al., 2016[47]), and by

[19] The skill premium is defined as the wage gap between high-skilled and low-skilled workers (based on occupation or educational attainment) controlling for other earnings characteristics in equation 1. The estimated increase of 6 percentage points is based on regressing the skill premium on a linear time trend and country fixed effects and using the estimated coefficient on the linear trend to predict the average gaps in 1990 and 2016. The sample for these regressions includes France (2002 to 2015), Italy (1991 to 2015), Japan (2005 to 2013), Netherlands (2001 to 2016), Norway (2004 to 2014), Portugal (1995 to 2009), Spain (1996 to 2016), Sweden (1999 to 2015), and the United Kingdom (1998 to 2018).

improving access to finance for investments in intangible assets, such as intellectual property. This could be particularly important to allow the entry and scaling-up of intangible intensive start-ups (Bajgar, Criscuolo and Timmis, 2019[44]).

37. Some policies that reduce the dispersion of wage premia between firms by containing profits at the top of the productivity distribution may reduce between-firm wage inequality but may have ambiguous effects on overall productivity growth. For instance, less restrictive intellectual property (IP) protection may strengthen competition at the top of the productivity distribution and facilitate market access. At the same time, it may also reduce the expected returns to innovation, with the overall effect on innovation incentives and productivity growth being uncertain. That said, improving some features of the IP system, in particular transparency about ownership and the development of a secondary market for IP assets might be beneficial in allowing entry of new firms in intangible-intensive sectors and their scaling-up via easier access to financing.

38. Labour market policies and collective bargaining institutions influence the extent to which productivity-related rents are shared with workers, but they may also affect the efficiency of resource allocation. The extent of sharing of productivity-related rents may be larger in firms predominantly employing high-skilled workers because of the greater competition between firms for such workers. A broader sharing of productivity gains may be achieved by policies and institutions that promote rent sharing with low-skilled workers, directly, through minimum wage regulations or collective bargaining, or indirectly by strengthening the bargaining position of workers through more generous unemployment benefits or employment protection. However, since differences in firm wage premia promote the sorting of the best workers to firms that can make the best use of their skills, limiting wage dispersion between firms may have adverse effects on the efficiency of resource allocation and ultimately aggregate productivity, unless these policies are accompanied by measures aimed at closing the productivity gap directly.

6.2. Determinants of worker sorting

39. The results in this paper suggest that the sorting of workers across firms accounts for a relatively minor share of changes in overall wage inequality. To some extent, this may reflect offsetting effects of skills-based sorting and sorting based on other earnings characteristics, such as gender or age. This strand of research will analyse skills-based sorting by relating sorting based on education and/or occupation at the country-industry level to measures of domestic and international outsourcing. For firms in the subset of countries where detailed information on workers' occupation is available, measures of domestic outsourcing could be constructed as the share of workers in food, cleaning, security and logistics occupations. Measures of domestic and international outsourcing could be constructed for all countries at the country-industry level using the OECD TiVA database (OECD, 2019[48]).

40. Reducing the sorting of similarly-skilled workers into similar firms may promote more equal wages but may have adverse effects on productivity growth. Such sorting may partly reflect the fact that high-performing workers and firms are complementary in the sense that only the best-managed and most-productive firms may be able to fully use the skills of the best workers and benefit from technological innovation (Andrews, Nicoletti and Timiliotis, 2018[40]). It may partly also reflect the outsourcing of low-skill intensive production stages, resulting in the concentration of low-skilled workers in firms paying low or zero wage premia. Promoting efficiency-enhancing sorting by removing barriers to job mobility while supporting the losers from sorting, for instance through targeted wage subsidies or the mutualisation of training across firms, may be more desirable than foregoing efficiency gains.[20]

[20] Not all types of job mobility contribute to the efficient allocation of workers across firms. For instance, high shares of temporary contracts are generally associated with high job mobility, but do not necessarily result in the efficient allocation of resources across firms.

41. This strand of follow-up research would also include an analysis of the way firms contribute to pay inequalities between men and women, as well as between younger and older workers. The gender wage gap may partly reflect the sorting of women into low-pay and low-productivity firms rather than pay differences between men and women within firms (Card, Cardoso and Kline, 2016[49]). To some extent, such sorting may be explained by the fact that women move less easily to firms that provide better wage and working conditions as a result of family commitments. Public policies that promote the mobility of women across all firms might have a double dividend in the sense that they may reduce the gender wage gap while raising productivity by enhancing the efficient allocation of workers across firms or raising the diversity of the workforce.[21] The sorting of older workers into firms employing predominantly other older workers may partly also reflect between-firm differences in working-time arrangements and raises a similar set of policy issues.

7. Conclusion

42. The results in this paper suggest that productivity developments matter for wage inequality, both directly, by affecting firm-wage premia, and indirectly, by affecting incentives for sorting of workers across firms. Over all, wage inequality developments are determined to a significant extent by firm dynamics rather than being fully explained by inequality in workers' earnings characteristics, such as skills and age. The implication is that a better understanding of the factors driving productivity dispersion between firms, the extent to which productivity-related rents are shared with different types of workers and the link of these developments with worker sorting across firms are crucial to developing public policies that address concerns around inequality.

43. Follow-up research will analyse the drivers of changes in between-firm wage inequality through the lens of the analytical framework developed in this paper, with a particular focus on the role of public policies in shaping the effects of globalisation and technological change. A first strand of follow-up research will analyse the drivers of firm wage premia, including the sharing of productivity-related rents. A second strand will analyse the drivers of worker sorting across firms, including the role of domestic and international outsourcing.

[21] A related new project funded by the Global Forum on Productivity aims to exploit the rich and unique information available in matched employer-employee to look at "the human side of productivity". It aims to provide a better understanding of the firm-internal drivers of productivity growth and productivity divergence by explicitly accounting for the fact that the firm is an organisation that is diverse (in terms of gender, age, nationality) and consists of people with different skills, where managers, owners and boards play an important role.

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Annex A. Details on data

1. In most countries, the LinkEED project uses social security or tax data providing information on the universe of workers, but for a number of European countries only worker- or firm-based random samples are available (Table A.1). Information on firm-level productivity is available only for a subset of countries and information on workers' skills differs widely across countries, with some countries providing no information on workers' education or occupation at all.

Table A.1. Overview of data sources

		Coverage	Employer	Sample structure	Longitudinal	Earnings data	Working time	Worker skills	Productivity data
Canada	Longitudinal Worker Files (LWF)	Salaried and self-employed in administrative tax records: 1989-2016 (current sample period in LinkEED: 1991-2016)	Firm	Universe	Yes	Annual (self-) employment income	No information	No information	No information
Estonia	Data from the Tax and Customs Board Register	All workers (current sample period used in LinkEED: 2002-2018)	Firm	Universe	Yes	Taxable annual income (inc. bonuses)	Number of months	No information	No information
France	Déclaration annuelle des données sociales unifiée (DADS) Panel	Private sector employees 1976-2015 (current sample period used in LinkEED: 2002-2015)	Firm (aggregated from establishment level)	Random worker sample (1/25th before 2002; 1/12th after)	Yes	Annual gross salary	Days worked; and hours from 1993. Part-time coefficient available, but the aggregations used in this paper contain no information	Occupation. Information on education by linking with EDP for subset of workers	Yes, for universe of firms through link with FARE/FICUS
	DADS Postes	Private sector employees 1995-2015		Universe	No (since 2002 workers followed for 2 years)				

		Coverage	Employer	Sample structure	Longitudinal	Earnings data	Working time	Worker skills	Productivity data
Germany	Integrierte Erwerbsbiografien (IEB); augmented with LIAB and Betriebspanel	Private sector employees: 1975-2017 (East Germany from 1993) (current sample period used in LinkEED: 1996-2016)	Establishment	Universe of workers, matched with employer on 31st December	Yes	Taxable payroll earnings. Values right-censored at 6,350 euro/month in West Germany and 5,700 euro/month in East Germany	Days worked. Indicator for part-time work, but the aggregations used in this paper contain no information	Education and Occupation	For subset of firms that can be matched to Betriebspanel (5,000 to 15,000 establishments sampled between 1993 [1996 for East Germany] and 2016) (currently not available in LinkEED)
Italy	Longitudinal Sample social security INPS (LoSai)	All salaried workers, 1985-2015 (current sample period used in LinkEED: 1991-2015)	Firm (social security reporting unit)	1/15th random sample of workers	Yes	Daily pay, censored (645 euro a day full-time in 2012)	Days worked. Part-time indicator and share of full time	Limited measure of occupation	No
Japan	Basic Survey of Wage structure, Basic Survey of Japanese Business Strcture and Activities	Employees working in larger than 50 employee firms and over 10M JPY capital stock (current sample period used in LinkEED: 2005-2013)	Firm, establishment	Sampling prefecture by industry	yes at the establishment level, no at the individual level	Earnings in January, annual bonuses in previous year	Hours worked in June	Years of education	Yes
Netherlands	Baanmerkenbus and Baanpersonenbus, Basisadministratie Persoonsgegevens (GBA), Algemeen Bedrijven Register (ABR) and Hoogsteopltab.	All salaried workers: 1999-2016 (current sample period used in LinkEED: 2001-2016)	Enterprise (bedrijfs-eenheid): More aggregate than establishment	Universe	Yes	Gross taxable wage, including bonuses and subsidies	Hours worked, days worked, Indicator for part-time workers	Education (for about halfthe sample, with sample weights)	Information on productivity for firms with at least 10 workers (currently not available in LinkEED)

		Coverage	Employer	Sample structure	Longitudinal	Earnings data	Working time	Worker skills	Productivity data
New Zealand	Integrated Data Infrastructure (IDI) – Inland Revenue (IR) & Business Register data	Universe, 1999-2017 (monthly) (current sample period used in LinkEED: 2000-2017)	Firm	Universe of employees and self-employed	Yes	Gross monthly earnings	No information	Cross-sectional data from linked Census 2013 on occupation/education	For around 70% of firms. Coverage increasing with firm size (currently not available in LinkEED)
Norway	Earnings data (Tax Register), augmented with employment history (National Education database)	All workers in tax records, 2004-2014 (current sample period used in LinkEED: 2004-2014)	Firm	Universe	Yes	Total annual earnings	Days worked per year, hours worked per week, indicator for part time	Education and Occupation	For a subset of firms (currently not available in LinkEED)
Portugal	Quadros de Pessoal	Private sector employees, 1991-2009 (current sample period used in LinkEED: 1991-2009)	Firm	Universe	Yes	Earnings in the reference month (generally October)	Hours worked. Part-time indicator	Education, occupation and job title	Sales
Spain	Muestra Continua de Vidas Laborales con Datos Fiscales (MCVL-CDF)	Everyone affiliated to general social security system, 1980-2016 (current sample period used in LinkEED: 1996-2016)	Establishment and firm	Random 4% sample of people	Yes, including retro-spectively from 1980	Annual earnings (1980-2016). Capped around 10% at top and bottom	Hours worked. Indicator for part-time and coefficient, but the aggregations used in this paper contain no information	Education and occupation	No
Sweden	SES	All employees employed in November, 1997-2014 (current sample period used in LinkEED: 1999-2015)	Firm and establishment	100% of the public sector; stratified sample covering 50% of all private sector firms	Yes (if they remain in the same firm)	Annual earnings	Hours worked	Education if trained in Sweden	Yes, for all private sector firms (currently not available in LinkEED)

		Coverage	Employer	Sample structure	Longitudinal	Earnings data	Working time	Worker skills	Productivity data
United Kingdom	Annual Survey of Hours and Earnings (ASHE)	1998-2018 (current sample period used in LinkEED: 1998-2018)	Firm	1% random sample of national insurance records	Yes	Weekly baseline pay; overtime pay and incentive pay	Basic hours and total hours	Occupation	No

Note: Where multiple databases are indicated in a single row (e.g. New Zealand), the paper matches all the databases in the row and uses this matched database throughout the paper. In France, there are two databases indicated in separate rows: DADS Postes is used throughout the paper, except in column 2 of Table B.1, where DADS Panel is used. Results for the United States are based on Barth et al (2016[11]).

Annex B. Supporting technical material

B.1. Small-sample bias correction

2. As mentioned in Section 3, the within-firm variance can be under-estimated if only a small sample of workers in a firm is observed as the firm-level average wage is estimated with error. The paper uses a corrected decomposition used by Hakanson, Lindqvist & Vlachos (2015[14]) as shown in the equation below, where *y* indicates earnings for person *i* in firm *j*, *n* indicates the sample size and *N* indicates the actual firm size[22]. The first term on the right-hand side, shows the within-firm variance with a correction factor which disappears if all workers in the firm are observed (N_{jt}= n_{jt}). The second term shows the between-firm variance.

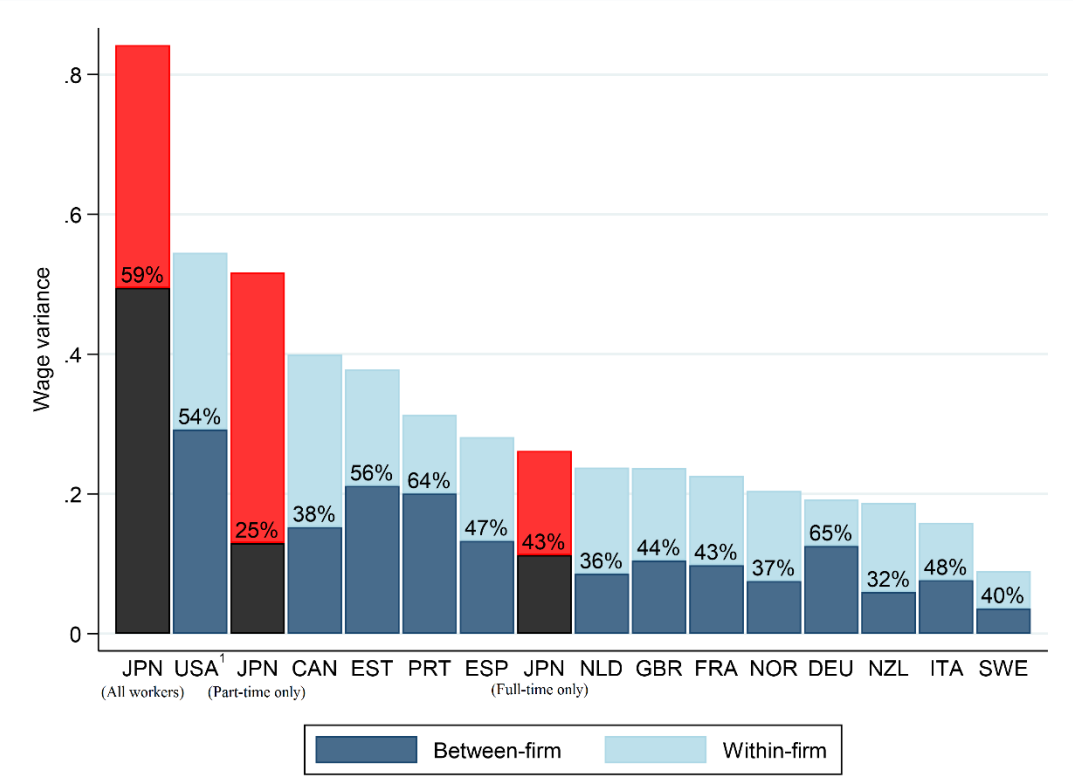
$$\frac{1}{n}\sum_{j}\sum_{i}(y_{ij}-\bar{y})^2 = \frac{1}{n}\sum_{j} n_j\left(\frac{N_j-1}{N_j}\right)\left(\frac{1}{n_j-1}\right)\sum_{i}\left(y_{ij}-\bar{y_j}\right)^2 + \frac{1}{n}\sum_{j} n_j\left[\left(y_j-\bar{y}\right)^2-\left(\frac{N_j-n_j}{N_j n_j}\right)\left(\frac{1}{n_j-1}\right)\sum_{i}\left(y_{ij}-\bar{y_j}\right)^2\right]$$

B.2. Treatment of part-time workers in Japan

3. In Japan, distinguishing between full-time workers and part-time workers suggests that the high wage variance for all workers shown in Figure 3, (Panel A) partly reflects large wage differences between full-time and part-time workers (Figure B.1). When focusing on full-time workers only, the variance of wages decreases by more than half.

[22] If the actual firm size is not known, it can be approximated by multiplying the observed firm size with the sampling fraction or by using the information on firm size category.

Figure B.1. Level of (log) wage variance, latest available year



Note: First year: 1991 for Canada, Italy, Portugal; 1992 for the United States; 1996 for Germany and Spain; 1998 for the United Kingdom; 1999 for Sweden; 2000 for New Zealand; 2001 for Netherlands; 2002 for France and Estonia; 2004 for Norway; 2005 for Japan. Latest available year: 2007 for the United States, 2009 for Portugal; 2013 for Japan; 2014 for Norway; 2015 for France, Italy and Sweden; 2016 for Canada, Germany, Netherlands and Spain; 2017 for New Zealand; 2018 for the Estonia and the United Kingdom.
1: Figures for the United States are based on Barth et al. (2016[11]).
Source: OECD calculations.

B.3. Comparison with an alternative sorting measure

4. Table B.1 compares the sorting measure of Barth et al. (2016[11]) based on observable earnings characteristics (denoted by ρ_y in Box 1) and of Borovičková and Shimer (2017[13]) based on residual wages (the residual from regressing worker-level wages on workers' earnings characteristics). Barth et al.'s (2016[11]) sorting measure corresponds to the correlation between workers' predicted wages based on observable earnings characteristics with the average firm-level wages.[23] Borovičková and Shimer's (2017[13]) sorting measure corresponds to the correlation of workers' residual wages (averaged over job spells in other firms) with the average wage of co-workers (leaving the worker herself out of the calculation of the firm average).

[23] This corresponds to $\frac{cov(\hat{s},\hat{S})+cov(\hat{s},\hat{y})}{\sqrt{V(\hat{y})+V(\hat{S})+2cov(\hat{s},\hat{y})}*\sqrt{V(\hat{S})}}$.

Table B.1. Comparison of sorting measures

	Sorting on average firm-level wage (Barth et al., 2016[3])	**Sorting on residual wages** (Borovičková and Shimer, 2017[4])
Canada	0.13	0.50
Estonia	0.14	0.51
Italy	0.47	0.38
Netherlands	0.39	0.31
Portugal	0.44	0.63
Spain	0.38	0.43
Sweden	0.51	0.42

Note: The measures are based on the period 2011-2017 for Canada, Estonia, Italy and Spain and 2004-2010 for Netherlands, Portugal and Sweden.
Source: OECD calculations.

B.4. Variables used in country-specific wage regressions

5. Table B.2 shows the variables available for the country-specific regressions to compute the variance decomposition described in Box 1. All countries have information on age and gender, and most have information on either education or occupation to proxy workers' skills.

Table B.2. Observable variables by country

	Age	Gender	Education	Occupation	Part time
Canada	✓	✓			
Estonia	✓	✓			
France	✓	✓		✓	
Germany	✓	✓	✓	✓	
Italy	✓	✓		✓	✓
Japan	✓	✓	✓		
Netherlands	✓	✓	✓		✓
New Zealand	✓	✓			
Norway	✓	✓	✓	✓	✓
Portugal	✓	✓	✓	✓	
Spain	✓	✓	✓	✓	✓
Sweden	✓	✓	✓	✓	✓
United Kingdom	✓	✓		✓	✓

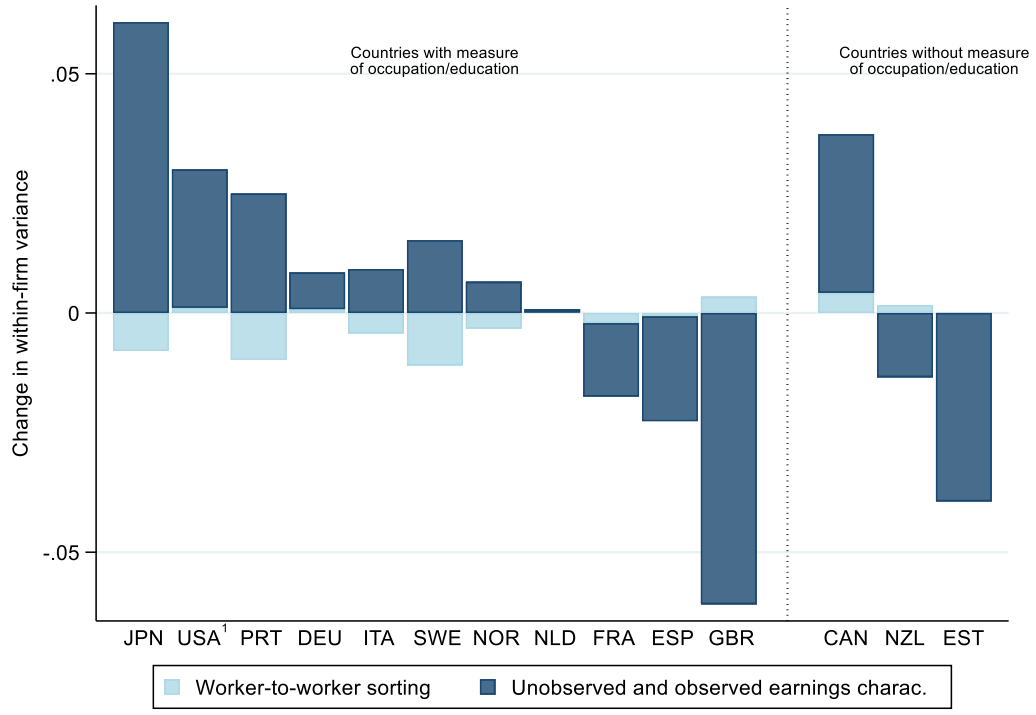
	Age	Gender	Education	Occupation	Part time
Canada	✓	✓			
Estonia	✓	✓			
France	✓	✓		✓	
Germany	✓	✓	✓	✓	
Italy	✓	✓		✓	✓
Japan	✓	✓	✓		
Netherlands	✓	✓	✓		✓
New Zealand	✓	✓			
Norway	✓	✓	✓	✓	✓
Portugal	✓	✓	✓	✓	
Spain	✓	✓	✓	✓	✓
Sweden	✓	✓	✓	✓	✓
United Kingdom	✓	✓		✓	✓

Note: The table shows the workers' earnings characteristics that are available to compute the variance decomposition described in Figure B.2. Sample period: Canada from 1991 to 2016; in Estonia from 2002 to 2018; in France 2002 to 2015; in Germany 1996 to 2016; in Italy from 1991 to 2015; in Japan from 2005 to 2013; in Netherlands from 2001 to 2016; in New Zealand from 2000 to 2017; in Norway from 2004 to 2014; in Portugal from 1995 to 2009; in Spain from 1996 to 2016; Sweden from 1999 to 2015; and in the United Kingdom from 1998 to 2018.
Source: OECD calculations.

B.5. Decomposition of the within-firm variance

6. The within-firm variance can be decomposed into three elements: the variance of workers' predicted wages ($V(\hat{s})$), the variance of returns to unobserved earnings characteristics ($V(\hat{\varepsilon})$), and the covariance of workers' predicted wages with the average predicted wage in their firms($V(\hat{s})\rho$ (Figure B.2).

Figure B.2. Change in within-firm variance



Note: First year: 1991 for Canada, Italy, Portugal; 1992 for the United States; 1996 for Germany and Spain; 1998 for the United Kingdom; 1999 for Sweden; 2000 for New Zealand; 2001 for Netherlands; 2002 for France and Estonia; 2004 for Norway; 2005 for Japan. Latest available year: 2007 for the United States, 2009 for Portugal; 2013 for Japan; 2014 for Norway; 2015 for France, Italy and Sweden; 2016 for Canada, Germany, Netherlands and Spain; 2017 for New Zealand; 2018 for the Estonia and the United Kingdom.
[1]: Figures for the United States are based on Barth et al. (2016[11]).
Source: OECD calculations.

B.6. Variance decomposition country-by-country

7. The full decomposition of the overall variance of wages in levels and changes described in Box 1 is reported in Table B.3.

Table B.3. Decomposition of wage variance into firm and worker characteristics

Countries with measure of occupation/education					
		First year	Latest year	Change	Change (% of first year)
France	**Total variance**	0.232	0.226	-0.006	-2.6
	Within	0.145	0.128	-0.017	-11.7
	Observed and unobserved earnings char.	0.160	0.145	-0.015	-17.4
	Worker-to-worker sorting	-0.015	-0.017	-0.002	-31.1
	Between	0.087	0.098	0.011	12.6
	Firm premium	0.048	0.053	0.005	10.4
	Sorting	0.039	0.045	0.006	15.4
	Worker-to-worker sorting	0.015	0.017	0.002	13.3
	Worker-to-firm sorting	0.024	0.028	0.004	16.7
Germany	**Total variance**	0.138	0.192	0.054	38.9
	Within	0.058	0.066	0.008	18.9
	Observed and unobserved earnings char.	0.062	0.070	0.008	15.8
	Worker-to-worker sorting	-0.004	-0.003	0.001	-24.2
	Between	0.081	0.126	0.045	53.3
	Firm premium	0.068	0.105	0.037	53.3
	Sorting	0.013	0.020	0.007	52.1
	Worker-to-worker sorting	0.004	0.003	-0.001	-20.5
	Worker-to-firm sorting	0.009	0.017	0.008	86.3
Italy	**Total variance**	0.146	0.159	0.013	8.9
	Within	0.077	0.082	0.005	6.5
	Observed and unobserved earnings char.	0.088	0.097	0.009	10.2
	Worker-to-worker sorting	-0.011	-0.015	-0.004	36.4
	Between	0.069	0.077	0.008	11.6
	Firm premium	0.045	0.043	-0.002	-4.4
	Sorting	0.024	0.034	0.010	41.7
	Worker-to-worker sorting	0.011	0.015	0.004	36.4
	Worker-to-firm sorting	0.013	0.018	0.005	38.5
Japan	**Total variance**	0.712	0.842	0.131	18.4
	Within	0.295	0.347	0.053	18.0
	Observed and unobserved earnings char.	0.396	0.457	0.061	15.4
	Worker-to-worker sorting	-0.101	-0.109	-0.008	7.9
	Between	0.417	0.495	0.078	18.7
	Firm premium	0.191	0.237	0.046	24.1
	Sorting	0.226	0.258	0.032	14.2
	Worker-to-worker sorting	0.101	0.109	0.008	7.9
	Worker-to-firm sorting	0.124	0.148	0.024	19.4
Netherlands	**Total variance**	0.202	0.238	0.036	17.8
	Within	0.151	0.152	0.001	0.7
	Observed and unobserved earnings char.	0.158	0.158	0.001	0.6
	Worker-to-worker sorting	-0.006	-0.006	0.000	0.0
	Between	0.051	0.086	0.035	68.6
	Firm premium	0.047	0.064	0.017	36.2
	Sorting	0.003	0.021	0.018	600.0
	Worker-to-worker sorting	0.006	0.006	0.000	0.0
	Worker-to-firm sorting	-0.003	0.015	0.018	-600.0

		First year	Latest year	Change	Change (% of first year)
Norway	**Total variance**	0.186	0.204	0.019	10.2
	Within	0.126	0.129	0.003	2.4
	Observed and unobserved earnings char.	0.136	0.143	0.006	4.4
	Worker-to-worker sorting	-0.011	-0.014	-0.003	27.3
	Between	0.060	0.075	0.016	26.7
	Firm premium	0.039	0.049	0.010	25.6
	Sorting	0.020	0.026	0.006	30.0
	Worker-to-worker sorting	0.011	0.014	0.003	27.3
	Worker-to-firm sorting	0.010	0.012	0.002	20.0
Portugal	**Total variance**	0.282	0.313	0.031	11.0
	Within	0.097	0.112	0.015	15.5
	Observed and unobserved earnings char.	0.119	0.144	0.025	21.0
	Worker-to-worker sorting	-0.022	-0.032	-0.010	45.5
	Between	0.184	0.200	0.016	8.7
	Firm premium	0.111	0.119	0.008	7.2
	Sorting	0.073	0.082	0.008	11.0
	Worker-to-worker sorting	0.022	0.032	0.010	45.5
	Worker-to-firm sorting	0.051	0.050	-0.002	-3.9
Spain	**Total variance**	0.330	0.281	-0.048	-14.6
	Within	0.171	0.148	-0.023	-13.2
	Observed and unobserved earnings char.	0.193	0.171	-0.022	-13.7
	Worker-to-worker sorting	-0.022	-0.022	-0.001	-16.2
	Between	0.158	0.133	-0.026	-16.1
	Firm premium	0.107	0.087	-0.020	-19.0
	Sorting	0.051	0.046	-0.005	-10.2
	Worker-to-worker sorting	0.022	0.022	0.001	3.3
	Worker-to-firm sorting	0.029	0.023	-0.006	-20.3
Sweden	**Total variance**	0.073	0.089	0.017	23.3
	Within	0.049	0.053	0.004	8.2
	Observed and unobserved earnings char.	0.055	0.070	0.015	27.3
	Worker-to-worker sorting	-0.006	-0.017	-0.011	183.3
	Between	0.024	0.036	0.012	50.0
	Firm premium	0.011	0.010	-0.001	-9.1
	Sorting	0.013	0.026	0.013	100.0
	Worker-to-worker sorting	0.006	0.017	0.011	183.3
	Worker-to-firm sorting	0.007	0.009	0.002	28.6
United Kingdom	**Total variance**	0.285	0.237	-0.048	-16.8
	Within	0.190	0.132	-0.057	-30.0
	Observed and unobserved earnings char.	0.214	0.153	-0.061	-28.5
	Worker-to-worker sorting	-0.024	-0.021	0.003	-12.5
	Between	0.095	0.105	0.009	9.5
	Firm premium	0.046	0.052	0.006	13.0
	Sorting	0.049	0.052	0.003	6.1
	Worker-to-worker sorting	0.024	0.021	-0.003	-12.5
	Worker-to-firm sorting	0.025	0.031	0.007	28.0
United States[1]	**Total variance**	0.457	0.545	0.088	19.3
	Within	0.223	0.253	0.030	13.5
	Observed and unobserved earnings char.	0.260	0.289	0.029	11.2
	Worker-to-worker sorting	-0.037	-0.036	0.001	-2.7
	Between	0.235	0.292	0.057	24.3
	Firm premium	0.147	0.196	0.049	33.3
	Sorting	0.087	0.096	0.009	10.3
	Worker-to-worker sorting	0.037	0.036	-0.001	-2.7
	Worker-to-firm sorting	0.050	0.060	0.010	20.0

Countries without measure of occupation/education					
		First year	Latest year	Change	Change (% of first year)
Canada	**Total variance**	0.313	0.399	0.087	27.8
	Within	0.209	0.247	0.037	17.7
	Observed and unobserved worker. char.	0.219	0.252	0.033	15.1
	Worker-to-worker sorting	-0.009	-0.005	0.004	-44.4
	Between	0.103	0.153	0.049	47.6
	Firm premium	0.088	0.141	0.053	60.2
	Sorting	0.015	0.011	-0.004	-26.7
	Worker-to-worker sorting	0.009	0.005	-0.004	-44.4
	Worker-to-firm sorting	0.006	0.006	0.000	0.0
Estonia	**Total variance**	0.505	0.378	-0.127	-25.1
	Within	0.206	0.167	-0.039	-18.9
	Observed and unobserved worker. char.	0.21	0.171	-0.039	-18.6
	Worker-to-worker sorting	-0.004	-0.004	0.000	0.0
	Between	0.299	0.211	-0.087	-29.1
	Firm premium	0.29	0.203	-0.087	-30.0
	Sorting	0.009	0.008	-0.001	-11.1
	Worker-to-worker sorting	0.004	0.004	0.000	0.0
	Worker-to-firm sorting	0.005	0.004	-0.001	-20.0
New Zealand	**Total variance**	0.218	0.187	-0.031	-14.2
	Within	0.139	0.128	-0.012	-8.6
	Observed and unobserved worker. char.	0.145	0.131	-0.013	-9.0
	Worker-to-worker sorting	-0.005	-0.004	0.002	-40.0
	Between	0.079	0.059	-0.020	-25.3
	Firm premium	0.072	0.055	-0.018	-25.0
	Sorting	0.007	0.005	-0.002	-28.6
	Worker-to-worker sorting	0.005	0.004	-0.002	-40.0
	Worker-to-firm sorting	0.001	0.001	0.000	0.0

Note: First year: 1991 for Canada, Italy, Portugal; 1992 for the United States; 1996 for Germany and Spain; 1998 for the United Kingdom; 1999 for Sweden; 2000 for New Zealand; 2001 for Netherlands; 2002 for France and Estonia; 2004 for Norway; 2005 for Japan. Latest year: 2007 for the United States, 2009 for Portugal; 2013 for Japan; 2014 for Norway; 2015 for France, Italy and Sweden; 2016 for Canada, Germany, Netherlands and Spain; 2017 for New Zealand; 2018 for the Estonia and the United Kingdom.

1. Numbers for the United States are based on Barth et al (2016[11]).

Source: OECD calculations.

B.7. Rent-sharing (preliminary)

8. The extent of sharing of productivity-related rents with workers is estimated based the following equation:

$$\hat{\gamma}_j = \alpha + \beta \log\left(\text{productivity}_j\right) + \varepsilon_j$$

where $\hat{\gamma}_j$ is the estimated firm premium from equation 1, α is the intercept and productivity is measured as sales per worker. β measures the elasticity of the firm wage premium with respect to productivity, which can be interpreted as a simple cross-sectional estimate of the rent-sharing elasticity. The equation is estimated separately for each country in each year. The results suggest that the elasticity is around 0.1. Thus, on average across the covered countries, about 10% of productivity-related rents are shared with workers.

Table B.4. Sharing of productivity-related rents by country

Elasticity of wages with respect to productivity

	2005	Latest year
France	0.07***	0.08***
	(0.00)	(0.00)
Japan	0.13***	0.12***
	(0.00)	(0.00)
Portugal	0.08***	0.08***
	(0.00)	(0.00)

Note: Latest year: 2015 for France, 2013 for Japan, and 2009 for Portugal.
Source: OECD calculations.

Annex C. Disclaimers and data references

Japan

Ryo Kambayashi, Satoshi Tanaka, and Shintaro Yamaguchi, "Report of Changes in Wage Inequality Between and Within-Firm: Evidence from Japan 1993-2013," (9th Sep. 2019), mimeograph.

New Zealand

The results in this paper are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI), managed by Stats NZ. The opinions, findings, recommendations, and conclusions expressed in this paper are those of the author(s), not Stats NZ. Access to the anonymised data used in this study was provided by Stats NZ under the security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular person, household, business, or organisation, and the results in this paper have been confidentialised to protect these groups from identification and to keep their data safe. Careful consideration has been given to the privacy, security, and confidentiality issues associated with using administrative and survey data in the IDI. Further detail can be found in the Privacy impact assessment for the Integrated Data Infrastructure available from http://www.stats.govt.nz/. The results are based in part on tax data supplied by Inland Revenue to Stats NZ under the Tax Administration Act 1994. This tax data must be used only for statistical purposes, and no individual information may be published or disclosed in any other form, or provided to Inland Revenue for administrative or regulatory purposes. Any person who has had access to the unit record data has certified that they have been shown, have read, and have understood section 81 of the Tax Administration Act 1994, which relates to secrecy. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements.

Norway

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United Kingdom

Office for National Statistics (2018). Annual Survey of Hours and Earnings, 1997-2018: Secure Access. 13th Edition. UK Data Service. SN: 6689, http://doi.org/10.5255/UKDA-SN-6689-12

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