Worker skills or firm wage-setting practices? Decomposing wage inequality across 20 OECD countries

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ABSTRACT

What drives differences in pay between firms? To answer this question, we build a harmonised cross-country linked employer-employee data set to analyse the role of firms in wage inequality in 20 OECD countries since the 2000s. The main finding is that, on average across countries, differences in wages between firms explain about half of overall wage inequality, whether measured in levels or in changes. The analysis reveals that differences in wage-setting practices across firms, as opposed to differences in average worker skills across firms, drive about two-thirds of the change in between-firm wage inequality during the period. Descriptive evidence suggests that firms have a greater impact on wage setting in countries with decentralised collective bargaining systems and lower levels of job mobility. *JEL codes:* D2, J31, J38.

Keywords: Wage inequality, Wage policies of a firm, Productivity, Labor market institutions, Linked employer-employee data

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Delivering broadly-shared economic growth has become more challenging in many countries, as productivity growth has slowed in a context of high or rising wage inequality. Designing better policies for broadly-shared growth requires an understanding of the mechanisms through which firms affect not only aggregate productivity but also inequality. Indeed, firms may not only determine the distribution of market income between capital and labour (e.g. Autor et al. (2020[1]), Kehrig and Vincent (2019[2]) and Schwellnus et al. (2018[3])), but also drive the distribution of labour income between workers, i.e. wage inequality, due to differences in pay policies between firms (e.g. Barth et al. (2016[4]; 2018[5]) and Song et al. (2019[6])). However, there is a lack of evidence on the contribution of firm wage-setting practices to wage inequality in different countries. Does the role of firms vary across countries, and why?

We provide answers to these questions by building a linked employer-employee dataset covering 20 OECD countries from the 2000s. The dataset is unique in several ways. First, the construction is based on a strict harmonisation protocol to ensure cross-country comparability, while the analysis is carried out in a decentralised approach to preserve data confidentiality and comply with the different data access requirements in each country. In most countries, our data consists of the universe or a large representative sample of workers in private-sector firms, among which there is plausibly a meaningful difference in pay practices. We measure inequality in total earnings during an average month in the year, using a harmonised data construction and treatment protocol, and link each worker to the firm that employs them. Second, it is panel data, which allows using econometric methods to account for worker and firm heterogeneity. Third, the data cover a broad range of countries that differ significantly in their public policies and institutions, as well as their inequality levels and trends. In total, in any given year, the sample covers about 26 million workers and 2 million firms spread across 15 European countries (Austria, Denmark, Estonia, France, Germany, Hungary, Italy, Finland, Netherlands, Norway, Portugal, the Slovak Republic, Spain, Sweden, United Kingdom) and 5 countries from the

Americas and the Asia-Pacific region (Canada, Costa Rica, Japan, New Zealand, and the United States).

Along with this unique data set, this paper makes three contributions. First, we document the levels and evolution of wage inequality between and within firms for countries across a diverse range of countries with distinct inequality dynamics and institutional frameworks. Until recently, linked employer-employee data were mostly used in a single-country context. This paper joins a small but growing literature (Hijzen et al., 2013[7]; Avent-Holt et al., 2020[8]; Busch et al., 2022[9]; Guvenen, Pistaferri and Violante, 2022[10]; Bertheau et al., 2023[11]) which analyses administrative employment and wage data across countries. Two notable cross-country studies that examine wage decompositions within and between firm are Lazear and Shaw (2009[12]) and Tomaskovic-Devey et al. (2020[13]). While Lazear and Shaw (2009[12]) focus on an earlier period and can online provide limited harmonisation, Tomaskovic-Devey et al. (2020[9]) analyse a similar period, building harmonised data that covers 9 out of 20 countries in this paper, and 5 additional countries. They show that between workplaces, inequalities are growing in 85% of countries and stable in others, a finding that does not extend to our sample. Importantly, both studies provide a limited exploration of the role workforce composition plays in shaping between-firm inequality.

The second contribution of this paper is to assess whether between-firm wage inequality is driven by workforce composition or by firm wage-setting practices. Disentangling these components is methodologically challenging but crucial for understanding the role of firms. Returns to skills have increased on the labor market in the last decades (Acemoglu and Autor, 2011[14]; Chinhui, Murphy and Pierce, 1993[15]) and may account for a significant share of observed wage disparities between firms, particularly due to the sorting of skilled workers into the same firms (Card et al., 2018[16]). But more importantly this decomposition also has critical normative implications, as differences in workforce composition and firm wage-setting practices require distinct policy approaches to reduce inequality. This study is the first to carry such a decomposition in a cross-country context, but it builds on a substantial body of research focused on single countries (Song

et al., 2019[6]; Barth et al., 2016[4]; Borovičková et al., 2020[17]; Card, Heining and Kline, 2013[18]; Macis and Schivardi, 2016[19]; Card, Cardoso and Kline, 2016[20]; Skans, Edin and Holmlund, 2009[21]). Unlike most of these papers, which primarily examine countries experiencing rising wage inequality, the present paper also includes countries with declining inequality trends. This broader coverage allows us to explore whether firm wage-setting practices play a similar role in both increasing and decreasing inequality contexts. Last, the paper also discusses the role of unobserved worker characteristics and their importance in quantifying the role of firm wage-setting practices.

Third, leveraging our broad country coverage, the analysis provides suggestive evidence on how structural factors and institutional settings shape firm wage-setting practices. Public policies and institutions can drive wage inequalities across firms by influencing the dispersion of firm productivity, enabling more productive firms to offer higher wages to their workers. But policies and institutions may also shape the transmission of productivity to firm wage-setting practices at a given level of productivity dispersion, either by affecting the degree of friction in the labour market or by institutionally limiting firms' wage-setting flexibility. To explore this, the paper examines the relationship between wage-setting practices, job mobility, and collective bargaining systems across the countries in the sample.

1. Econometric framework

Decomposing wage dispersion between and within firms

Wage inequality is measured as the total variance of logarithmic monthly wages, which is additively decomposable, scale-independent and more comprehensive than alternative inequality measures, such as the $90^{th}/10^{th}$ percentile ratio. The total variance of wages can be decomposed into the variance of average wages between firms and the variance of individual wages within firms

$$V(w_{ij}) = V(\overline{w}_j) + V(w_i - \overline{w}_j)$$

$$V^{total} = V^{between} + V^{within} \quad (1)$$

where w_i denotes the logarithmic wage of worker *i* in firm *j* and $\overline{w}_j$ the average logarithmic wage in firm *j*. To disentangle the role of wage premia and workforce composition for between-firm wage dispersion, we first estimate firm wage premia and then decompose the between-firm variance of wages into a component due to differences in firms' wage premia and one due to differences in workforce composition across firms.

Estimating firm wage premia

In the baseline specification, covering all countries, firm wage premia are estimated conditional on observable worker characteristics, using a traditional human capital earnings equation augmented with firm fixed effects as in the paper by Barth, Bryson, Davis and Freeman (2016[4]) (BBDF hereinafter) :

$$w_{ijt} = \sum_k x_{k,it}\beta_k + \gamma_j + \theta_t + \varepsilon_{ijt} \quad (2)$$

where w_{ijt} denotes the logarithmic wage of worker *i* in firm *j* in year *t*; $x_{k,it}$ denotes a set of observable worker characteristics k; β_k denotes the estimated return to these characteristics; γ_j denotes estimated firm fixed effects, θ_t is a time fixed effect, and ε_{ijt} 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 A.2 for the list of variables included in the empirical model by country). Equation 2 is estimated year by year. In a robustness check, for a subset of countries, firm wage premia are estimated controlling for observable and unobservable worker characteristics using the AKM model (Abowd, Kramarz and Margolis, 1999[22]).

Decomposing between-firm wage dispersion

Following BBDF, the total variance of w_{ijt} can be written as follows:

$$V^{total} = V(\hat{s}) + V(\hat{\gamma}) + 2cov(\hat{s}, \hat{\gamma}) + V(\hat{\varepsilon}) \qquad (3)$$

where $V(\hat{s})$ is the variance of predicted wages based on workers' observable characteristics; $V(\hat{\gamma})$ is the variance of estimated 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 w_i can be re-written as:

$$V^{total} = \underbrace{\left[V(\hat{s})\rho + 2V(\hat{s})\rho_\gamma + V(\hat{\gamma})\right]}_{} + \underbrace{\left[V(\hat{s}) + V(\hat{\varepsilon}) - V(\hat{s})\rho\right]}_{} \qquad (4)$$

$$= \qquad V^{between} \qquad + \qquad V^{within}$$

where ρ_γ is the correlation of workers' predicted wages 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).

Equation 4 shows that the between-firm variance can 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 contribution of the firm-wage premia variance to overall wage inequality obtained from equation 2 represents a possible upper-bound estimate of its true contribution, since it may in part capture unobservable worker characteristics. At the same time, the estimated contribution of sorting (both worker-to-firm and worker-to-worker) is likely to represent a lower bound estimate due to the potential presence of sorting on unobservable worker ability. To some extent, these issues can be addressed by including worker in addition to firm fixed effects using an AKM model (Abowd, Kramarz and Margolis, 1999[22]). However, estimation of the AKM -model requires panel data on a large sample of workers, which is only available for a subset of countries in the harmonised dataset. Moreover, estimates of worker and firm fixed effects may be biased by limited and endogenous worker mobility (Andrews et al., 2008[23]; Bonhomme, Lamadon and Manresa, 2019[24]). For these reasons, this paper first presents baseline estimates obtained using worker observables and then proceeds to a wage decomposition based on the AKM two-way fixed effects model as a robustness check.

3. Data

Data Sources. To implement the decomposition of wage inequality between and within firms, this paper makes use of linked employer-employee data for 20 countries drawn from administrative records designed for tax or social security purposes or, in a few cases, mandatory employer surveys (e.g. United Kingdom).[2] Table 1 provides an overview of the main features of the datasets used (with more details provided in Table A.1 in the Annex). Each cross-section of the data covers about 26 million workers and 2 million firms across the 20 countries, for a total of 377 million worker-year observations in the entire unbalanced panel.

[2] 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. Results for the United States, based on the same methodology that we use in this paper, are taken from BBDF (2016[4]) and cover the years 1992 to 2007.

Table 1. Overview of harmonised linked-employer dataset

	Earnings data source	Sample structure	Time coverage	Number of workers	Number of firms
Austria	Social security administration	Universe	2002-2017	1,754,990	99,879
Canada	Tax administration	Universe	1991-2016	5,081,047	134,064
Costa Rica	Social security administration combined with register data	Universe	2006-2017	436,448	8,421
Denmark	Tax administration combined with register data	Universe	2001-2017	1,044,718	57,983
Estonia	Tax administration	Universe	2003-2017	311,684	24,511
Finland	Tax administration	Universe	2004-2018	690,381	15,375
France	Mandatory employer survey	8.3% random worker sample	2002-2017	565,506	66,232
Germany	Social security administration	10% random worker sample	1996-2016	1,058,723	148,027
Hungary	Social security administration	50% random worker sample	2003-2018	600,598	25,229
Italy	Social security administration	6.7% random worker sample	2002-2015	461,714	84,806
Japan	Survey	Firm sample stratified by prefecture and industry	2001-2016	267,252	5,769
Netherlands	Social security administration	Universe	2010-2019	3,204,021	70,623
New Zealand	Tax administration	Universe	2000-2017	760,800	52,497
Norway	Tax administration	Universe	2004-2014	1,370,475	66,716
Portugal	Mandatory employer survey	Universe	2002-2017	1,304,983	36,347
Slovak Republic	Social security administration	Universe	2014-2019	914,331	42,143
Spain	Social security and tax administration	4% random worker sample	2002-2017	240,677	40,014
Sweden	Tax administration	Universe	2001-2015	1,659,705	104,609
United Kingdom	Mandatory employer survey	1% random worker sample	1997-2019	77,073	11,580

United States	Business Register, Economic Census, other surveys	Sample (see table note)	1992-2007	4,300,000	800,000
Total				26,105,126	1,894,825

Note: Number of firms and workers refer to the last year of the harmonised dataset used for analysis in each country. This is the basis for the calculation of results shown in Table 1, Panel A. For the United States, we report the data from BBDF (2016[4]), which relies on a combination of different data sources. For further information on the datasets please refer to Table A.1 & Table A.2

In most countries, our data have the major advantage of being comprehensive, covering the entire population of workers and firms. The information is generally of high quality, notably with respect to wages, given the potentially important financial or legal implications of reporting errors and extensive administrative procedures for quality control. Since tax and social security systems differ in their administrative requirements across countries, with potentially significant implications for their comparability across countries, we apply a number of sample restrictions, informed by the literature as well as intensive exploratory analysis using a small subset of countries, to harmonise the data.

Sample restrictions on firms. The analysis is restricted to the private sector[3], and excludes the own-account workers by focusing on firms with two employees or more. Including own-account workers and public sector firms would increase the importance of 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 are typically highly compressed.

Sample restrictions on workers and earnings. The main analysis focuses on total monthly earnings since information on working time is unavailable in several countries.[4] In an attempt to exclude part-timers, all workers with earnings below 90% of the monthly earnings of a full-time worker at minimum wage are dropped. In the absence of a minimum wage, those below 45% of

[3] Civil servants are not always directly identified in the data. When the information is available we drop them. In addition, in all country we drop workers from the "public government and defence" sector.

[4] These countries are Austria, Canada, Costa Rica, Estonia, Finland, Hungary, New Zealand, the Slovak Republic, and Sweden. In Germany a part-time indicator is available, but no further information on hours worked.

the monthly median wage for a full-time worker are dropped. Using hourly wages for the subset of countries where this is possible does not change the main results. Earnings information is reported in gross terms, i.e. total labour cost minus employer social security contributions and based on all taxable earnings, including overtime and other bonuses. To deal with the issue of top coding at the contribution threshold in social security data,[5] censored wages are imputed based on regression analysis using the predicted wage and the distribution of estimated error terms based on methods developed by Dustmann et al. (2009[25]) and Card et al. (2013[18]).[6]

The data typically cover the universe of workers and their employers, but in some cases, represents large representative samples of workers or firms. Worker-based samples only cover a fraction of workers in a firm, introducing measurement error in average firm wages. In worker-based samples, we correct for sampling error that biases down within-firm wage dispersion relative to between-firm wage dispersion using the correction proposed by Hakanson et al. (2015[26]).[7]

The resulting datasets generally cover the past two decades in all countries except Costa Rica, Hungary, Japan, Norway and the Slovak Republic, where the sample period is about one decade. They are broadly consistent with other national and cross-country data sources regarding levels

[5] 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).

[6] Censored wages are imputed by estimating Tobit regressions separately by year and categories of workers (e.g. 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, its trends over time and between and within-firm decompositions (De la Roca, 2017[35]).

[7] The correction-adjusted decomposition of wage inequality between and within firms is given by:

$$\frac{1}{n}\sum_j\sum_i(w_i - \overline{w})^2 = \frac{1}{n}\sum_j n_j\left(\frac{N_j-1}{N_j}\right)\left(\frac{1}{n_j-1}\right)\sum_i\left(w_i - \overline{w_j}\right)^2 + \frac{1}{n}\sum_j n_j\left[\left(w_j - \overline{w}\right)^2 - \left(\frac{N_j-n_j}{N_j n_j}\right)\left(\frac{1}{n_j-1}\right)\sum_i\left(w_i - \overline{w_j}\right)^2\right]$$

where w indicates earnings for person i in firm j, n indicates the number of observed workers in the firm and N the actual firm size. 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 (Nj= nj), while the second term shows the corrected between-firm variance.

and changes in overall wage inequality (Criscuolo et al., 2020[27]). Except for Japan, all datasets follow workers across firms over time.[8]

4. Decomposition results

4.1 Between and within firm wage dispersion

The between and the within components of overall wage dispersion are obtained directly from the data (see equation 1). On average, across countries, the dispersion of average wages between firms — not controlling for differences in worker composition — accounts for about half of the overall dispersion of wages (Figure 1). While there are large cross-country differences in the overall *magnitude* of the between firm component (ranging from a variance of 0.05 in Sweden to 0.3 in the United States), these cross-country differences are correlated with differences in the overall variance of wages, meaning that the *share* of between-firm inequality in overall wage inequality is more compressed across countries than the *absolute* differences are.

These numbers are broadly in line with those of previous studies. Recent research using cross-country employer survey data for European countries estimates that wage dispersion between establishments explains around 60% of aggregate wage inequality (Zwysen, 2022[28]; International Labour Organization, 2016[29]). Similarly, Tomaskovic-Devey et al. (2020[13]) report that 20% to 50% of overall wage inequality arises between firms in their study. A previous cross-country study covering European countries and the United States during the 1980s and 1990s found that wage dispersion between firms accounts for between 20% and 40% of aggregate wage inequality (Lazear and Shaw, 2009[12]).

[8] For France, two datasets are available, a cross-sectional one that covers the universe of workers but does not follow workers over time and a panel one based on an 8% random sample of workers. The results reported in this paper are based on the panel dataset.

Changes in the dispersion of average wages between firms also account for around half of the changes in overall wage inequality (Panel B). This is true both for countries where overall wage inequality increased over the observation period – slightly more than half of the countries covered – and for countries where overall wage inequality has declined. Again, these results are broadly consistent with those from previous studies. According to Lazear and Shaw (2009[12]) changes in wage dispersion between firms account for at least 60-70% of changes in overall wage dispersion. Tomaskovic-Devey et al. (2020[13]) report that the proportion of overall inequality that is attributable to the between-workplace component rose in twelve out of fourteen countries by 5% on average. In contrast, overall wage inequality rose by about 11%.[9]

A striking fact is that in most countries, between-firm wage dispersion and within-firm wage dispersion have tended to evolve in the same direction. This is true in 16 out of the 20 countries included in the sample, and both in countries where overall wage dispersion was falling and in countries where it was rising. This suggests that the underlying drivers of inequality increase inequality between workers within the same firm as well as inequality between firms. For example, an increase in the relative productivity of skilled workers could lead to higher between-worker inequality (a rising skill premium) and higher between-firm inequality, if more productive firms compete harder for skilled workers by offering higher wage premia and/or if workers of similar skill levels increasingly cluster in the same firms. The next sub-section will dive deeper into the extent to which between-firm wage dispersion is driven by the sorting of similar workers into firms versus differences in firm pay premia.

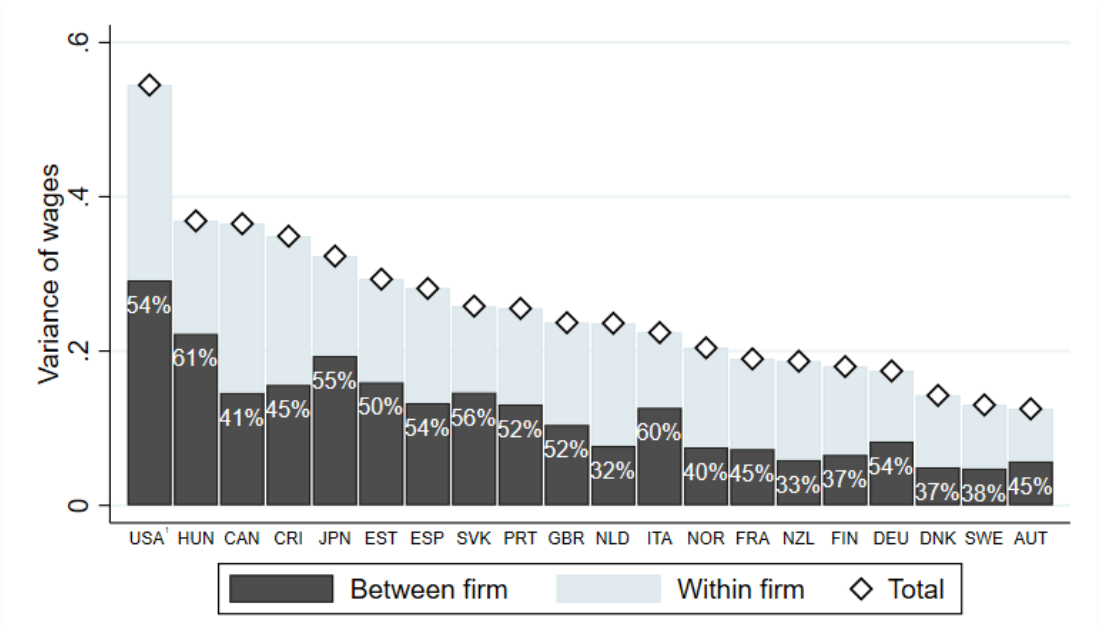
These findings are robust to the choice of the sample period. The full estimates of overall wage inequality for each year and country included in this paper are shown in Figure A.1. The figure

[9] Tomaskovic-Devey et al. (2020[13]) also report that both overall and between-firm inequality increased in almost all countries, whereas we find that it increased in about half the countries and decreased in the other half. The difference between their and our results seems to be entirely explained by country coverage: both their study and ours report falling inequality in Hungary and France, and falling inequality in Japan since 2005 (when our data coverage starts). However, our study includes additional OECD countries not reported in Tomaskovic-Devey et al. (2020[13]) where inequality has been falling: Estonia, New Zealand, the Slovak Republic, Spain, Portugal, and the United Kingdom.

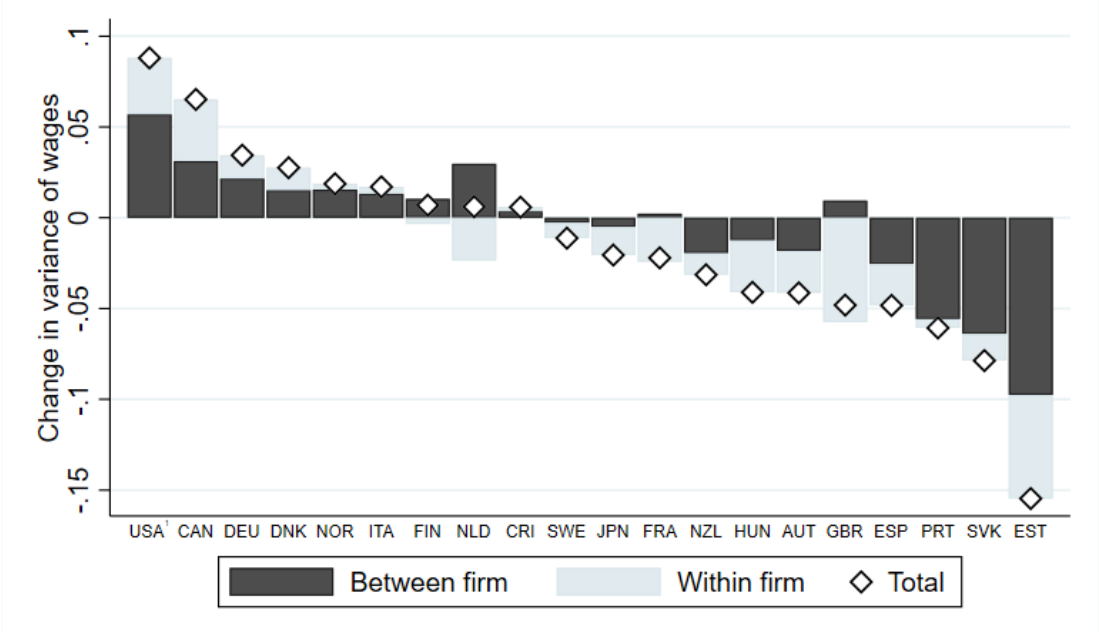
shows that trends in wage inequality have been remarkably stable over the past two decades, with trends either increasing or decreasing in a country over the entire period. The exception is Germany, where wage inequality increased until the global financial crisis and has been falling since. Despite significant changes in inequality in some countries, the cross-country ranking of inequality remained roughly unchanged over the last two decades. Figure A.2 shows changes in wage inequality within and between firms for a comparable 10-year period between 2005 and 2015, rather than the first and last year in the data. The magnitude and the country ordering, as well as the within-between decomposition, are very similar to that shown in Figure 1.B, except for Germany.

Figure 1. 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: Based on equation (1). 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: 1992 for the United States; 1995 for Canada, Germany and Italy; 1996 for Spain; 1998 for the United Kingdom; 1999 for Sweden; 2000 for Austria, Finland and New Zealand; 2001 for Denmark and Netherlands; 2002 for Estonia, France and Portugal; 2003 for Hungary; 2004 for Norway; 2005 for Japan, 2006 for Costa Rica; 2014 for Slovakia. Latest available year: 2007 for the United States; 2011 for Hungary; 2013 for Japan; 2014 for Norway; 2015 for France, Italy and Sweden; 2016 for Canada, Germany, Netherlands and Spain; 2017 for Costa Rica, Denmark, Finland, New Zealand and Portugal; 2018 for Austria, Estonia, Slovakia and the United Kingdom.
1. Values for the United States are based on BBDF (2016[4]).

4.2 The components of between-firm inequality: firm premia dispersion or workforce composition?

By accounting for the observable characteristics of workers in the wage equation (equation 2), the between-firm component of wage inequality can be decomposed further into differences in firm-specific wage premia and the sorting of workers with different observable characteristics into firms paying different average wages (equation 4). The role of unobservable characteristics is discussed further below.

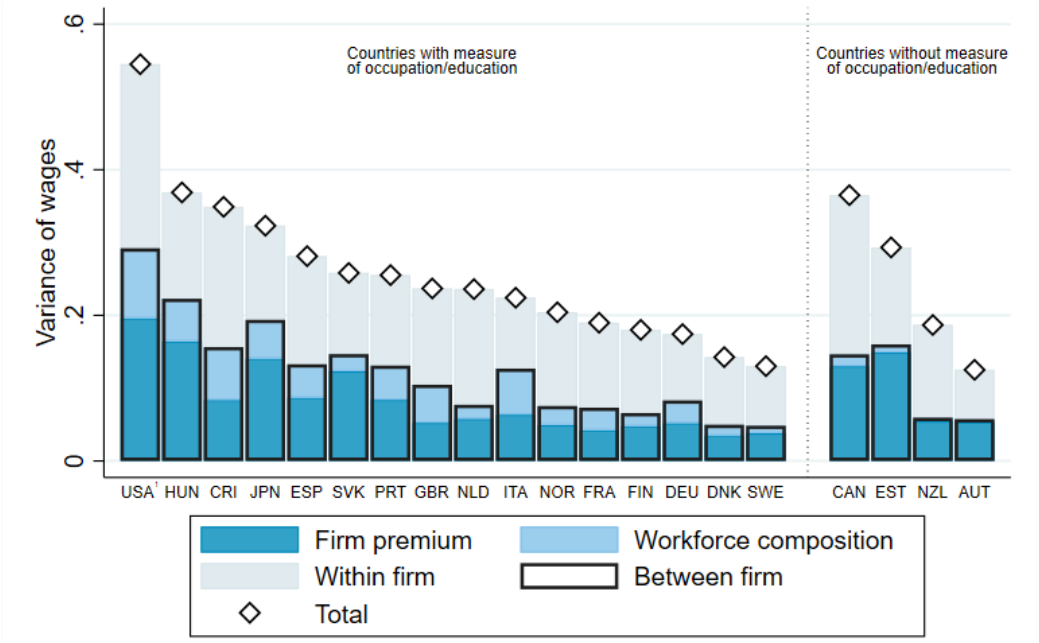
On average, across countries, the *dispersion of firm wage premia* accounts for around two-thirds of the between-firm wage inequality, with worker sorting across firms accounting for about one-third (Figure 2). The pattern is very similar for wage inequality in levels or changes. The

contribution of firm wage premia to between-firm wage inequality is fairly similar across countries where we have information on education or occupations. In Austria, Canada, Estonia and New Zealand, where only information on age and gender is available, unsurprisingly, the estimated contribution of firm wage premia in *levels* tends to become larger, as differences in the occupational or educational composition of workers are incorporated into the estimated firm wage premia.

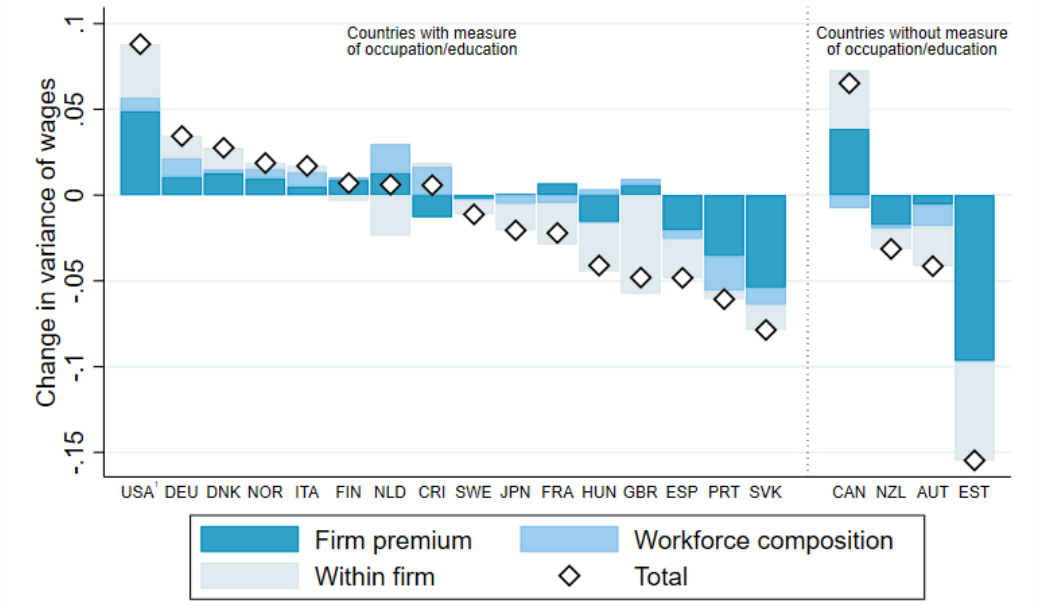
The remaining third of between-firm wage inequality, both in levels and changes, can be explained by observable differences in the workforce composition across firms. Workforce composition affects inequality between firms when workers with similar wages tend to cluster together in the same firms, i.e. when there is *sorting* of workers. However, only the sorting of higher-paid workers into higher-wage premia firms leads to an increase in overall wage inequality. By contrast, when higher-paid workers cluster together, but not in any particular kind of firm – called worker-to-worker sorting – this only affects the distribution of within-firm versus between-firm wage dispersion, not overall wage inequality.

Figure 2. Distinguishing between firm-wage premia and worker sorting

Panel A. Contributions to the level of wage dispersion, latest available year



Panel B. Contribution to changes in wage dispersion, latest year – first year



Note: Based on equation (2). 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 year: 1992 for the United States; 1995 for Canada, Germany and Italy; 1996 for Spain; 1998 for the United Kingdom; 1999 for Sweden; 2000 for Austria, Finland and New Zealand; 2001 for Denmark and Netherlands; 2002 for Estonia, France and Portugal; 2003 for Hungary; 2004 for Norway; 2005 for Japan, 2006 for Costa Rica, 2014 for Slovakia. Latest available year: 2007 for the United States; 2011 for Hungary; 2013 for Japan; 2014 for Norway; 2015 for France, Italy and Sweden; 2016 for Canada, Germany, Netherlands and Spain; 2017 for Costa Rica, Denmark, Finland, Portugal and New Zealand; 2018 for Austria, Estonia, Slovakia and the United Kingdom.

1. Figures for the United States are based on BBDF (2016[4]).

4.3 Robustness to alternative methods of estimating wage premia

An alternative to estimating firm wage premia according to equation (2) is to estimate the two-way fixed-effects "AKM model" proposed by Abowd, Kramarz and Margolis (1999[22]), which augments equation (2) with an individual worker fixed effect (μ_i):

$$w_{ijt} = \sum_k x_{k,it}\beta_k + \gamma_j + \mu_i + \theta_t + \varepsilon_{ijt} \qquad (5)$$

This controls for any time-invariant factors, such as ability and skills, which relate to a worker's individual labour productivity and are not already measured by workers' observable characteristics. As before, the dispersion of firm wage premia corresponds to the variance of firm fixed effects, $var(\gamma_j)$. The advantage of this alternative approach over the BBDF specification is that in the latter, unobserved worker skills may be captured by the firm fixed effects, thereby artificially inflating $var(\gamma_j)$. The disadvantage is that in small samples with few job switchers, the AKM model suffers from limited mobility bias which inflates the estimated contribution of firm wage premia (Andrews et al., 2008[23]; Bonhomme, Lamadon and Manresa, 2019[24]). Consequently, in small samples, it may still overstate the role of wage premia dispersion in overall wage inequality.[10]

Figure 3 shows the correlation between firm wage premia estimated using the baseline BBDF method and those estimated using the AKM method, for the subset of 12 countries for which estimation of the AKM model was feasible. Including worker fixed effects reduces the contribution of firm wage premia to overall wage inequality by about half to about 15%. This may suggest that between-firm differences in wage dispersion reflect for about one third differences in wage premia

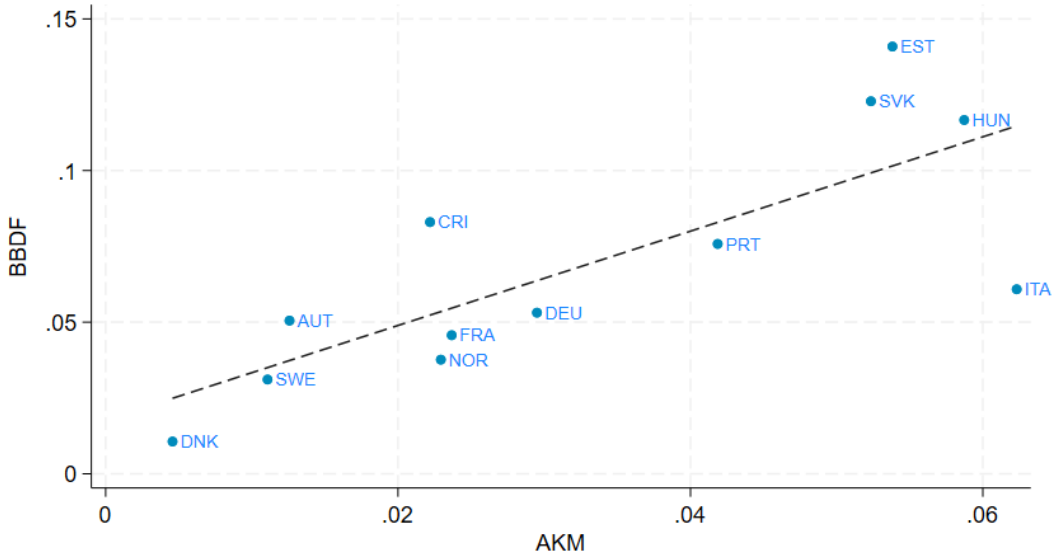
[10] Moreover, the AKM model is only identified for a sub-sample of the entire available data – a connected set of workers and firms – although, in practice, this limitation might not be very significant in the case of large sample or population data.

dispersions, one third sorting based on unobservable worker characteristics and one third sorting based on observable worker characteristics. Note that while including worker fixed effects reduces the contribution of firm-wage premia in overall wage inequality, the cross-country pattern of the importance of wage premia dispersion remains broadly stable (Panel A). Italy is an outlier, which may be explained by limited mobility bias: it has the smallest sample among the countries covered in this part of the analysis (a 7% sample of workers) and the lowest job-to-job mobility (see Causa, Luu and Abendschein (2021[30]) for comparable job mobility estimates across EU countries).[11] For countries where no information on occupation or education of workers is available – Austria, Costa Rica and Estonia in this sub-sample – the BBDF method estimates are particularly large relative to the fitted line trend, which confirms the interpretation that differences in unobserved worker characteristics are partially incorporated into the estimated firm wage premia. However, Panel A of Figure 3 suggests that this does not materially affect the overall cross-country pattern of firm wage dispersion.

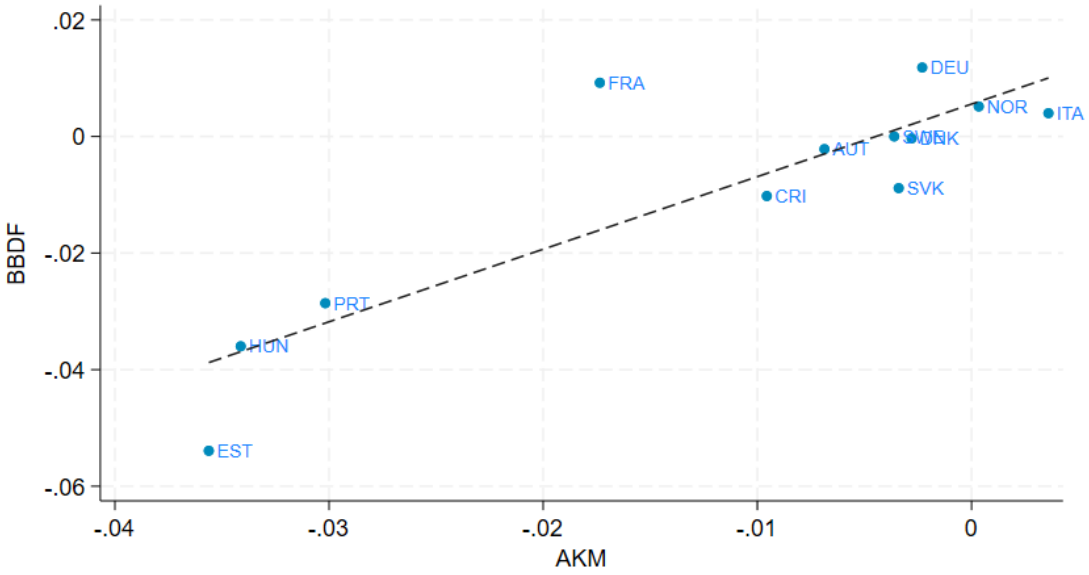
[11] When Italy is excluded, the R-squared correlation coefficient in Figure 3A increases from 0.61 to 0.84.

Figure 3. Cross-country pattern of firm wage premia is robust to AKM

A. Cross-sectional firm premium dispersion



B. Changes in firm premium dispersion



Note: The scatter plot shows firm wage premium dispersion estimated using the baseline BBDF (on the y-axis) against firm wage premia dispersion in the same country using the alternative AKM method. In Panel A, the cross-section corresponds to the last available year in each country. In panel B, the changes correspond to the difference in variance between the last and first years available. The dashed lines show the best linear fit. R-squared in Panel A is 0.61 for all countries (0.84 when Italy is excluded); R-squared in Panel B is 0.75. Sample is restricted to a subset of 12 countries (out of 20) where an AKM model could be estimated.

Panel B of Figure 3 shows the correlation in *changes* in firm wage premia dispersion across the two methods. The within-country changes in firm wage premia dispersion across the two estimation methods are even more closely aligned than the levels, which is consistent with changes in worker sorting on unobservables not being a major driver of changes in wage inequality. Changes in between-firm inequality reflect for about two-thirds changes in wage premia dispersion and one third changes in the pattern of sorting across firms. This suggests that wage-setting practices are increasingly important for understanding wage inequality developments.

In further analysis, we show that changes in the importance of wage premia dispersion in overall dispersion are driven by manufacturing, while the importance of wage-premia dispersion in services has remained broadly constant (Figure A3). The differences in the time-trend is statistically significant from 2008. A similar picture emerges when looking at the contribution of firm wage premia only to between-firm inequality rather than overall inequality (Figure A4). These results suggests that the increasing role of firm wage premia both within manufacturing, and relative the services sector (where pay composition remained stable) is a key driver behind the growing role of firms in explaining wage inequality in the sample of countries analysed.

5. An exploration of the determinants of firm wage premia dispersion

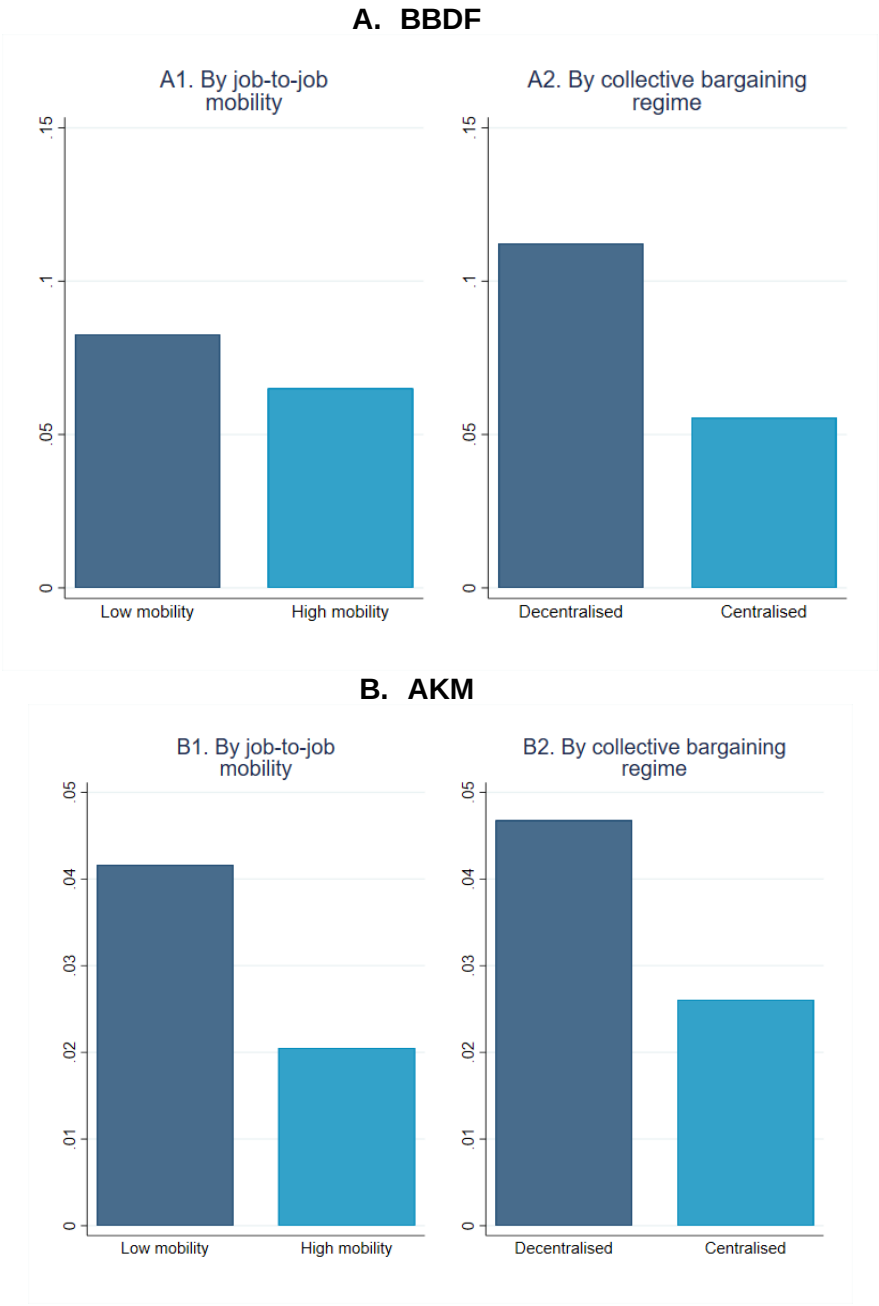
The importance of firm wage premia to overall wage inequality, coupled with the robust pattern of firm wage premia dispersion across countries, raises important questions about the role of policies and institutions. In fact, at a given level of labour market frictions, public policies and institutions may shape the dispersion of firm productivity and, thereby, the dispersion of firm wage premia (Andrews, Criscuolo and Gal, 2016[31]). But policies and institutions may also shape the transmission of productivity to firm wage premia at a given level of productivity dispersion, either

by affecting the degree of friction in the labour market or by institutional limits on the dispersion of wage premia.

Figure 4 provides suggestive evidence by comparing firm wage premia dispersion across countries grouped according to the degree of voluntary job mobility between firms (Causa, Luu and Abendschein, 2021[30]) and the degree of centralisation of their collective bargaining systems as defined by the OECD (OECD, 2019[32]). Panel A uses the firm wage premia dispersion obtained from the BBDF method; while Panel B uses the firm wage premia dispersion based on AKM instead (for the subset of 12 countries).

Figure 4. The role of job mobility and collective bargaining in firm wage premia dispersion

Firm wage premia dispersion across country groups, log points



Note: This figure makes use of the dispersion in firm wage premia as documented in Figure 1. Data on collective bargaining regime is available for all countries (OECD, 2019[32]); data on job mobility is available for European countries only (Causa, Luu and Abendschein, 2021[30]). Countries with decentralised bargaining regimes (9): Canada, Costa Rica, Estonia, Japan, Hungary, New Zealand, the Slovak Republic, United Kingdom, United States; countries with more centralised bargaining regimes (11): Austria, Denmark, Germany, Finland, France, Italy, Portugal, the Netherlands, Norway, Spain, Sweden. Countries with low job mobility (7, European countries only): France, Germany, Hungary, Italy, Norway, Portugal and the Slovak Republic; countries with high job mobility (8, European countries only): Austria, Denmark, Estonia, Finland, the Netherlands, Spain, Sweden, United Kingdom.

These simple descriptive statistics provide several insights. First, firm wage premia dispersion is higher in countries with limited job mobility (Panels A1 and B1). The difference is particularly pronounced when firm premia are estimated using AKM, perhaps reflecting the fact that the countries in this sample without a measure of skills (Austria and Estonia) all fall into the high mobility group.[12] This is consistent with the view that high-productivity firms offer higher wage premia (relative to low-productivity firms) to attract and retain the workers required to reach their desired employment levels in labour markets with higher frictions and, thus, less mobility.

Second, firm wage premia dispersion is higher in countries with more decentralised collective bargaining institutions (Panels A2 and B2). These are countries where collective bargaining predominantly takes place at the firm level or wages are set through individual-level bargaining. Using the same indicators, Garnero (2020[33]) shows that countries with more centralised bargaining systems tend to have lower earning inequalities. Our findings show that this may partly be driven by a lower dispersion of firm wage premia. The difference in firm premia across these groups is quantitatively meaningful: going from centralised bargaining institutions to decentralised ones is associated with a decline in the dispersion of firm wage premia from the 25th to the 75th percentile. While we do not have comparable data for the evolution of bargaining systems over time and by sector, our previous results showing the increasing importance of wage premia specifically in the manufacturing sector would be consistent with the notion that centralised bargaining has been in declining in particular in the previously heavily unionised manufacturing sector.

Third, even for countries with similar collective bargaining arrangements, firm wage premia dispersion tends to be higher in countries with low job mobility (Appendix Figure A.5).[13] The

[12] For these countries, the BBDF method is particularly prone to confounding (unobservable) skills with firm wage premia.

[13] Due to the smaller country sample for AKM, this four-way country split can only be performed for firm wage premia obtained using the BBDF method.

results are qualitatively similar when using the share of firm wage premia dispersion in overall wage dispersion instead of its level (Appendix Figure A.6).

6. Conclusion

In many countries, low productivity growth has coincided with rising wage inequality. Widening wage and productivity gaps between firms may have contributed to both developments. This paper employs a novel harmonized cross-country linked employer-employee dataset covering 20 countries to analyze the role of firms in wage inequality. The main finding is that, on average across countries, between-firm wage inequality accounts for about one-half of overall wage inequality, both in levels and in changes. Differences in wage-setting practices across firms as opposed to differences in worker skills account for about two-thirds of changes in between-firm wage inequality, but just about one third of the level of between-firm wage inequality. In other words, differences in wage-setting practices play an increasingly significant role in explaining inequality development across countries.

Our results suggest that productivity dynamics influence wage inequality, both directly, through their effect on firm wage premia, and indirectly, by shaping the sorting of workers across firms. Thus, wage inequality developments are determined to a significant extent by firm dynamics, in addition to differences in workers' characteristics, such as skills and experience. These findings imply that high or rising inequality may not only require policies to support low-wage workers, such as in the areas of skills and wage-setting, but also measures to narrow dispersion in pay premia between firms. This includes measures that promote the catch-up of lagging firms and job creation by leading firms. As shown in follow-up work by Criscuolo et al. (2021[34]), such policies would not only help to strengthen aggregate productivity growth, but also contribute to smaller wage inequality between firms, as lower productivity dispersion reduces wage-premia dispersion between firms.

Beyond directly influencing productivity dispersion, public policies and institutions may shape how productivity differences translate into wage premia dispersion. A better understanding of the extent to which productivity-related rents are shared with different types of workers, and their effects on worker sorting across firms are crucial for developing public policies that address concerns around slowing productivity growth and increasing wage inequality. In particular, public policies may influence competition for workers among employers and constrain the wage-setting power of firms. The exploratory evidence in this paper suggests that wage premia differences between firms tend to be more pronounced in countries with limited job mobility, i.e. where differences in wage premia are not competed away by highly mobile workers, as well as countries with decentralised collective bargaining systems, i.e. with fewer institutional restrictions on the wage-setting behaviour of firms. This highlights the potential of policies aimed at lowering worker mobility costs and strengthening wage-setting institutions.

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Annex A. Additional tables and figures

Table A.1. Overview of data sources

		Earnings data source	Employer	Sample structure	Longitudinal	Earnings data	Working time	Worker skills
Austria	AMS-BMASK Arbeitsmarktdaten-bank	Social security administration	Firm	Universe	Yes	Gross monthly earnings	Days worked (but no information on hours or part-time status)	No information
Canada	Longitudinal Worker Files (LWF)	Tax administration	Firm	Universe	Yes	Annual earnings	No information	No information
Costa Rica	Register of Economic Variables (REVEC) from the Central Bank of Costa Rica (BCCR)	Social security administration combined with register data	Firm	Universe	Yes	Gross monthly earnings	No information	Occupation
Denmark	Integrated Database for Labour Market Research (IDAN) and UDDA	Tax administration combined with register data	Firm	Universe	Yes	Hourly wage	Days worked and hours worked	Education and Occupation
Estonia	Data from the Tax and Customs Board Register	Tax administation	Firm	Universe	Yes	Taxable annual income (inc. bonuses)	Number of months	No information
France	Déclaration annuelle des données sociales unifiée (DADS) Panel	Mandatory employer survey	Firm (aggregated from establishment level)	Random worker sample (1/12th)	Yes	Annual gross salary	Days worked; hours, and part-time coefficient.	Occupation
Finland	FOLK employment data from Statistics Finland, Employer Payroll Report from Tax Administration	Tax administration	Firm	Universe	Yes	Annual gross earnings including cash benefits and bonuses	Days worked (but no information on hours or part-time status)	Education

		Earnings data source	Employer	Sample structure	Longitudinal	Earnings data	Working time	Worker skills
Germany	Integrierte Ewerbsbiographien (IEH)	Social Security administration	Establishment	10% random worker sample	Yes	Taxable payroll earnings.	Days worked. Indicator for part-time work, but no information on hours.	Education and Occupation
Hungary	ADMIN II - Panel of administrative data (OEP, ONYF, NAV, NMH, OH)	Social security administration	Firm	50% random sample of population, taken in 2003	Yes	Gross monthly wage.	Days worked in month (but no information on hours)	Occupation
Italy	Longitudinal Sample social security INPS (LoSai)	Social security administration	Firm (social security reporting unit)	1/15th random sample of workers	Yes	Daily pay.	Days worked. Part-time indicator and coefficient	Limited measure of occupation
Japan	Basic Survey of Wage structure	Mandatory employer survey	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
Netherlands	SPOLIS, POLIS, GBA, ABR and Hoogsteopitab	Social security administratin	Enterprise (bedrijfs-eenheid): More aggregate than establishment	Universe	Yes	Gross taxable wage, including bonuses and subsidies	Hours worked. Indicator for part-time workers	Education (for about half the sample, with sample weights)
New Zealand	Integrated Data Infrastructure (IDI) – Inland Revenue (IR) & Business Register data	Tax administration	Firm	Universe	Yes	Gross monthly earnings	No information	No information
Norway	Earnings data (Tax Register), augmented with employment history (National Education database)	Tax administration	Firm	Universe	Yes	Total annual earnings	Days worked per year, hours worked per week, indicator for part time	Education and Occupation
Portugal	Quadros de Pessoal	Mandatory employer survey	Firm	Universe	Yes	Earnings in the reference month (generally October)	Hours worked. Part-time indicator	Education, occupation and job title

		Earnings data source	Employer	Sample structure	Longitudinal	Earnings data	Working time	Worker skills
Slovak Republic	Slovak Linked Employer-Employee database	Social Security Administration	Firm	Universe	Yes	Gross monthly earnings	No information	Education
Spain	Muestra Continua de Vidas Laborales con Datos Fiscales (MCVL-CDF)	Everyone affiliated to general social security system, 1980-2016 (sample period used in LinkEED: 1996-2016)	Establishment and firm	Random 4% sample of people	Yes, including retro-spectively from 1980	Annual earnings.	Hours worked. Indicator for part-time and coefficient.	Education and occupation
Sweden	Longitudinell integrationsdatabas för sjukförsäkrings- och arbetsmarknadsstudier (LISA)	Tax administration	Firm	Universe	Yes	Annual earnings	Number of months	Education
United Kingdom	Annual Survey of Hours and Earnings (ASHE)	1998-2018 (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
United States	Longitudinal Business Database	Business Register, Economic Census and other surveys	Firm	Universe	Only firms, not workers	Quarterly earnings	No information	Education

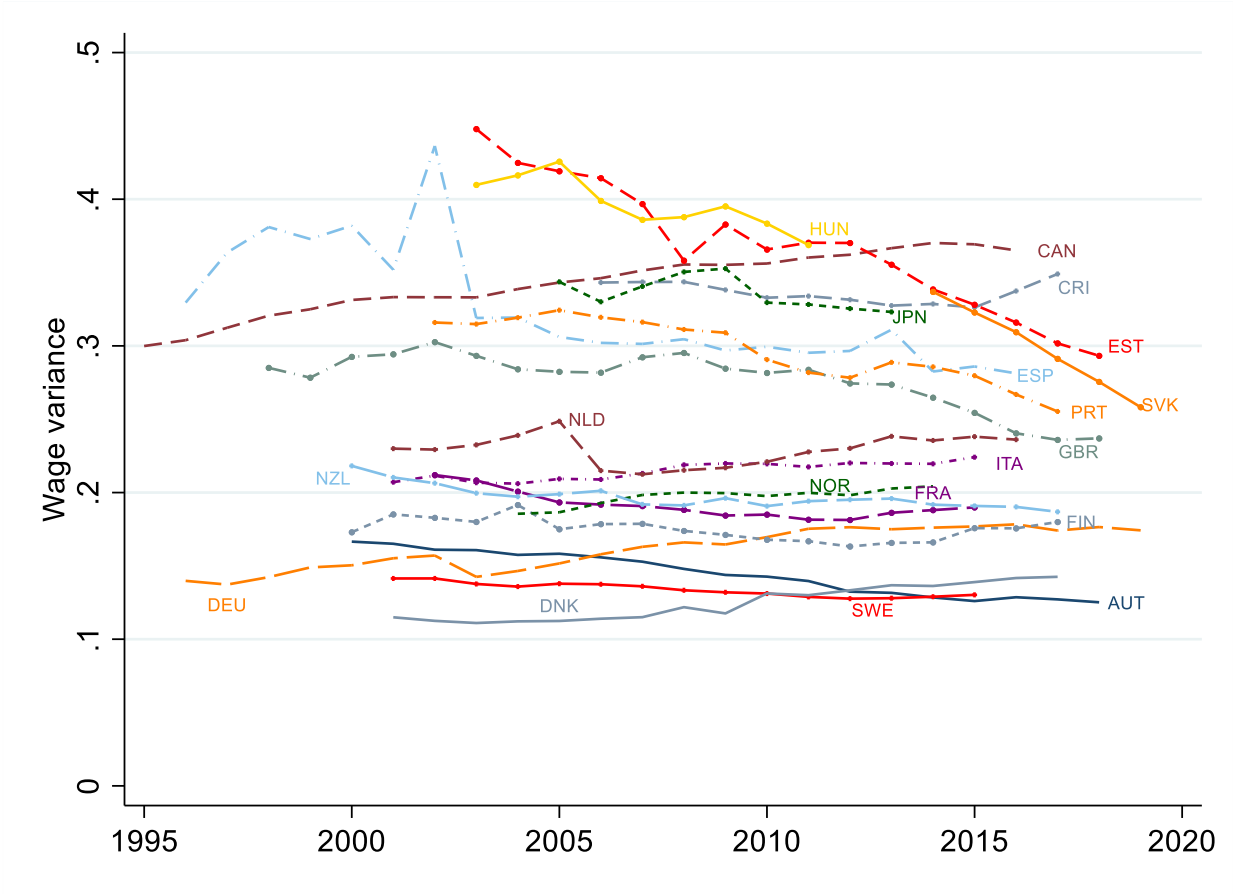
Note: Where multiple databases are indicated in a single row (e.g. New Zealand), the paper matches all the databases in the row and uses this matched database throughout the paper. In France, DADS Panel is used for consistency. Results for the United States are based on BBDF (2016[4]). For Hungary, the sample was drawn once in 2003, without subsequent replacement. For Japan, the sampling probability depends on prefecture and industry, the two sample strata. For the United Kingdom, the sampling frame refers to national insurance records . For Sweden, the sampling structure is stratified by firm size, and workers in larger firms are oversampled.

Table A.2. Observable variables by country

	Age	Gender	Education	Occupation	Part time
Austria	✓	✓			✓
Canada	✓	✓			
Costa Rica	✓	✓		✓	
Denmark	✓	✓	✓	✓	✓
Estonia	✓	✓			
Finland	✓	✓	✓		
France	✓	✓		✓	✓
Germany	✓	✓	✓	✓	✓
Hungary	✓	✓		✓	
Italy	✓	✓		✓	✓
Japan	✓	✓	✓		
Netherlands	✓	✓	✓		✓
New Zealand	✓	✓			
Norway	✓	✓	✓	✓	✓
Portugal	✓	✓	✓	✓	✓
Slovak Republic	✓	✓	✓		
Spain	✓	✓	✓	✓	✓
Sweden	✓	✓	✓	✓	✓
United Kingdom	✓	✓		✓	✓
United States	✓	✓			

Note: The table shows the workers' earnings characteristics that are available to compute the variance decomposition described in Figure 2. See Table A.1 for data sources.
Source: OECD calculations.

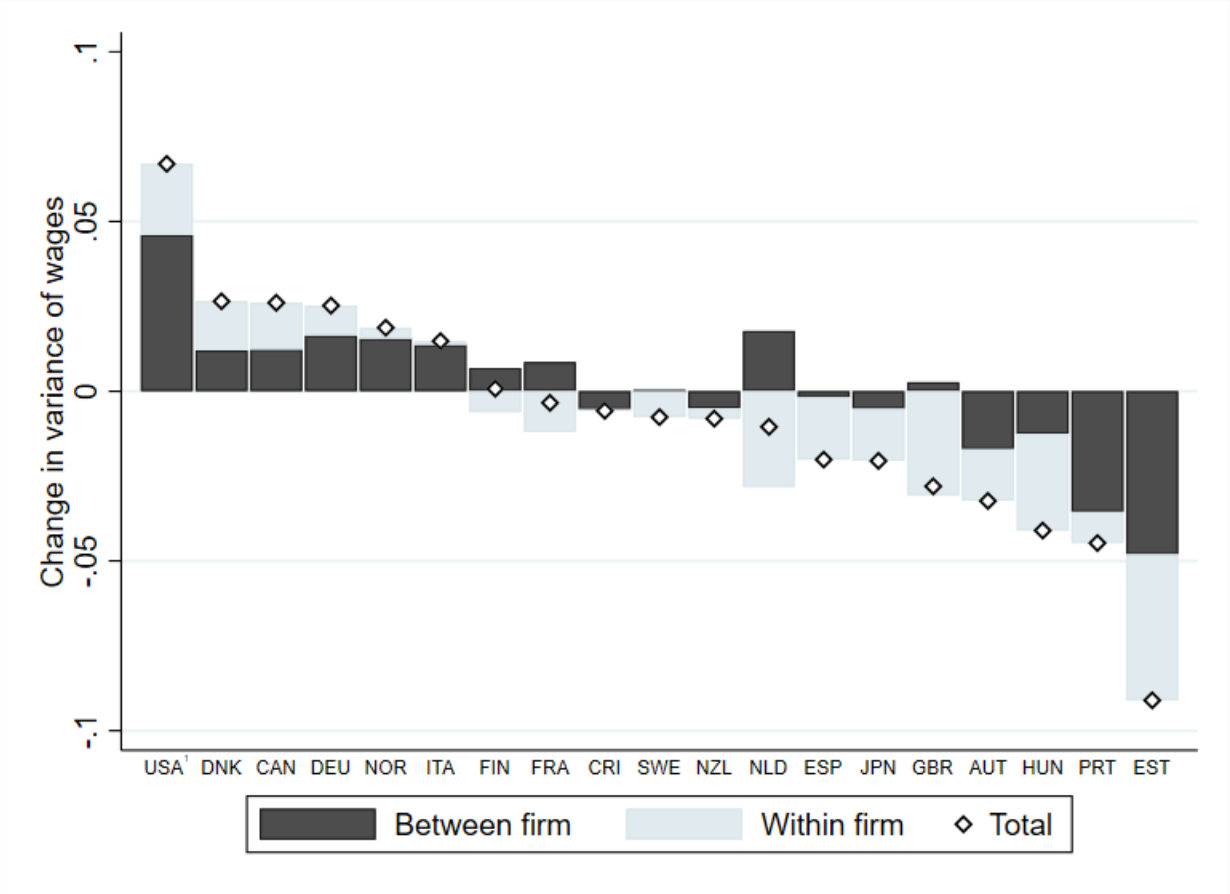
Figure A1. Total log wage variance, all years and countries



Note: This graph shows the variance of log real wages for each country and year in the data used for this paper, for 19 OECD member countries. Countries are identified by the ISO-3 codes: Austria (AUT), Canada (CAN), Costa Rica (CRI), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Hungary (HUN), Italy (ITA), Japan (JPN), Netherlands (NLD), Norway (NOR), New Zealand (NZL), Portugal (PRT), Slovak Republic (SVK), Spain (ESP), Sweden (SWE), United Kingdom (GBR). Year-by-year time series not available for the United States.
Source: OECD calculations

Figure A2. Change in (log) wage variance during the last decade

2005-2015, based on equation (1).

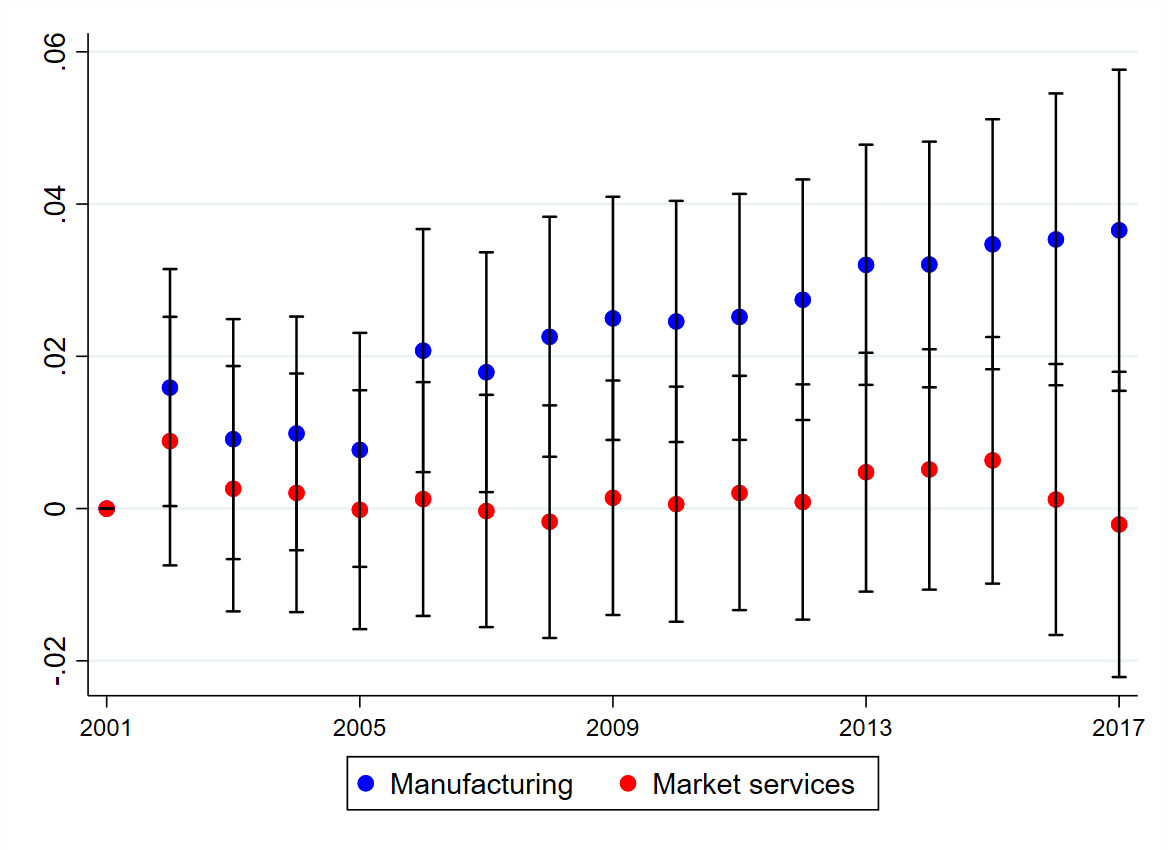


Note: The net height of the bars (represented by the diamond) shows the change in the total variance of log wages, with the dark-shaded component showing the change in the between-firm variance and the light-shaded bar showing the change in the within-firm variance. This is similar to Figure 1B, but applies a consistent 10-year observation period. The period is 2005-2015 for all countries where available, with the exceptions of Norway (2004-2014), Costa Rica (2006-2016), Japan (2005-2013), Hungary (2003-2011), and the United States (1997-2007). The observation period for the Slovak Republic is below 10 years.

1. Values for the United States are based on BBDF (2016[4]).

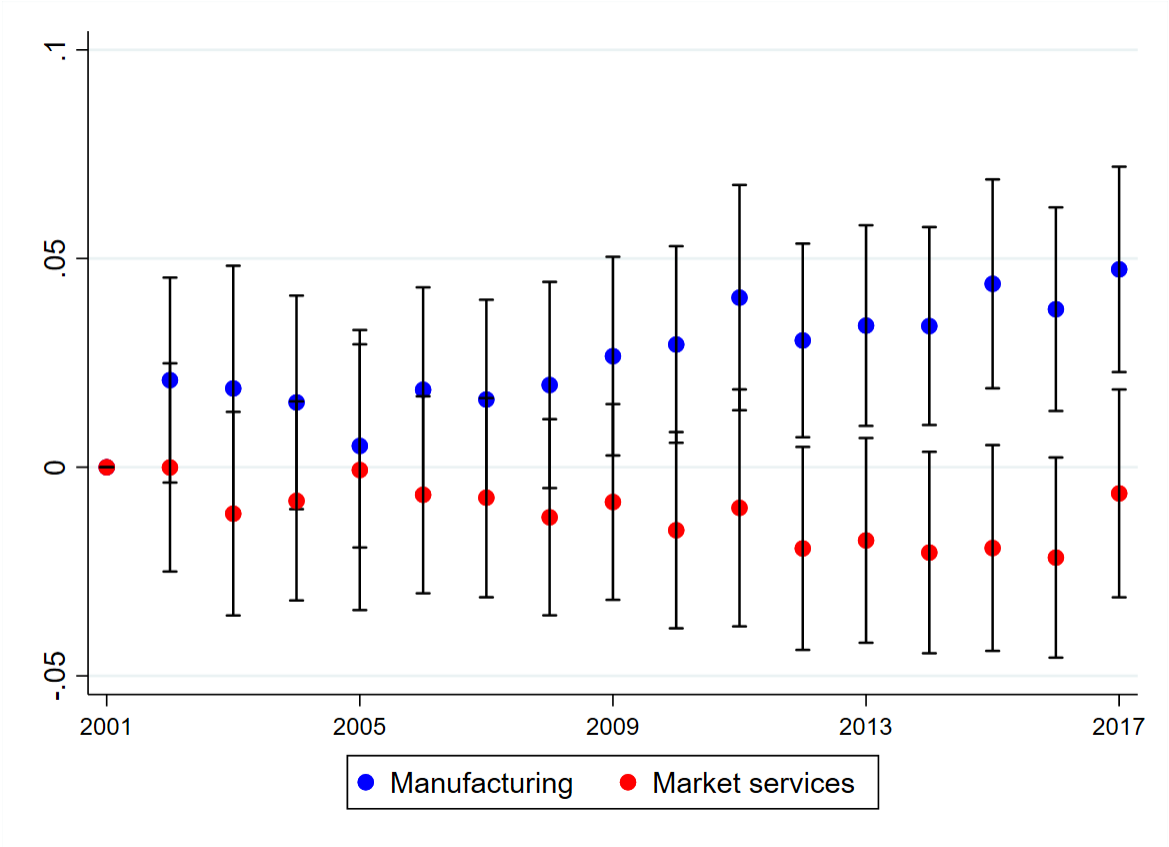
Source: OECD calculations.

Figure A3. The contribution of firm wage premia to pay dispersion in manufacturing is on the rise



Note: Based on regressions of the share of firm wage premia dispersion in overall wage wage dispersion in industry *i* , country *c* and year *t* on sector-specific time trends (sector-time fixed effects) and country-industry fixed effects. The dots represent coefficients on sector-specific time dummies for manufacturing and market service industries, respectively, estimated in a single joint regression model with interaction terms. Coefficients normalised (2001 = 0). Bars denote 95% confidence intervals. In addition, for each year, a hypothesis test on the null hypothesis of the equality of coefficients across sectors is performed. For every year from 2008, the p-values on these tests are below 0.05. Country sample excludes Denmark and the United Kingdom, for which industry-level data is not available in the pooled cross-country dataset.

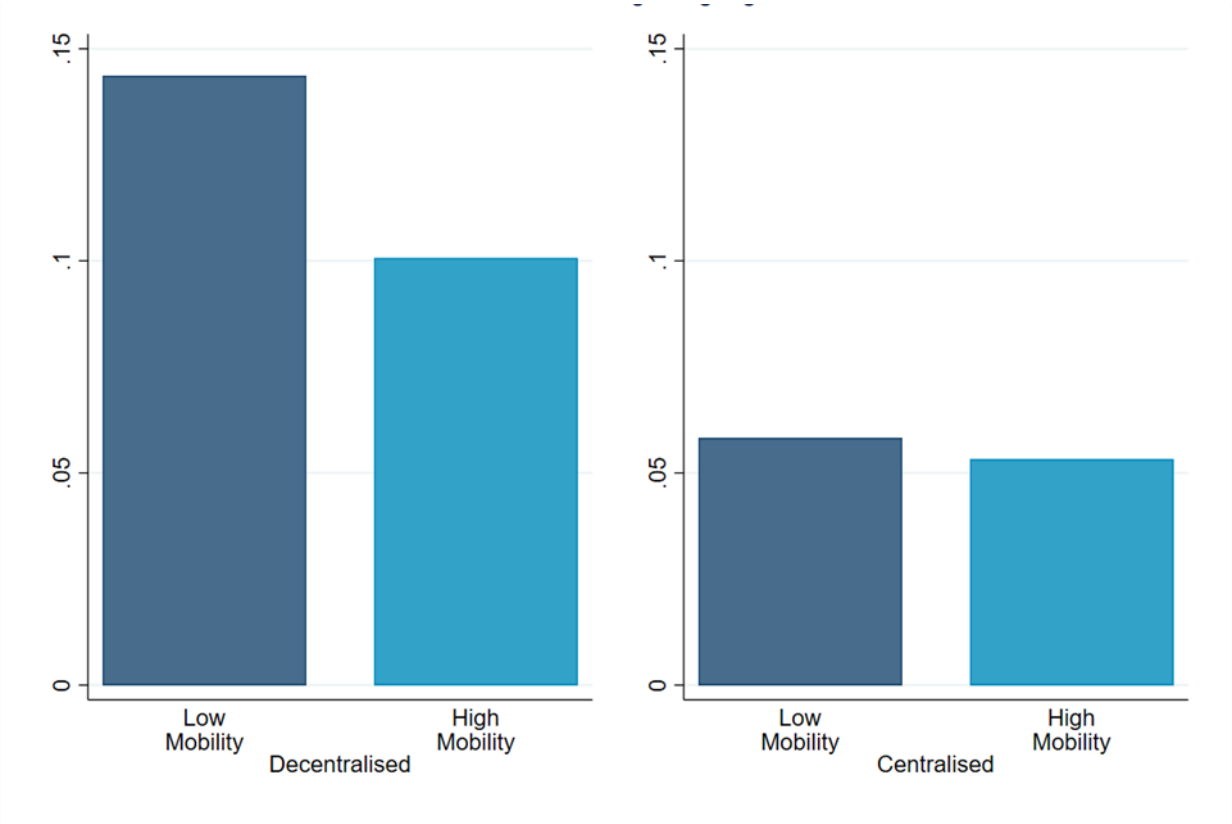
Figure A4. Wage premia account for an increasing share of between-firm wage inequality in manufacturing



Note: Based on regressions of the share of firm wage premia dispersion in between-firm wage dispersion in industry *i* , country *c* and year *t* on sector-specific time trends (sector-time fixed effects) and country-industry fixed effects. The dots represent coefficients on time dummies for manufacturing and market service industries, respectively, estimated in a single joint regression model with interaction terms. Coefficients normalised (2001 = 0). Bars denote 95% confidence intervals. In addition, for each year, a hypothesis test on the null hypothesis of the equality of coefficients across sectors is performed. For every year from 2009, the p-values on these tests are below 0.05. Country sample excludes Denmark and the United Kingdom, for which industry-level data is not available in the pooled cross-country dataset.

Figure A5. Firm wage premia by collective bargaining regime and job-to-job mobility

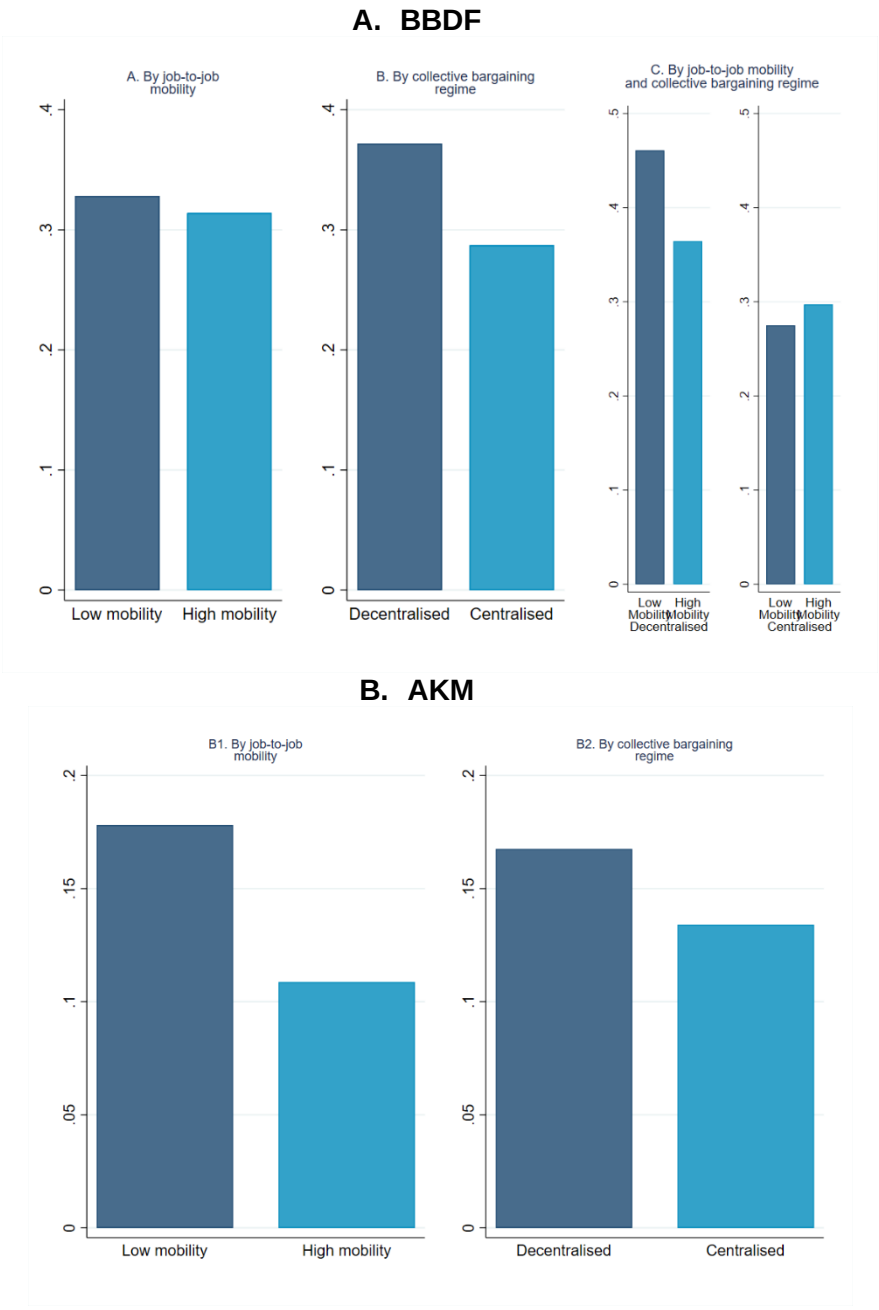
2005-2015, based on equation (1).



Note: This figure shows the share of wage premia in overall wage dispersion by country group. Data on collective bargaining regime is available for all countries; data on job mobility is available for European countries only. Countries with decentralised bargaining regimes (9): Canada, Costa Rica, Estonia, Japan, Hungary, New Zealand, the Slovak Republic, United Kingdom, United States; countries with centralised bargaining regimes (11): Austria, Denmark, Germany, Finland, France, Italy, Portugal, the Netherlands, Norway, Spain, Sweden. Countries with low job mobility (7, European countries only): France, Germany, Hungary, Italy, Norway, Portugal and the Slovak Republic; countries with high job mobility (8, European countries only): Austria, Denmark, Estonia, Finland, the Netherlands, Spain, Sweden, United Kingdom.
Source: OECD calculations.

Figure A6. The share of firm wage dispersion and overall wage inequality by job-to-job mobility and collective bargaining regime

Firm wage premia dispersion across country groups, log points

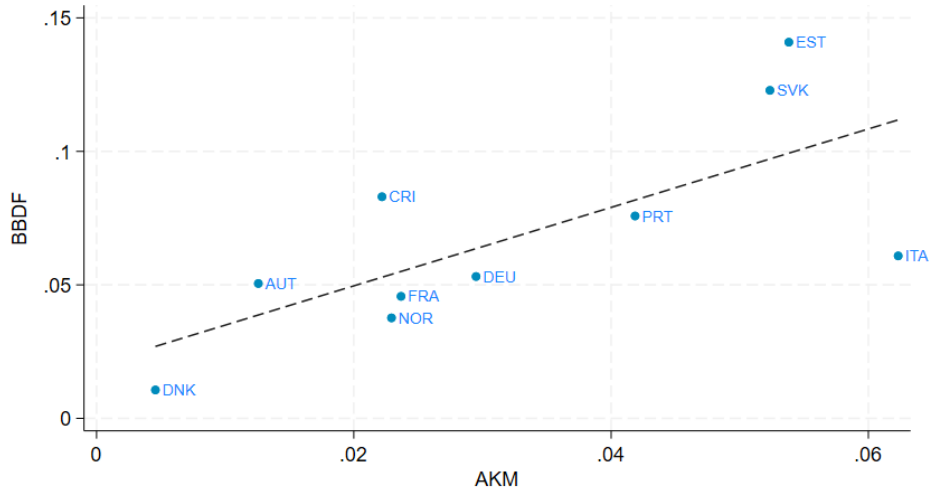


Note: This figure shows the share of wage premia in overall wage dispersion by country group. Data on collective bargaining regime is available for all countries; data on job mobility is available for European countries only. Countries with decentralised bargaining regimes (9): Canada, Costa Rica, Estonia, Japan, Hungary, New Zealand, the Slovak Republic, United Kingdom, United States; countries with centralised bargaining regimes (11): Austria, Denmark, Germany, Finland, France, Italy, Portugal, the Netherlands, Norway, Spain, Sweden. Countries with low job mobility (7, European countries only): France, Germany, Hungary, Italy, Norway, Portugal and the Slovak Republic; countries with high job mobility (8, European countries only): Austria, Denmark, Estonia, Finland, the Netherlands, Spain, Sweden, United Kingdom.
Source: OECD calculations

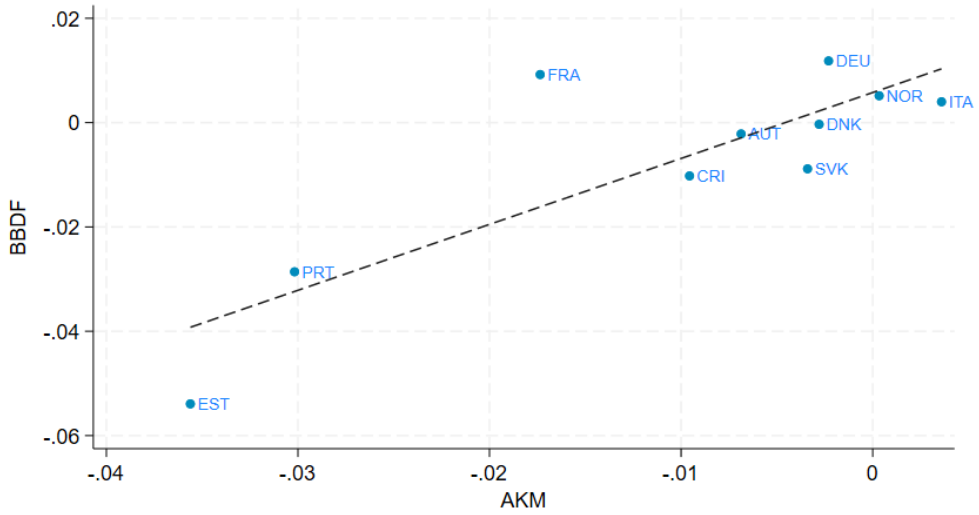
Annex B. Key cross country analysis excluding Hungary, New Zealand and Sweden

Figure B1. Cross-country pattern of firm wage premia is robust to AKM

A. Cross-sectional firm premium dispersion



B. Changes in firm premium dispersion

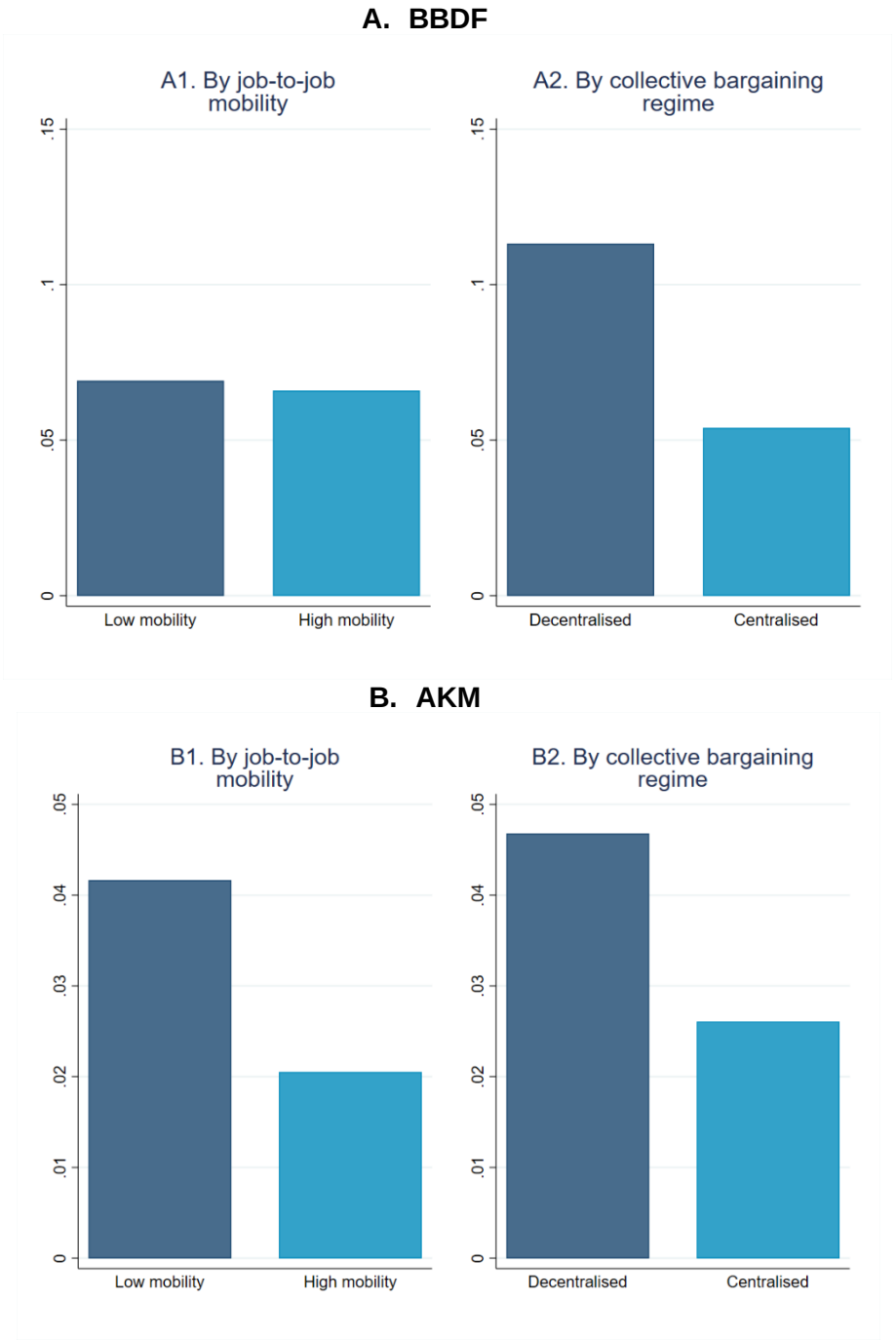


Note: The scatter plot shows firm wage premium dispersion estimated using the baseline BBDF method (on the y-axis) against firm wage premia dispersion in the same country using the alternative AKM method. In Panel A, the cross-section corresponds to the last available year in each country. In panel B, the changes correspond to the difference in variance between the last and first years available. The dashed lines

show the best linear fit. R-squared in Panel A is 0.51 for all countries (0.80 when Italy is excluded); R-squared in Panel B is 0.69. Sample is restricted to a subset of 12 countries (out of 20) where an AKM model could be estimated.

Figure B2. The role of job mobility and collective bargaining in firm wage premia dispersion

Firm wage premia dispersion across country groups, log points



Note: This figure makes use of the dispersion in firm wage premia as documented in Figure 1. Data on collective bargaining regime is available for all countries (OECD, 2019[32]); data on job mobility is available for European countries only (Causa, Luu and Abendschein, 2021[30]). Countries with decentralised bargaining regimes (9): Canada, Costa Rica, Estonia, Japan, Hungary, the Slovak Republic, United Kingdom, United States; countries with more centralised bargaining regimes (11): Austria, Denmark, Germany, Finland, France, Italy, Portugal, the Netherlands, Norway, Spain. Countries with low job mobility (7, European countries only): France, Germany, Italy, Norway, Portugal and the Slovak Republic; countries with high job mobility (8, European countries only): Austria, Denmark, Estonia, Finland, the Netherlands, Spain, United Kingdom.

Annex C. Disclaimers and data references

Canada

The research was undertaken while Wen-Hao Chen was a senior economist at Statistics Canada, Ottawa, Canada. The authors acknowledge and thank Statistics Canada for their research support.

Denmark

Antoine Bertheau gratefully acknowledges financial support from the Norwegian Research Council, Norway (grant number 315760)

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

These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) which are carefully managed by Stats NZ. For more information about the IDI please visit https://www.stats.govt.nz/integrated-data/. The results are based in part on tax data supplied by Inland Revenue to Stats NZ under the Tax Administration Act 1994 for statistical purposes. 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

Erling Barth acknowledges funding from Norwegian Research Council grant #280307, and from Core – Centre for research on gender equality, Oslo.

OECD

Balazs Stadler contributed to the project during his tenure at the OECD

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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