The Graying Job Ladder: The Role of Ageing for Reallocation and Growth

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Abstract

This paper analyses how workforce ageing has tended to slow aggregate wage and productivity growth by dampening growth-enhancing job reallocation. Using linked employer-employee data for 17 countries, we offer three key insights. First, growth-enhancing job reallocation accounts for about a fifth of aggregate wage and productivity growth. This process is mainly driven by job-to-job mobility ("job ladder") of younger workers. Second, since older workers are less mobile than younger workers, they contribute less to growth-enhancing job reallocation. Third, given the rising employment share of older workers, workforce ageing has depressed aggregate wage and productivity growth through growth-enhancing job reallocation. A shift–share decomposition shows that this amounts to 0.12 percentage points lower annual aggregate wage and productivity growth over the 2000s and 2010s.

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1 Introduction

Advanced economies are undergoing a rapid demographic transition that threatens to weigh on long-term prosperity and living standards (see e.g. OECD, 2025). While macro-level studies suggest that population ageing reduced wage and labour productivity growth in the United States during the 1980–2010 period (Maestas et al., 2023), the precise mechanisms connecting demographic change to this slowdown remain unclear. Potential offsets like capital deepening appear small (Acemoglu and Restrepo, 2021; Maestas et al., 2023), and micro-level evidence on the direct link between an older workforces and firm productivity is mixed and often context-dependent (Hernæs et al., 2023; Carta et al., 2021; Goebel and Zwick, 2009; Börsch-Supan and Weiss, 2016).

This ambiguity suggests that the link between ageing and declining wage and productivity growth may stem less from declines within firms and more from frictions in the allocation of resources between firms of different quality. Indeed, aggregate wage and productivity growth depends critically on the continuous growth-enhancing reallocation of resources up the job ladder from lower- to higher quality firms (Haltiwanger et al., 2018). Yet, while a separate literature has documented a fall in labour market dynamism (Decker et al., 2020; Hopenhayn et al., 2022), it has largely focused on firm entry and adjustment frictions rather than demographic composition. Also recent evidence confirms that worker reallocation across firms is a key driver of aggregate productivity growth, as productivity gains materialize disproportionately through workers' transitions toward more productive employers (Albagli et al., 2024).

In this paper, we bridge these perspectives by quantifying the impact of ageing on growth-enhancing reallocation using harmonised linked employer-employee data from 17 high-income countries covering the 2000s and 2010s.[1] We demonstrate that the shift toward an older workforce slows the process of growth-enhancing reallocation. By increasing the share of workers whose labour market transitions are less responsive to firm quality, ageing mechanically dampens the aggregate capacity of the economy to reallocate labour to its most productive uses. Our analysis proceeds in four steps to document the stylised facts, isolate the mechanism, and quantify the aggregate impact.

First, we establish the life-cycle patterns of sorting across 17 diverse labour markets. In every country in our sample, and despite vast differences in labour market institutions, young workers move up the job ladder at significantly higher rates than older workers, sorting into higher-wage and higher-productivity firms. This consistency suggests that the age-mobility gradient is a structural feature of labour markets in advanced economies (Engbom, 2019), rather than a phenomenon related to country-specific labour market institutions.

[1] Austria, Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Lithuania, the Netherlands, New Zealand, Norway, Portugal, Spain, and Sweden.

Second, we isolate the mechanism linking labour market transitions and growth by estimating the responsiveness of firm-level employment growth to firm quality. Following the framework of Decker et al. (2020), we find that high-quality firms grow primarily by attracting younger workers through job-to-job transitions. As the workforce ages, this responsiveness to firm quality decreases. Older workers are less likely to transition up the job ladder to higher quality firms, perhaps due to higher moving costs (e.g. housing or family ties) or a preference for non-wage amenities over wage premiums. Consequently, an ageing workforce reduces the speed at which resources are reallocated toward higher-quality firms, slowing aggregate growth in wages and productivity.

Third, we connect this firm-level responsiveness to aggregate wage and productivity growth. We show that the between-firm component of aggregate growth depends jointly on the responsiveness of worker transitions and the dispersion of firm quality (labour productivity or average firm wages). A worker-level decomposition based on Hahn et al. (2021) further confirms that job-to-job mobility is the primary driver of aggregate wage growth and declines with age. In contrast, the contributions of flows into and out of non-employment are often smaller or negative, partially counterbalancing the positive impact of job-to-job transitions.

Fourth, we quantify the implications of ageing for aggregate wage and productivity growth using a shift-share decomposition. We find that workforce ageing has dampened aggregate wage growth due to slowed reallocation by approximately 0.12 percentage points per year over the 2000s and 2010s. Given that average annual wage growth from reallocation was only 0.6% over this period, this represents a substantial drag. The impact on productivity growth is of a similar magnitude (-0.12 pp). Importantly, we distinguish between a *share effect* of ageing (changes in composition) and a *differential shift effect* (changes in age-specific mobility). While the composition effect is negative, we document that the drag of ageing was partially offset by a positive differential shift, where older workers became more responsive to differences in firm quality over time.

These findings have several policy implications. The importance of the job ladder implies that policies providing flexibility for firms need to be complemented with policies that promote job mobility for workers. Traditionally, discussions on efficiency-enhancing reallocation have emphasized employment flexibility (e.g. employment protection, product market regulation). Policies should therefore combine employment flexibility for firms with measures that facilitate worker mobility, including by addressing policy-related barriers such as professional licensing requirements or the widespread use of non-compete clauses, and by tackling barriers linked to skill mismatches or geographic immobility.

Policies that sustain a flexible workforce across all ages and that support mid-career and older workers are particularly relevant. Since these groups are less mobile, ageing slows growth-enhancing job reallocation and dampens aggregate growth. Whether this lower mobility reflects

higher moving costs (e.g. job security, housing, fewer working years left) or better matches, policy has a role to play in supporting transitions of older workers to higher-quality firms. This includes targeted employment and training services, but also reforms that reduce moving costs, such as portable severance pay, lower transaction taxes in housing markets, or more flexible rental regulations. Policies can also strengthen incentives for mobility at older ages through training and career guidance.

The remainder of the paper is organized as follows. Section 2 describes the linked employer–employee data and our process of harmonisation. Section 3 documents the universal decline in job mobility with age. Section 4 examines firm-level responsiveness, showing that the speed of growth-enhancing reallocation declines as workers age. Section 5 connects these micro-dynamics to aggregate growth in wages and productivity. Finally, Section 6 quantifies the contribution of ageing to the productivity slowdown, and Section 7 concludes.

2 Data

We analyse worker mobility along the firm-quality distribution using linked employer-employee data from 17 countries (see Table 1 for details): Austria, Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Lithuania, the Netherlands, New Zealand, Norway, Portugal, Spain, and Sweden. These data are constructed from administrative records that typically originate from social security or tax registers, and in most cases cover the universe of workers and firms. Throughout our analysis, we denote these workers by $i \in \{1, \ldots, N\}$ and firms by $j \in \{1, \ldots, J\}$.

In some cases, where the universe of workers and firms is not available, the data instead cover a large and representative sample.[2] The period of observation across our datasets varies somewhat across countries but typically covers the early 2000s up to 2019 (see Table 1), allowing for consistent cross-country comparisons of employment dynamics, job reallocation, and the contribution of labour mobility to wage and productivity growth. Crucially, we conduct our empirical analysis separately for each country before comparing patterns across countries. This approach ensures that cross-country differences in data collection (e.g., wage reporting units) do not confound our results, provided that rankings within countries are consistent.

The underlying data contain a large variety of information on workers and firms, at the minimum including age, gender and wages (or earnings)[3] for workers, as well as 2-digit NACE industries and employment levels for firms. In some countries, we also record information on

[2]Specifically: Belgium (10% sample of workers), France (1/12th sample of workers), Germany (10% sample of workers), Italy (8.6% sample of firms), and Spain (4% sample of workers). Notably, in countries with firm-based samples, like Italy, information on the firms workers transition from and to the sampled firms is retained, permitting the analysis of labour market mobility.

[3]We impute earnings following the procedure of Card et al. (2013) where they are censored above a certain ceiling (e.g. in Germany).

working hours[4] as well as tenure at their current employer[5] for workers. On the firm-level, some countries have additional information on value-added, which is derived from balance sheet data and defined as revenues minus intermediate inputs.[6] Based on this, we define firm-level labour productivity as value-added per person employed.

2.1 Harmonising the data

To the extent possible, we harmonise the datasets across countries to ensure methodological consistency. For example, in line with Haltiwanger et al. (2018) and Decker et al. (2020), we exclude employment in the public and the agricultural sector[7], and also exclude self-employment. Employment is therefore defined as dependent, non-agricultural private sector employment. As a result, workers registered as not employed under this definition may be employed in the public sector, self-employed, unemployed or inactive. For each dataset, we restrict the sample to workers aged 15 to 64. Workers are also restricted to have a single job per year by selecting the primary employer, defined as the job from which an employee receives the highest earnings in a given year, while ties are handled by selecting at random.

Whenever possible, we derive individual hourly wages by dividing annual earnings from the main employer by the total hours worked for this employer in the same year.[8] These encompass regular wages, overtime, and bonuses, all before taxes and social security deductions, which we deflate to 2015 constant units using the OECD Consumer Price Index. For countries where information on hours is not available, we use equivalent daily, monthly or annual earnings.[9] For both wages and labour productivity, we set zero or negative values to missing while retaining the employment spell of workers. To address outliers, the annual top 0.1% of wages as well as

[4]This is the case for Denmark, Finland, France, Hungary, Italy, the Netherlands, Portugal, and Sweden. Where available, we use paid hours, and otherwise contractual hours (as in Hungary, Italy, and Sweden).

[5]Where tenure is not available, we compute it from the available data, aware that it may be subject to left-censoring.

[6]Value added measures are available for Canada, Denmark, Finland, France, Hungary, Italy, Netherlands, Portugal, and Sweden. Due to methodological breaks affecting employment levels and productivity measures, value added data for France exclude the years 2008-2009 and 2015-2017. For the Netherlands, value added data exclude the financial sector.

[7]Recent evidence suggests that ignoring the public sector introduces only negligible bias in measuring aggregate labour market dynamics, particularly in European contexts where the two sectors are highly segmented with limited direct mobility between them (see e.g. Fontaine et al., 2020). We take a broad definition of the public sector, excluding industries coded O through U in the NACE rev. 2 classification (education, health, culture, other services, private households with employed persons, and extraterritorial organisations).

[8]For Hungary, Portugal, and Sweden, we compute hourly wages by dividing monthly wages by monthly hours worked.

[9]Since our analysis focuses on movements along the *within-country* firm-quality distribution, cross-country differences in the unit of measurement (e.g. hourly vs. daily) do not confound our results, provided that these measures yield consistent relative rankings of firms within each country. While the absence of working time measures in countries with significant part-time employment (e.g., Austria and Germany) could affect precision, the literature documents a significant wage penalty for part-time work, implying a positive correlation between working hours and hourly wages (see e.g. Hirsch, 2005). Consequently, firms ranking low in daily, monthly or annual earnings typically rank low in hourly wages as well, preserving the ordinal structure of the job ladder.

wages below 80% of the minimum wage are winsorised.[10] We winsorise firm labour productivity at the annual top and bottom 1% across the entire distribution.

2.2 Measuring firm quality

To analyse the process of growth-enhancing reallocation on the labour market, we require a consistent measure of firm quality that allows us to rank employers within each country. We define the quality $q_{j,t}$ of firm j in year t primarily by the average log wages of workers employed in the firm, and alternatively by log labour productivity, measured in terms of value-added per worker, for the nine countries where this information is available. To reduce the role of measurement error, which is present in particular for labour productivity measures, firm quality is averaged between $t-1$ and $t-3$.

While average wages and labour productivity are not the only measures of firm quality that may determine labour market mobility (see e.g. Sorkin, 2018; Cazes et al., 2015; Le Barbanchon et al., 2021), they remain the standard proxies for firm quality in the literature on job ladders and reallocation (e.g. Haltiwanger et al., 2018; Bertheau and Vejlin, 2025). Moreover, given the large cross-country dimension of our analysis, average wages represent the only quality metric consistently available across all administrative datasets in our sample.

Recent evidence highlights the complex relationship between wage and productivity measures to rank firms. Lochner and Schulz (2024) document a non-monotonic 'hump-shaped' relationship where the most productive firms do not necessarily pay the highest wages, while workers sort more strongly based on wages. Conversely, Bertheau and Vejlin (2025) argue that total factor productivity (TFP) may be a better indicator of the job ladder than wages, as high-productivity firms exhibit stronger net poaching rates. However, they also demonstrate that less direct productivity measures (such as sales per worker) can yield misleading cyclical results. Given these measurement challenges and the fact that workers sort strongly on wages (Lochner and Schulz, 2024), we rely on average wages as our primary metric, while using productivity as a supplementary measure where available.[11]

[10] For countries that do not have a country-wide minimum wage, we winsorise wages below 20% of the median. For consistency of the German data, where a minimum wage was introduced in 2015, only wages below 20% of the median are winsorised.

[11] Another option would be to measure firm quality using firm fixed effects based on the model of Abowd et al. (1999, henceforth AKM). We opt for average wages for several reasons. First, AKM estimates are only identified within a "connected set" of firms linked by worker mobility. For the countries where our datasets are random firm or worker samples, many of these links are broken, drastically reducing the connected set and introducing severe selection bias towards large firms. Second, AKM estimates suffer from "limited mobility bias" in small firms (Bonhomme et al., 2023), creating measurement error, particularly for smaller countries in our data. Third, Haltiwanger et al. (2025) demonstrate that rankings based on average wages and AKM fixed effects are highly correlated, suggesting little loss of generality in our context. Moreover, as AKM fixed effects are identified from the very mobility patterns we analyse, using average wages alleviates concerns regarding mechanical correlations between firm rankings and worker flows.

2.3 Identifying labour market transitions

The panel structure of our data allows us to track both workers and firms over time and to separately identify different types of labour market flows along the firm-quality distribution between $t-1$ and t: hires through job-to-job transitions, separations through job-to-job transitions, hires from non-employment, separations into non-employment, and within-firm stayers. We also define net terms of these flows. Specifically, net job-to-job mobility is defined as the difference between job-to-job hires and job-to-job separations. Similarly, net entry from non-employment is the difference between hires from non-employment and separations into non-employment. We assign flows originating from workers entering the sample for the first time (e.g., new labor market entrants) to hires from non-employment, as well as flows originating from workers permanently exiting (e.g., retirement or death) to separations into non-employment.[12]

In order to reduce the potential of spurious transitions confounding our results, we employ the method proposed by Hethey-Maier and Schmieder (2013) to identify cases where firm IDs change for administrative reasons or through corporate restructuring events (such as mergers and acquisitions).[13] We clean these transitions because they do not correspond to a worker's genuine move across the job-quality ladder or a change in the underlying economic unit. Their inclusion would introduce noise without reflecting true labour market transitions. Finally, we exclude the first year of observation for each country's results, as flow measures conditional on the labour market in $t-1$ are mechanically undefined at the start of the sample.

A potential limitation of our data is that job-to-job transitions are measured on an *annual* basis. As discussed in the literature (e.g. Foster et al., 2001; Moscarini and Postel-Vinay, 2016; Hahn et al., 2021; Bertheau and Vejlin, 2022), relying on yearly observations may imply some measurement error in capturing the exact timing of worker flows across firms (time aggregation bias) as individuals may experience multiple intermediate transitions or short non-employment spells that remain unobserved at our sampling frequency.

In our setting, however, this concern is mitigated because our main interest lies in the *direction* of movement along the firm-quality ladder rather than the exact frequency of transitions. Consequently, our estimates of wage- or productivity-enhancing reallocation are likely *conservative* for two reasons. First, annual data naturally filter out high-frequency noise, capturing the worker's *net* reallocation between t and $t+1$. Even if a worker moves across several firms

[12] Our measure of sample entry includes all workers observed in year t who were not present in the sample in prior years. Notably, in the initial years of the sample, we cannot distinguish between genuine labour market entrants and re-entrants who were employed prior to the start of our observation period. Similarly, sample exit measures may include workers who return to employment after our observation period ends. As such, the distinction between sample entry/exit and employment mobility is not well-defined at the beginning and the end of our sample period. Pooling entry/exit flows with non-employment flows avoids such misclassification.

[13] We do so only for data that contains the universe of workers and firms, as the method proposed by Hethey-Maier and Schmieder (2013) relies on identifying maximum clustered inflows and outflows, which are not well defined on sampled data.

within the year, what matters for our analysis is whether she ends up in a firm with higher (or lower) quality. Second, as we demonstrate in Appendix A using high-frequency Austrian spell data, aggregation bias affects quantity and quality in opposite directions. While time aggregation inflates the *gross volume* of transitions by including transitions with intermediate non-employment spells, these moves are significantly less likely to be productivity-enhancing than genuine job-to-job transitions. The potential inclusion of intra-annual non-employment spells in our definition of job-to-job mobility therefore dilutes the measured efficiency of flows, implying that the relative importance of job-to-job mobility for efficiency-enhancing reallocation is likely even higher than what we report.

Overall, the richness of our data and the large cross-country dimension makes it possible to quantify the contribution of job reallocation to wage and productivity dynamics, while accounting for the role of firm entry and exit, as well as compositional changes in the workforce.

3 Workers' mobility by age and gross job reallocation

Job mobility declines with age for several reasons. First, older workers face limited geographical mobility, often due to stronger family ties and higher rates of home ownership (Mincer, 1978; Oswald, 1999). Second, labour market frictions and institutional constraints play a crucial role. For instance, tenure-related benefit entitlements can strongly tie tenured workers to their current employer (Kettemann et al., 2017; Garcia-Louzao, 2022). Similarly, because dismissal risk is inversely related to tenure (Topel and Ward, 1992), switching jobs entails a loss of accumulated security, which is compounded by the significantly lower re-employment probabilities faced by older workers (Chan and Stevens, 2001).

Beyond these constraints, economic incentives also depress mobility as workers age. Older workers typically possess substantial firm-specific human capital, which is non-transferable and increases with tenure (Becker, 1964; Stevens, 1994). Furthermore, as they are more likely to have already climbed the job ladder to a suitable match, the marginal value of searching for outside offers naturally declines (Engbom, 2019). Simultaneously, the time horizon for reaping the returns on new human capital investments shortens, while cognitive adaptability may eventually decline (Skirbekk, 2004). Consequently, rational agents choose to reallocate early in their careers when the returns to mobility are highest, becoming increasingly reluctant to switch employers as they age.

This is exactly what we find in the data. In Figure 1, we plot the probability of a job-to-job transition and the probability of entering employment from non-employment.[14] For both transition types, the age profile of job mobility exhibits a remarkably similar qualitative decline

[14]Transitions from non-employment include sample entry, corresponding to the flow of those who enter the dataset for the first time.

across the 17 countries we consider. A noteworthy feature of Figure 1 is the consistency of this pattern across very different countries, suggesting that institutional factors may influence the level of job mobility, but probably play a limited role in shaping the evolution of mobility by age.

We then look at the evolution of mobility over time. Table 2 provides a concise representation of the long-run behaviour of worker flows, averaged across the 17 countries. The first row reports the average level of each flow at the midpoint of the sample period (year 2013), whereas the second reports their annual evolution net of country averages. Job-to-job mobility, which in our definition may also include intra-annual transitions in and out of non-employment, amounts to roughly 16% of total employment each year. Employment hires (i.e. hires of workers with past work experiences, but not employed the previous year) constitute a smaller share—around 8%. Sample entry and exits are the shares of those who find a job for the first time or abandon it and leave the sample, respectively. They both amount on average to roughly 7%.

When cumulated over a 15-year horizon—approximately the average length of our sample—these trends imply economically meaningful changes. Job-to-job mobility displays a persistent decline of –0.001 per year, corresponding to a cumulative reduction of 1.5 percentage points over 15 years. Given a midpoint level of 0.16, this amounts to a drop of nearly 10 percent. Gross flows and sample entry instead exhibit just a slightly negative trend (–0.0013 per year). The other flows instead tend to increase over time on average.

Table B.2 in Appendix B reports the country-specific trends in gross flows. Over the 15-year period we consider, substantial decline in dynamism is observed in Canada, Denmark, the Netherlands, Norway, and New Zealand. The quantitative impact of these country-level trends is, however, relatively small, and we therefore abstract from them in the analysis that follows.

Table 3 reports a decomposition of worker flows across age groups based on regressions that include only age fixed effects and country-by-year fixed effects. These statistics capture the pure life-cycle structure of mobility, averaged across 17 OECD countries: they measure how each age group differs from young workers (15–24), after netting out aggregate shocks that vary across countries and time. Across all flow types, the pattern is remarkably consistent. Young workers exhibit the highest mobility and therefore constitute the reference group. Mobility declines immediately and sharply with age. For job-to-job hires (column 3), the estimated fixed effects become increasingly negative across age groups, with workers aged 55–64 displaying levels more than 14 percentage points lower than those aged 15–24. Employment hires (col. 4) show a milder but still monotonic decline with age.

Sample entry (col. 5) exhibits even stronger age gradients. Entry rates fall by around 20–24 percentage points relative to the youngest workers, while exit rates display a distinct

asymmetry: exit declines with age up to 54 but increases again for the 55–64 group, reflecting retirements and administrative exits linked to labour force withdrawal. Gross flows (col. 7) combine all components and show the steepest declines: the fixed effects for the 55–64 group are nearly 65 percentage points below those of the youngest workers, reflecting both lower job-to-job mobility and lower churn within employment.

Panel B of Table 3 combines the age fixed effects with the average employment shares of each age group, identifying the quantitative role of each cohort in shaping the aggregate level of flows. Middle-aged workers (35–54) consistently generate the largest negative contributions: they have large population shares and substantially lower mobility than young workers. Older workers (55–64) have the lowest mobility, but their relatively smaller population share produces somewhat smaller contributions in absolute terms.

4 Firm-level responsiveness and worker flows

Declining dynamism, e.g. job creation and destruction in incumbent firms (as well as entry and exit of firms), may be one factor that has contributed to the slowdown of wage and productivity growth observed in many high-income countries during the 2000s and the 2010s. To achieve *growth-enhancing* reallocation, workers must move from less productive and lower-paying firms to more productive and better paying firms. If the overall dynamism is slowing down, this may push down growth-enhancing reallocation as well.

For example, Decker et al. (2020) examine the decline in U.S. business dynamism and its impact on productivity, and find that while idiosyncratic shocks to firm productivity have become more dispersed, firms' responsiveness, i.e. their ability to adjust employment in reaction to these shocks, has weakened. Decker et al. (2020) connect this decline to growing adjustment frictions, such as regulatory constraints or organisational rigidities. As a result, the US economy reallocates resources less efficiently than in the Eighties and Nineties, contributing to slower aggregate productivity growth.

To measure the extent of this growth-enhancing job reallocation at the micro level in our framework, we follow the methodology of Decker et al. (2020). Concretely, for all private-sector non-agricultural firms, we estimate an employment-weighted firm-level regression on how employment growth in firm j responds to firm quality:

$$\Delta E_{jt} = \beta_0 + \beta_1 q_{jt-1} + \beta_2 E_{jt-1} + \delta_t + \varepsilon_{jt} \tag{1}$$

where ΔE_{jt} is the DHS employment growth rate[15] of firm j at time t, lagged firm quality

[15]DHS employment growth is defined as $\Delta E_{jt} = \frac{E_t - E_{t-1}}{0.5(E_t + E_{t-1})}$ following Davis et al. (1996). This normalization is robust to firm entry and exit, as it can be calculated even when $E_{t-1} = 0$ (entry) or $E_t = 0$ (exit).

of firm j is denoted by q_{jt-1} and lagged employment by E_{jt-1}. Time fixed effects enter as δ_t. As mentioned above, firm quality is mainly proxied by average log wages and, when available, we also run regressions using log labour productivity measured by value added per worker. To enhance cross-country comparability, firm quality q_{jt-1} is standardized in the corresponding year and country, measuring the change in employment growth rates associated with a one standard deviation increase in firm quality.

The coefficient β_1 of equation (1) measures the *responsiveness* of employment growth to firm quality.[16] A positive and significant β_1 means that higher-quality firms expand employment relative to lower-quality firms, implying growth-enhancing job reallocation. In this sense, β_1 can be interpreted as a measure of the strength of the job ladder, capturing the speed with which the labor market reallocates workers toward higher quality firms. Importantly, we can decompose this overall responsiveness of employment growth to firm quality into the specific labor market flows that contribute to growth-enhancing reallocation (i.e., net job-to-job mobility and net non-employment mobility), by replacing the dependent variable of Equation (1), ΔE_{jt}, with the DHS version of the respective flow. Because speed of growth-enhancing job reallocation or its flows is constrained by labor market distortions and adjustment frictions (Decker et al., 2020), any obstacle to efficient resource flow translates into a lower estimated β_1 coefficient.

Compared to Decker et al. (2020), our data have a shorter time coverage which do not allow us to fully analyse the evolution of responsiveness over a long time horizon. Nevertheless, estimating this equation is particularly useful in our framework, because it allows us to disentangle the contribution of job-to-job flows and flows in and out of non-employment to employment growth and to isolate the contribution of ageing.

An important caveat of this model is that it can only be estimated for incumbent firms (due to non-defined firm quality for entrants). Therefore, we essentially ignore firm entry, which can be a considerable source of labour market dynamism and aggregate growth (Haltiwanger et al., 2014). In the following sections, which explore growth-enhancing reallocation and the role of ageing, however, this limitation is likely to yield conservative estimates of the negative impact of ageing on aggregate wage and productivity growth. The main reason is that declining population growth rates imply that incumbent firms can absorb a larger share of the new labour supply, leaving less residual labour supply to be absorbed by firm entry (Hopenhayn et al., 2022).[17] Consequently, while firm entry remains vital for dynamism, its relative contribution to aggregate growth likely declines as workforce growth slows, suggesting that our focus on

[16] By running the alternative regression with industry fixed effects γ_i, we measure the speed of growth-enhancing job reallocation within industries. The speed of reallocation between industries can then be obtained by taking the difference between the coefficient estimated without industry fixed effects and the coefficient estimated with them.

[17] Hopenhayn et al. (2022) also argue that the decline in firm entry, and the resulting rightward shift in the firm-age distribution, affects reallocation. However, the main channel they consider is that older firms create, destroy, and reallocate jobs at lower rates, and not because older workers move less.

incumbent reallocation captures the dominant channel of adjustment in ageing economies.

Figure 2 reports the estimates of β_1, the firm-level responsiveness of employment growth to average wage levels, for each country and the contribution of net job-to-job mobility and net employment mobility, defined as the firm-level sum of inflows and outflows and averaged over the period of data availability (see Appendix Figure C.1 for responsiveness measured relative to labour productivity instead). The figure shows that responsiveness is rather similar across countries, averaging close to 4%, with the exception of Hungary and Italy at the two extremes. Notably, job-to-job mobility explains about 70% of the overall speed of growth-enhancing reallocation, showing a considerably stronger correlation with firm quality than employment mobility. The role of job-to-job mobility is particularity important in countries like Denmark, Sweden, New Zealand and Canada, and less so in Hungary, Portugal and Italy.

Figure 3 further reports the estimated responsiveness of job-to-job flows and net employment flows to firm quality over time (by country in grey; unweighted average in red) (see Appendix Figure C.2 for responsiveness to labour productivity). Despite the large time variability, particularly within countries, the average responsiveness of both flows is relatively stable over time, with some volatility around the 2008 global financial crisis. This stability suggests that the job-ladder mechanism, driven by job-to-job transitions, is a persistent structural feature of these labor markets rather than a purely cyclical phenomenon. The figure also confirms the relatively stronger responsiveness of job-to-job flows to firm quality compared to net employment flows for all the years considered.

We then analyse the relative contribution of job-to-job flows and employment flows at different points of the firm quality distribution. To this end, we estimate Equation (1) by replacing the continuous measure of lagged firm q_{jt-1} with quintile dummies recording the position of firm j in the lagged firm quality distribution. The coefficients on the firm quality quintile dummies are expressed in deviation from aggregate employment growth and decomposed to identify the contributions of job-to-job mobility and employment. The results are reported in Figure 4, year by year (see Appendix Figure C.3 for responsiveness to labour productivity).

Employment growth only responds sizably and positively to firm quality in the upper 40% of the firm quality distribution and negatively in the lower 20%. Moreover, job-to-job flows in the fourth and fifth quintiles are the main drivers of responsiveness among incumbent firms, with more modest contributions of net employment flows. Conversely, while firms in the lowest 20% of the firm quality distribution also lose a non-negligible share of workers through net employment flows, they primarily shed workers through job-to-job flows. Based on this evidence we can conclude that the mechanism that reallocates jobs from firms of lower quality to firms of higher quality mostly depends on direct job-to-job flows.

Given the evidence on the negative age-gradient in job-to-job transitions presented in Section 3, we also estimate Equation (1) by 10-year age group, again using the continuous measure

of lagged firm q_{jt-1}. Figure 5 reports the results year by year, distinguishing between the contributions of job-to-job flows and net employment flows (see Appendix Figure C.4 for responsiveness to labour productivity). The responsiveness of employment growth to firm quality is particularly high when flows involve younger cohorts, both for job-to-job flows and net employment flows, and monotonically declines with age. Notably, the contribution of job-to-job flows is relatively higher than that of net employment flows until age 44. Beyond this age, the flows of older workers are only weakly correlated with firm quality with little to no difference between job-to-job flows and net employment flows. This steep decline in responsiveness by age, which indicates that sorting slows down significantly as workers age, is the key mechanism that we will leverage in Section 6 to quantify the impact of ageing on aggregate wage and productivity growth.

The age-related decline in the contribution of job-to-job flows to responsiveness is sharper than that of employment flows. Several factors may explain the lower responsiveness of employment growth to firm quality at older ages. First, supply-side factors may reduce responsiveness. Older workers often face higher costs of mobility (e.g., home ownership, family ties) or may trade off pecuniary gains for non-wage amenities (job security, flexible hours) over wage premiums offered by high-quality firms. Second, demand-side factors may also play a role, as firms may face higher adjustment costs for older workers, or the complementarity between capital and labor may differ by age. Third, older workers may also feel that they have little to gain from changing employers either as they have already climbed the job ladder and marginal value of job transitions is lower (see e.g. Engbom, 2019). In contrast, net employment flows are likely driven more by involuntary movements, exhibiting a significantly weaker age gradient. While our framework cannot fully disentangle these channels, whether driven by frictions or preferences, the sorting of older workers is significantly less responsive to productivity and wage signals than that of younger workers, dampening the process of reallocation and its contribution to aggregate growth.

5 From firm-level responsiveness to aggregate growth

Having established that workers flow directionally toward higher quality firms, primarily through job-to-job transitions among younger workers, we now quantify the aggregate economic dividend of this process. While the previous section demonstrated that high quality firms grow faster, this section explores how much this process contributes to overall wage and productivity growth in contrast to within-firm growth that comes about through sources other than labour market reallocation.

To answer this, we decompose aggregate firm quality growth $\Delta\bar{q}_t$ into a within-firm component – firm quality increases for workers who remain with the same employer (stayers) – and a between-firm component – firm quality increases driven by the reallocation of workers

across firms through job-to-job transitions and employment mobility. We decompose aggregate growth as follows:

$$\Delta \bar{q}_t = \underbrace{\sum_j \bar{e}_{j,t} \Delta q_{j,t}}_{\text{Within-firm}} + \underbrace{\sum_j \Delta e_{j,t} (\bar{q}_{j,t} - \bar{q}_t)}_{\text{Between-firm}} \tag{2}$$

where $e_{j,t}$ represents the employment share of firm j at time t among all firms in the sample. To avoid approximation errors and residual cross-terms, we use time-averages for weights and reference values over the two periods t and $t-1$, with $\bar{e}_{j,t}$ being the average employment share, $\bar{q}_{j,t}$ the firm's average quality, and $\bar{q}_t$ denotes the average aggregate firm quality. The first term captures the contribution of within-firm quality growth, weighted by the firm's average size. The second term represents the contribution of between-firm reallocation. This term is positive if firms with higher-than-average quality ($\bar{q}_{j,t} > \bar{q}_t$) increase their employment share ($\Delta e_{j,t} > 0$).

Since changes in employment weights $\Delta e_{j,t}$ are proportional to $\beta q_{j,t-1}$, the reallocation component can be expressed as

$$\sum_j \Delta e_{j,t} (\bar{q}_{j,t} - \bar{q}_t) \;\approx\; \beta_1 \operatorname{Var}(q_{j,t-1}) \tag{3}$$

highlighting that the contribution of growth-enhancing reallocation to aggregate growth depends jointly on responsiveness (β_1 from Equation (1)) and the dispersion of firm quality ($\operatorname{Var}(q_{j,t-1})$). Intuitively, if firms with higher $\bar{q}_{j,t}$ gain employment weight ($\Delta e_{j,t} > 0$), the aggregate average quality $\bar{q}_t$ rises via reallocation.

Alternatively, one can focus on the contribution of different types of labour market mobility to firm quality growth using a worker-level decomposition, following Hahn et al. (2021). Here, we define dummy variables that capture the mobility state for each worker i in each period t following a similar convention as in Section 4: job stayers (r_{it}), job-to-job movers (j_{it}), hires from non-employment (h_{nit}), and separations into non-employment (s_{nit}). The total number of workers of each mobility type is denoted as R_t, J_t, H_{Nt}, and S_{Nt}, respectively. The number of workers employed in period $t-1$ is therefore:[18]

$$E_{t-1} = R_t + J_t + S_{Nt},$$

[18] Job stayers (R_t) and job-to-job movers (J_t) do not affect total employment between $t-1$ and t. Changes in total employment are instead driven by hires from non-employment (H_{Nt}) and separations into non-employment (S_{Nt}).

while in period t it is:

$$E_t = R_t + J_t + H_{Nt}.$$

With these definitions, aggregate firm quality growth $\Delta\bar{q}_t$ can be decomposed into the contributions of different labour market mobility types (see Hahn et al., 2021, for details):

$$\begin{aligned}\Delta\bar{q}_t = &\underbrace{\frac{\left(\frac{R_t}{E_t} + \frac{R_t}{E_{t-1}}\right)}{2R_t}\sum_i r_{it}\Delta q_{it}}_{\text{Stayers}} + \underbrace{\frac{\left(\frac{J_t}{E_t} + \frac{J_t}{E_{t-1}}\right)}{2J_t}\sum_i j_{it}\Delta q_{it}}_{\text{Job-to-job movers}} \\ &+ \underbrace{\frac{1}{H_{Nt}}\sum_i h_{nit}\left(q_{it} - \tilde{q}_t\right)}_{\text{Entrants from non-employment}} - \underbrace{\frac{1}{S_{Nt}}\sum_i s_{nit}\left(q_{i,t-1} - \tilde{q}_t\right)}_{\text{Exits to non-employment}}\end{aligned} \tag{4}$$

Here, q_{it} denotes the firm quality,[19] i.e. the average wage or labour productivity of the firm individual i is employed at in year t, and $\tilde{q}_t$ is a reference level of firm quality for non-employed workers, based on a weighted average for stayers and job-to-job movers:

$$\tilde{q}_t = \frac{R_t}{R_t + J_t}\left(\frac{1}{2R_t}\sum_i r_{it}(q_{i,t} + q_{i,t-1})\right) + \frac{J_t}{R_t + J_t}\left(\frac{1}{2J_t}\sum_i j_{it}(q_{i,t} + q_{i,t-1})\right)$$

Formally, the worker-level decomposition can be related back to the firm-level regression in Equation (1), since the between-firm term corresponds to the product of responsiveness and dispersion of firm quality (i.e. $\beta_1 \text{Var}(q_{j,t-1})$). The larger the dispersion and the speed to which workers move to highly paying firms, the higher is wage growth. However, unlike the firm-level analysis of growth-enhancing job reallocation, the worker-level decomposition of aggregate wage growth is not limited to incumbent firms but also includes workers entering new firms.

Figure 6 reports the results by country (see Appendix Figure C.5 for results concerning labour productivity). By shifting the structure of employment to firms of higher quality, job-to-job mobility plays a significant role in aggregate wage growth in all the countries considered. On average across countries, job-to-job mobility contributes 0.9 percentage points to average annual wage and productivity growth. While the contribution of job-to-job mobility is considerable, it is largely offset by the negative contribution of employment mobility. This mainly reflects life cycle effects that arise as young workers start their careers in low wage and low productivity firms. Consequently, the large contribution of job-to-job mobility primarily reflects its role in integrating new entrants into the labour market. On net, overall job reallocation, which is the sum of job-to-job and employment mobility, contributes 0.3 percentage points

[19] Unlike the firm-level analysis presented in Section 4, we measure firm quality directly in period t, rather than relying on an average between $t-1$ and $t-3$.

to aggregate wage growth (16% of total growth). The remaining part reflects wage growth within continuing worker-firm matches ("stayers"). The importance of job-to-job mobility for aggregate wage growth is consistent with previous findings by Hahn et al. (2021) for the United States and Hijzen et al. (2024) for Norway.

Next, Figure 8 reports the evolution of the within component, the job-to-job component and the employment mobility component by country (grey lines) and year, with the red line corresponding to the unweighted average across countries (see Appendix Figure C.6 for results concerning labour productivity). This figure confirms that the evolution of wages is highly influenced by cyclical conditions. Both the within and the job-to-job components declined considerably during the global financial crisis and increased again afterward, returning close to their levels after the crisis.

Last, Figure 7 reports the same decomposition by age group. Younger cohorts tend to work in firms characterised by lower within component (see Appendix Figure C.7 for results concerning labour productivity). Thus, for them, firm quality increases mainly through job mobility (and to less extent employment mobility). In the older age groups instead firm quality growth is mainly determined by the within component, i.e. growth inside the firm. For older workers job mobility is negligible while employment mobility is negative, suggesting both that older workers forced to separate and re-enter the labour market after some year are likely to be negatively selected. This suggests that older workers separated from employment have difficulties to reallocate in high quality firms. Importantly, for each age group the bars are ordered in descending order with respect to total firm quality growth. It is interesting to note that country ranking varies across age groups.

6 The role of ageing in growth-enhancing job reallocation

The previous sections have shown that the reallocation of employment towards higher-quality firms is mainly driven by job-to-job mobility, and that this process weakens sharply with age. If the relative share of older workers in the workforce increases with the general process of demographic ageing, one would expect that workforce ageing reduces the degree of job-to-job mobility and the speed of growth-enhancing job reallocation as a whole. With fewer movements of workers towards higher-quality firms, this should result in lower wage and productivity growth. Below we explicitly test to what extent ageing has contributed to slowing aggregate wage and productivity growth due to its dampening effects on the overall responsiveness to firm quality and job-to-job mobility.

Formally, we can decompose the aggregate between-firm component of Equation (2) by age

groups k. For this, we start by defining the age-specific between-firm component as:

$$G_t^{(k)} \equiv \sum_j \Delta e_{j,t}^{(k)} (\bar{q}_{j,t} - \bar{q}_t),$$

where $\Delta e_{j,t}^{(k)}$ denotes the change in firm j's share of age group k's total employment. The aggregate between-firm component is then the weighted average of these age-specific components:

$$G_t = \sum_k s_{k,t} G_t^{(k)}$$

where $s_{k,t}$ is the employment share of age group k in the total economy.

In a standard shift-share framework, we can then decompose the change in the aggregate between-firm component into:

$$\Delta G = \underbrace{\sum_k \Delta s_k \, \overline{G}^{(k)}}_{\text{Share (demographic composition)}} + \underbrace{\sum_k \overline{s}_k \, \Delta G^{(k)}}_{\text{Shift (responsiveness)}} \tag{5}$$

where bars denote period averages.

The *share component* captures how shifts in the demographic structure, i.e. the increase in older workers' share s_k, reduce the scope for growth-enhancing reallocation. The *shift component* instead captures changes in age-specific responsiveness $G^{(k)}$, holding employment shares constant.

To link this to the firm-level regressions of Section 4, note that each age-specific between-firm component $G_t^{(k)}$ depends on the group's responsiveness ($\beta_1^{(k)}$) and the dispersion of firm quality ($\text{Var}(q_{j,t-1})$):

$$G_t^{(k)} \approx \beta_1^{(k)} \text{Var}(q_{j,t-1})$$

Consequently, we can approximate the aggregate between-firm component G_t as the employment-weighted sum of these components:

$$G_t = \sum_k s_{k,t} G_t^{(k)} \approx \sum_k s_{k,t} \beta_1^{(k)} \text{Var}(q_{j,t-1})$$

so that ageing affects growth both via composition (lower s_k of younger, more mobile workers) and via differential responsiveness (lower $\beta_1^{(k)}$ for older groups). Thus, the between component can change over time because the share of older workers increases and responsiveness remains constant (*share component*) or because responsiveness increases while the shares remain constant (*shift component*).

Turning back to Equation (5), the shift component measuring age-specific changes in responsiveness, can be decomposed into an average shift component that captures general changes in labour market dynamism affecting all age groups equally, and into a differential shift component that differs across age groups k. Formally, we can therefore express Equation (5) as:

$$\Delta G = \underbrace{\sum_k \Delta s_k \, \overline{G}^{(k)}}_{\text{Share (composition)}} + \underbrace{\sum_k \overline{s}_k \, \Delta G_k^{\text{diff}}}_{\text{Differential shift (age-specific dynamics)}} + \underbrace{\Delta G^{\text{common}}}_{\text{Common shift (common dynamics)}} \tag{6}$$

One factor that may give rise to differential changes in between-firm growth due to growth-enhancing job reallocation across age groups may be ageing, as longer working lives may change the incentives for job mobility to better firms disproportionately among older workers. Note that, even though this Section only considers the sum of the share and differential shift components as the role of ageing, it might increase mobility and growth-enhancing reallocation at any age — for youth, who will be in short supply, and for the old, who will have longer working lives. The common shift component might therefore also contain some effect of ageing among many other factors.

Based on the age-specific components of worker mobility and firm-quality growth discussed in Section 5, Table 4 presents the shift–share decomposition of the between-firm component. As this analysis is sensitive to the start and end years of the data (see Table 1), we restrict the sample to the twelve countries with continuous time series available from 2005 to 2018 (six for productivity) to ensure a consistent period. All components in the table represent cumulative contributions over the sample period, averaged across countries.

Table 4 reports the decomposition of aggregate wage and productivity growth into within-firm and between-firm components, alongside the shift–share decomposition of the latter. While aggregate growth for both wages and productivity is driven by a combination of within-firm growth and between-firm reallocation, the relative importance of these channels differs. For (real) wages, average aggregate growth amounts to 1.67 percentage points, of which approximately two-thirds are attributable to within-firm growth (1.12 percentage points), with the remaining third driven by between-firm reallocation (0.55 percentage points). In contrast, productivity growth relies more heavily on within-firm dynamics. Of the 1.56 percentage point average growth rate, 1.37 percentage points originate from within-firm growth, while only 0.35 percentage points are explained by reallocation across firms.

Decomposing the between-firm component reveals a consistent negative contribution from demographic ageing. For both wages and productivity, the share (composition) component is negative, indicating that shifts in the age structure of employment have reduced the scope for growth-enhancing reallocation. This negative composition effect is only partially offset by the

shift component, which remains positive for both outcomes.

A further breakdown of the shift component demonstrates that its positive contribution primarily reflects the common shift component, which captures improvements in reallocation dynamics that affect all age groups similarly. The differential shift component is comparatively small, suggesting that changes in age-specific responsiveness play a limited role. Consequently, the overall contribution of ageing (the sum of the share and differential shift components) is negative for both wages and productivity, amounting to approximately -0.12 percentage points (7% and 8% of the total effect, respectively). Ultimately, the table highlights that demographic ageing has acted as a drag on aggregate growth, primarily through changes in the age composition of employment, while common improvements in labour market dynamism have only partially compensated for this effect.

The productivity slowdown observed over the last two decades is primarily driven by the shift in the age structure of employment toward older workers (0.24 percentage points) and their lower responsiveness to between-firm wage differences compared to younger cohorts. This structural shift toward older workers mainly reflects workforce ageing, though declining youth employment rates—due to long-term fertility reductions and extended education retention—also play a minor role. However, these adverse composition effects are partially offset by differential trends in age-specific growth rates. This positive differential shift likely reflects institutional changes, such as pension reforms that have extended working lives. As the time horizon for reaping returns on job search expands, the incentives for older workers to reallocate to higher-quality firms increase, partially mitigating the pure composition effect of an ageing workforce.

Figure 10 dissects the between-firm contribution by reporting the share, common shift, and differential shift components at the country level. Notably, the share (composition) component is negative in all countries, despite substantial heterogeneity in magnitude. This confirms that changes in the employment age structure have systematically reduced the scope for growth-enhancing job reallocation across all economies, even if the intensity of this effect varies.

By contrast, the shift components exhibit greater cross-country variability. The common shift component differs widely, reflecting heterogeneous trends in overall labour market dynamism and the general responsiveness of worker reallocation to firm quality. The differential shift component, while smaller in magnitude, is positive in nearly all countries. This indicates that age-specific responsiveness has generally evolved more favourably than common trends would imply. It suggests that older workers have not experienced a disproportionate decline in growth-enhancing mobility, thereby partially offsetting the negative drag of demographic composition.

The corresponding decomposition for productivity, reported in Appendix C.2, exhibits a qualitatively similar pattern. This reinforces the conclusion that the dominant channel through

which ageing affects aggregate growth is the changing age composition of employment, rather than systematically negative age-specific dynamics.

These findings have important policy implications. While the demographic shift toward an older workforce is largely inevitable, the sharp decline in reallocation responsiveness at older ages is not immutable. As shown by the positive differential shift in some countries, older cohorts can exhibit higher growth-enhancing mobility rates under the right conditions. Policies that reduce specific barriers to job transitions for older workers could therefore play a crucial role. By fostering a labour market where older workers remain responsive to firm quality, such interventions can counterbalance the structural drag of ageing on aggregate productivity growth (see e.g. OECD, 2025).

7 Conclusions

Growth-enhancing job reallocation, the shift of employment towards higher-wage and higher-productivity firms, is a central driver of aggregate economic growth. Our findings confirm that this process is primarily the result of job-to-job mobility, whereas movements in and out of non-employment play a much more limited role for wage and productivity growth.

Crucially, however, the capacity for this growth-enhancing reallocation is unevenly distributed across the lifecycle. We document a sharp age-responsiveness gradient where growth-enhancing reallocation is disproportionately driven by younger workers, while older workers exhibit both lower mobility and lower responsiveness to firm quality wage signals. Consequently, as the workforce ages, the scope for efficiency-enhancing reallocation naturally narrows. The qualitative homogeneity of this age-responsiveness gradient across 17 diverse countries suggests it is a structural feature of advanced economies, rather than a by-product of specific national institutions.

By tracing these findings to aggregate outcomes, our shift-share decomposition quantifies the economic cost of this gradient. We find that demographic ageing has mechanically dampened aggregate growth, acting as a drag primarily through changes in the age composition of employment (the share component). While this negative composition effect has been partially offset by positive trends in growth-enhancing mobility at older ages, these development have only partially compensated for the structural headwinds of an ageing workforce.

Overall, the findings underscore the dual challenge of sustaining business dynamism and adapting labour markets to demographic change. Policies that reduce barriers to mobility, particularly for mid-career and older workers, and that strengthen firms' ability to adjust employment in response to productivity signals, will be crucial to sustain inclusive productivity growth.

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Tables

Table 1: Data sources

Country	Dataset / Source	Coverage	Period
Austria	Social security records	Universe of employees and firms (private sector)	2000–2019
Belgium	BCSS sample	10% sample of employees (private sector), representative	2002–2019
Canada	Employer-Employee Dynamics Database	Large administrative sample of workers and firms	2001–2019
Denmark	IDA register	Universe of employees and firms	2000–2019
Estonia	Tax and Customs Board register	Universe of employees and firms	2003–2019
Finland	FOLK register, Employer Payroll Report	Universe of employees and firms	2000–2019
France	DADS panel (INSEE)	8.5% sample of workers, representative	2002–2019
Germany	Integrierte Erwerbsbiographien (IEB)	10% sample of employees, representative	2000–2019
Hungary	ADMIN - I - Panel (OEP, ONYF, NAV, NMH, OH)	Universe of employees and firms	2003–2017
Italy	INPS Social Security Data	8.6% sample of firms	2006–2018
Lithuania	SODRA register	25% sample of the social security population	2000–2019
Netherlands	Social statistics database (CBS)	Universe of employees and firms	2006–2019
New Zealand*	IDI & LBD Databases	Universe of employees and firms	2000–2019
Norway	Aa-registeret & LTO	Universe of employees and firms	2008–2019
Portugal	Quadros de Pessoal	Universe of employees and firms (private sector)	2002–2019
Spain	MCVL-CDF register	4% sample of workers	2006–2019
Sweden	LISA, FEK & JOBB register	Universe of employees and firms	2002–2018

Note: Access to the NZ data was provided by Stats NZ under conditions designed to give effect to the security and confidentiality provisions of the Data and Statistics Act 2022. The results presented in this study are the work of the authors, not Stats NZ or individual data suppliers. These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) and Longitudinal Business Database (LBD) which are carefully managed by Stats NZ. For more information, please visit 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.

Table 2: Average Intercepts and Slopes of Worker Flows

	Job-to-Job Hires	Employment Hires	Sample Entry	Sample Exit	Gross Flows
Flow (average)	0.1599	0.0804	0.0797	0.0703	0.6133
Time trend	-0.0010	0.0020	-0.0008	0.0036	-0.0013

Note: Average across countries. Observations not weighted. Country f.e. effects absorbed. Base year=2013.

Table 3: Age Effects and Age-Weighted Contributions to Worker Flows

Age group	Share	Job-to-Job Hires	Employment Hires	Sample Entry	Sample Exit	Gross Flows
Panel A: Age Fixed Effects (Beta)						
Ages 15–24	0.1264	–	–	–	–	–
Ages 25–34	0.2407	-0.0570	-0.0065	-0.2067	-0.0173	-0.4174
Ages 35–44	0.2547	-0.1007	-0.0304	-0.2279	-0.0296	-0.5764
Ages 45–54	0.2371	-0.1191	-0.0412	-0.2325	-0.0270	-0.6400
Ages 55–64	0.1411	-0.1423	-0.0478	-0.2358	0.0478	-0.6431
Panel B: Age-Weighted Contributions (Share × Beta)						
Ages 15–24	0.1264	–	–	–	–	–
Ages 25–34	0.2407	-0.0137	-0.0016	-0.0498	-0.0042	-0.1005
Ages 35–44	0.2547	-0.0256	-0.0078	-0.0580	-0.0075	-0.1468
Ages 45–54	0.2371	-0.0282	-0.0098	-0.0551	-0.0064	-0.1518
Ages 55–64	0.1411	-0.0201	-0.0067	-0.0333	0.0067	-0.0907

Note: Average across countries. Observations not weighted. Country× year f.e. effects absorbed.

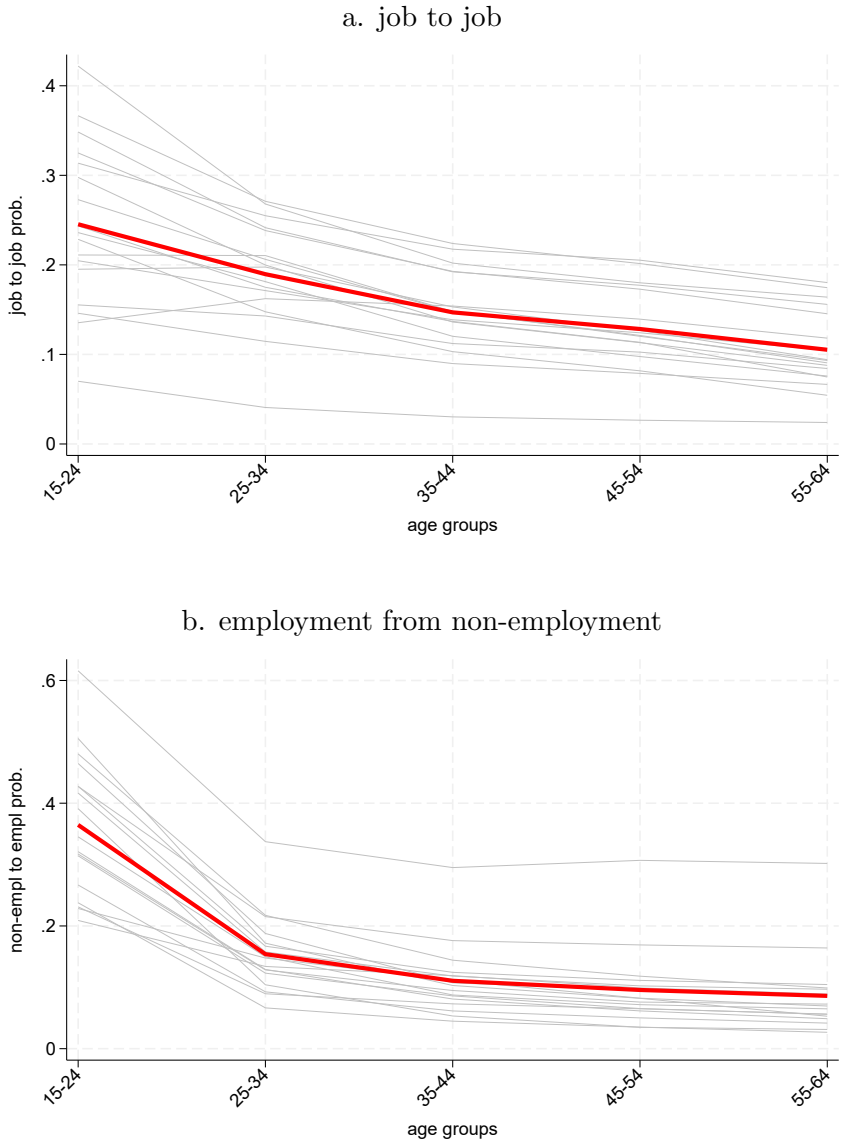
Table 4: Average decomposition of aggregate growth (percentage points)

	Total	Within	Between	Share	Shift	Diff.	Common	Ageing
Wage growth	1.67	1.12	0.55	−0.24	0.79	0.11	0.67	−0.12
Productivity growth	1.56	1.37	0.19	−0.12	0.30	0.01	0.31	−0.12

Notes: The table reports average growth rates and their decomposition into within-firm and between-firm components. The between-firm component is further decomposed into a composition (share) effect and a shift effect, the latter split into a common shift component and a differential shift component. The ageing contribution is defined as the sum of the share and differential shift components. All figures are expressed in percentage points. The average presented in the table is restricted to countries with sufficiently long and uninterrupted time series (2005-18, see Table 1). For wages growth this includes Austria, Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Lithuania, New Zealand, Portugal and Sweden. For productivity growth, this includes Canada, Denmark, Finland, France, Portugal and Sweden

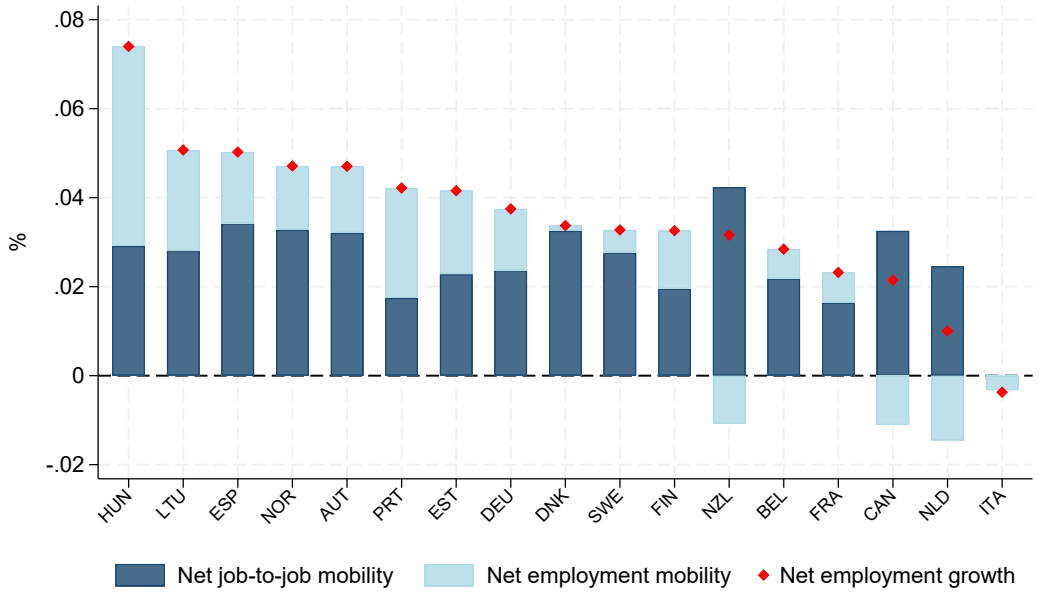
Figures

Figure 1: Probability of job-to-job transition and entry into employment, by age group and average across countries (red line).



(a) Job-to-job transition probability: workers moving from one job to another between time $t-1$ and time t. (b) Employment probability: probability of being non-employed at time $t-1$ and employed at time t. Grey lines: country estimates; red line: unweighted average over 17 countries.

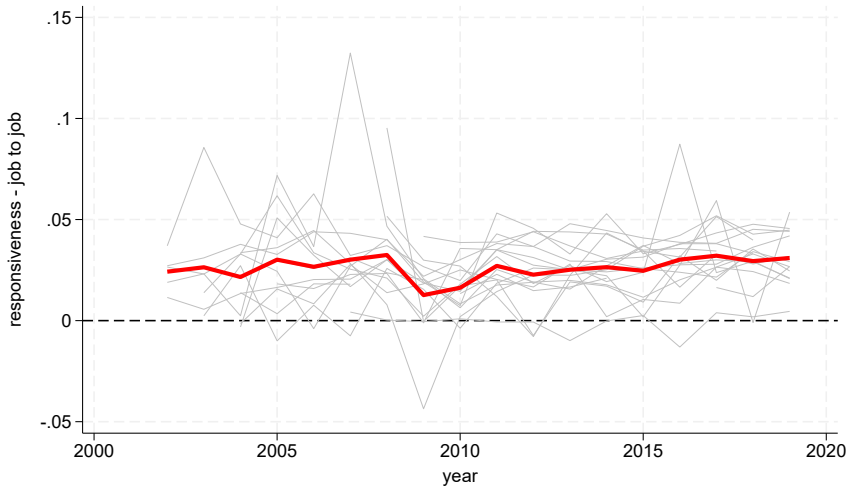
Figure 2: Responsiveness (growth-enhancing reallocation) by country and contribution of the different types of flow



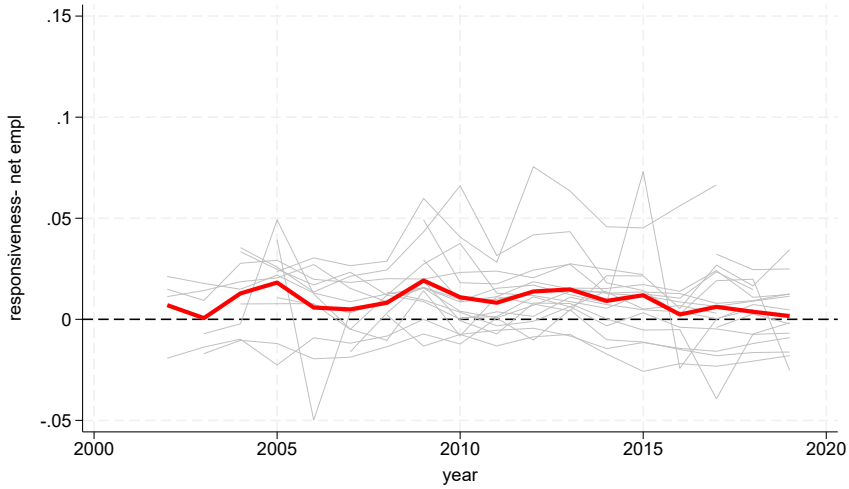
Net employment growth: average annual employment growth rate in deviation from aggregate employment growth rate. Net job-to-job mobility: contribution of workers changing employer from one year to the next in deviation from aggregate employment growth rate. Net employment mobility: contribution of workers entering or existing employment from year to the next in deviation from aggregate employment growth rate. Private sector non-agricultural dependent employment.

Figure 3: Responsiveness (growth-enhancing reallocation) of job-to-job flows and net employment growth by time and average across countries (red line).

a. job to job flows

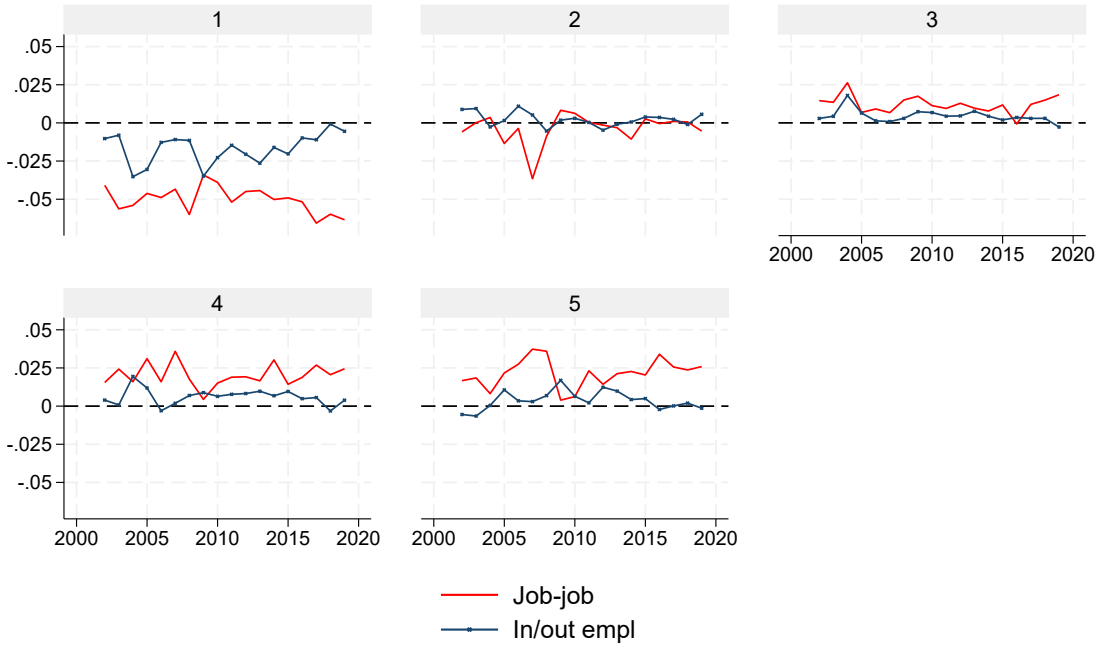


b. employment flows



Net employment growth: employment growth rate per year in deviation from aggregate employment growth rate. Net job-to-job mobility: contribution of workers changing employer from one year to the next in deviation from aggregate employment growth rate. Net employment mobility: contribution of workers entering or existing employment from year to the next in deviation from aggregate employment growth rate. Private sector non-agricultural dependent employment. Grey lines: country estimates; red line: unweighted average over 17 countries.

Figure 4: Responsiveness (growth-enhancing reallocation). Net employment growth among incumbent firms and its components due to net job-to-job and employment mobility by quintile of the firm-distribution of wages, relative to average employment growth



Net job-to-job mobility: contribution due to workers changing employer from one year to the next in deviation from aggregate employment growth rate. Net employment mobility: contribution due to workers entering or existing employment from year to the next in deviation from aggregate employment growth rate. Private sector non-agricultural dependent employment. Quintiles of the employment-weighted distribution of firm wages. Firms are ranked based on the moving average in wages over the previous three years. Unweighted average across countries, over 17 countries.

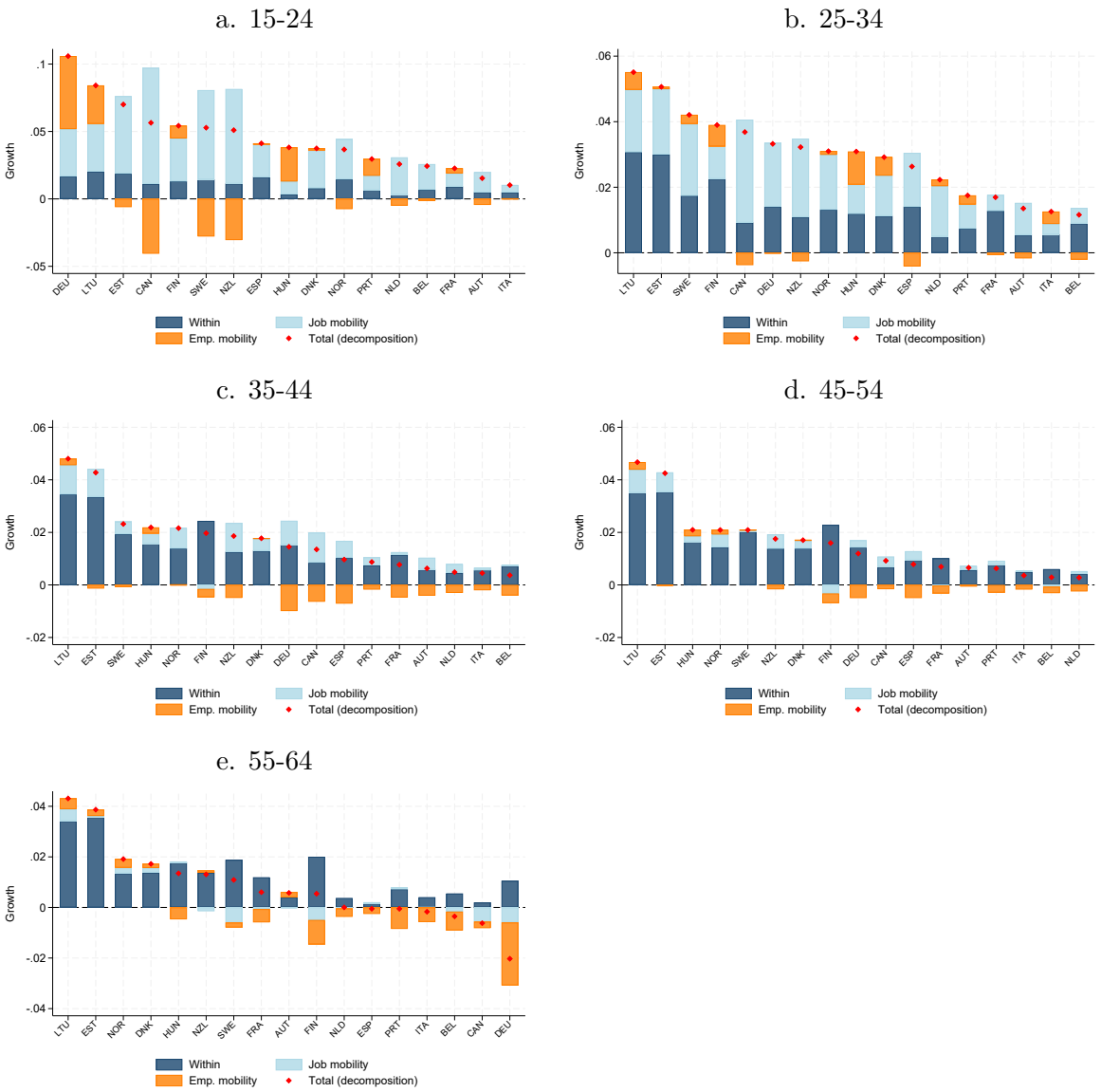
Figure 5: Responsiveness (growth-enhancing reallocation) by type of flow and age group: unweighted averages only

Job-to-job mobility (net): contribution of workers changing employer from one year to the next. Employment mobility: contribution of workers entering or existing employment from year to the next (net). Private sector non-agricultural dependent employment. red and blue lines: unweighted averages over 17 countries.

Figure 6: Within and between firm components: cross-country differences in aggregate wage growth

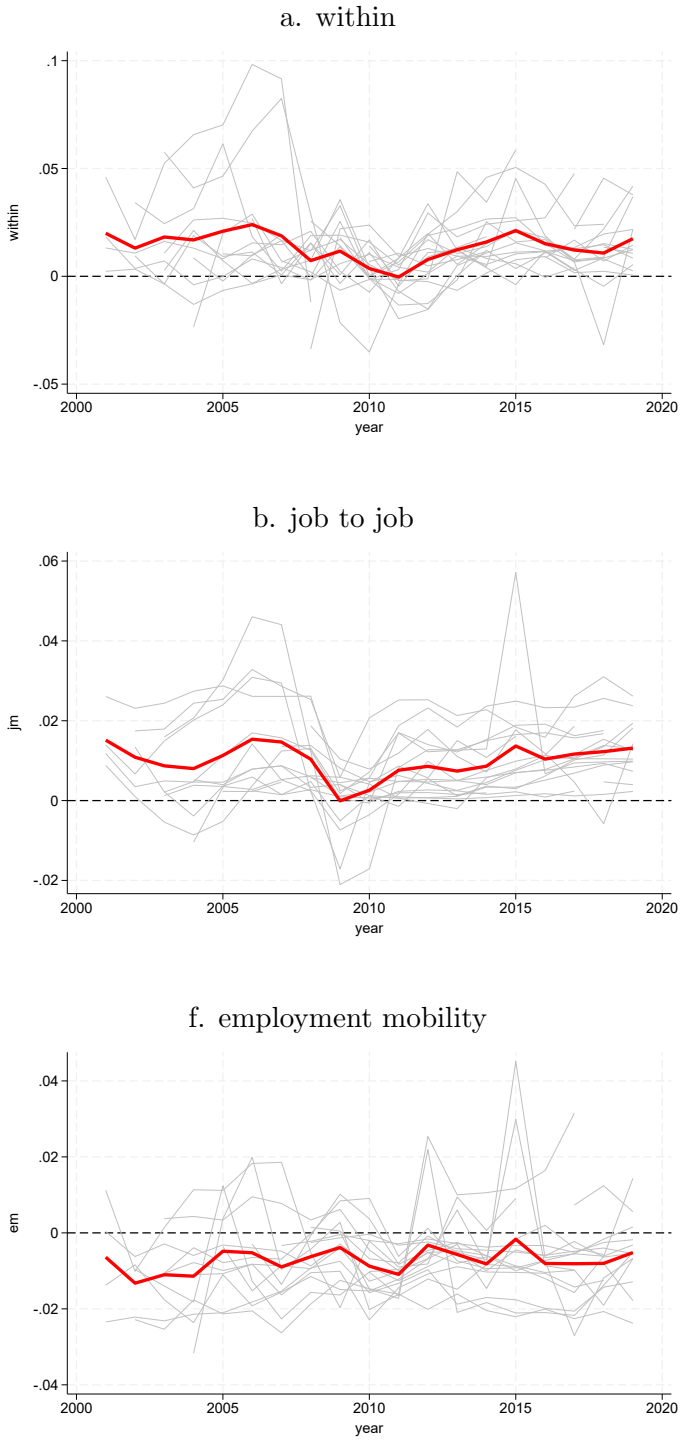
Total: average annual aggregate growth. Stayers: average annual aggregate growth associated among staying in the same firm. Job-to-job mobility: average annual between-firm growth due to the effect of net job-to-job mobility on the employment-weighted quality-composition of firms. Employment mobility: average annual between-firm growth due to the effect of net employment mobility on the employment-weighted quality-composition of firms. Sample attrition: sum of flows of those never entered employment before time t or permanently exiting at time t.

Figure 7: Within and between firm components: cross-country differences in aggregate wage growth. By age group



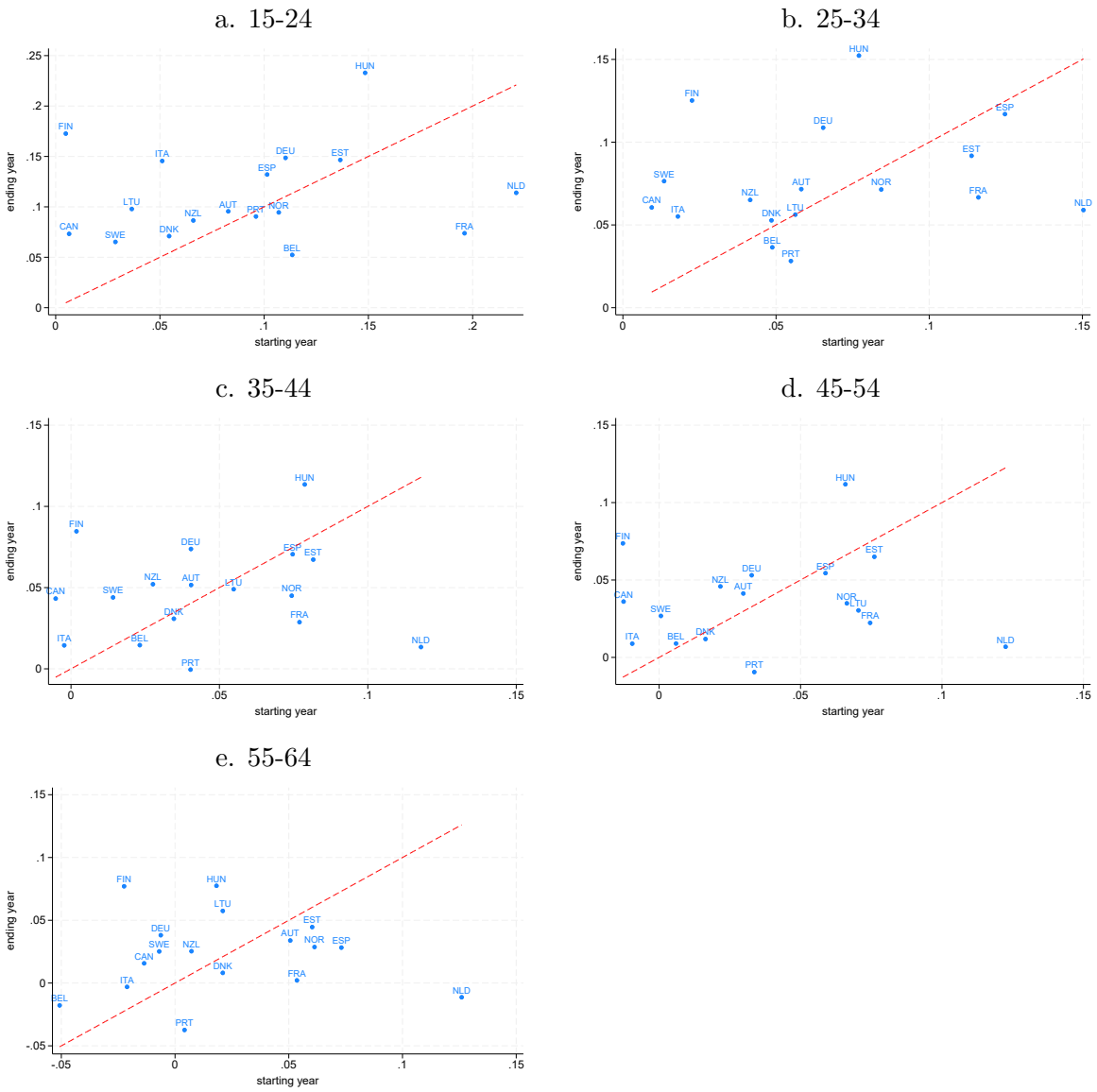
Total: average annual aggregate growth. Stayers: average annual aggregate growth associated among staying in the same firm. Job-to-job mobility: average annual between-firm growth due to the effect of net job-to-job mobility on the employment-weighted quality-composition of firms. Employment mobility: average annual between-firm growth due to the effect of net employment mobility on the employment-weighted quality-composition of firms. Sample attrition: sum of flows of those never entered employment before time t or permanently exiting at time t. By age group.

Figure 8: Contribution of the between and within component over time (red lines).



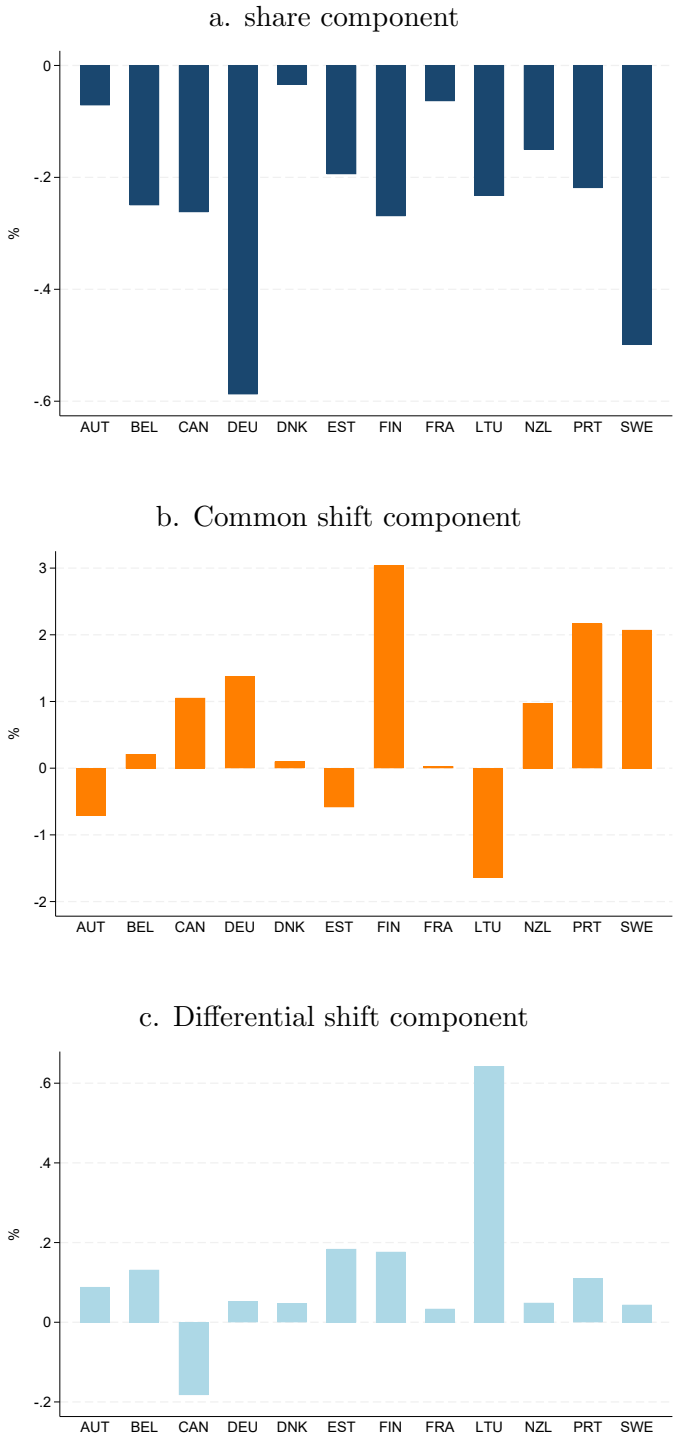
The contributions are calculated according to Equation 4. Grey lines: contribution of each country. Red line: unweighted average across 17 countries.

Figure 9: Evolution of responsiveness over time. By age group



Differences in job reallocation (β_1) between the first and the last available years. By age group. 17 countries. 45-degree line in red.

Figure 10: Shift and share decomposition of the between component. Average wage growth.



The contributions are calculated according to Equation 5. The average presented in the table is restricted to countries with sufficiently long and uninterrupted time series (2005-18, see Table 1).

Appendix

A Sensitivity to Time Aggregation Bias

A potential concern regarding the use of annual administrative data is that time aggregation bias may distort the measurement of job transitions up- or down the firm quality ladder. Specifically, annual data may conflate job-to-job transitions with transitions involving intermediate non-employment spells throughout the year. While the main text argues that annual data provides a conservative estimate of upward mobility, this annex validates that claim using high-frequency spell data from Austria, which allows us to observe the exact duration of non-employment between jobs.

We compare the direction of mobility by computing the probability of moving to a higher-wage firm, measured in our baseline annual data against actual job-to-job transitions defined at varying high-frequency horizons (1 week, 2 weeks, 1 month, and 1 quarter). We compute this for two aggregation formats present in our data. First, the data are constructed as "ever-worked" data, capturing a worker in year t if we observe her working at least once during t and keep the employer from whom she derives higher earnings in case she switches jobs during the year. Second, we also construct a "point-in-time" format, only measuring a worker in year t if we observe her working at least one day in the first week of October of year t.[20] If a worker works for two different employers during that week, we keep the one from whom she derives largest earnings.

Table B.1 reports the job-to-job transition rate and the share of transitions directed toward better-paying firms, defined by firm average wage.[21] First, regarding the *volume* of reallocation, time aggregation significantly inflates measured mobility. As shown in the first row of each panel, the annual job-to-job transition rate considerably larger than the rate at higher frequencies. This confirms that annual data captures a large volume of spurious transitions involving intermediate non-employment spells. Regarding the *quality* of reallocation, however, two key patterns emerge. First, the *direction* of reallocation is consistent across data frequencies. Whether measured annually or at high frequency, the majority of job-to-job transitions (between 55% and 60%) are directed toward higher-wage firms. This suggests that time aggregation does not generate spurious upward mobility or alter the qualitative conclusion that job mobility contributes to moving workers up the firm ladder. Second, the annual estimates are consistently *conservative*. Across all horizons and data formats, the share of upward moves in the annual data is strictly lower than in the high-frequency data. For example, in the ever-worked sample, 55.25% of annual transitions are to better firms, compared to 59.71% of

[20] Most of our data are of the "ever-worked" format, with only the Portuguese data being in the "point-in-time" format, where the data reflects a reference week in each year's October.

[21] Note that data on labour productivity is not available for Austria.

transitions with a gap of 2 weeks or less. This attenuation arises because annual data includes transitions with intermediate non-employment spells. As shown in the Austrian data, these transitions are significantly less likely to be quality-enhancing than genuine job-to-job moves. Consequently, their inclusion in the annual sample dilutes the measured degree of upward mobility, confirming that our main results likely represent a lower bound on the contribution of reallocation to wage growth.

B Additional Tables

Table B.1: Impact of Time Aggregation on Transition Rates and Quality

	Annual	**High-Frequency**			
		1 Week	*2 Weeks*	*1 Month*	*1 Quarter*
Panel A: Ever-Worked Data					
Job-to-job transition rate	10.66%	3.09%	3.46%	4.10%	6.16%
% upward moves (avg. wage)	55.25%	60.01%	59.71%	59.45%	57.93%
Panel B: Point-in-Time Data					
Job-to-job transition rate	8.04%	3.40%	3.78%	4.42%	6.19%
% upward moves (avg. wage)	56.72%	59.77%	59.54%	59.26%	58.00%

Note: "Annual" refers to transitions between years t and $t+1$ in aggregated data.
"High-Frequency" refers to transitions with gaps not exceeding the specified horizon.

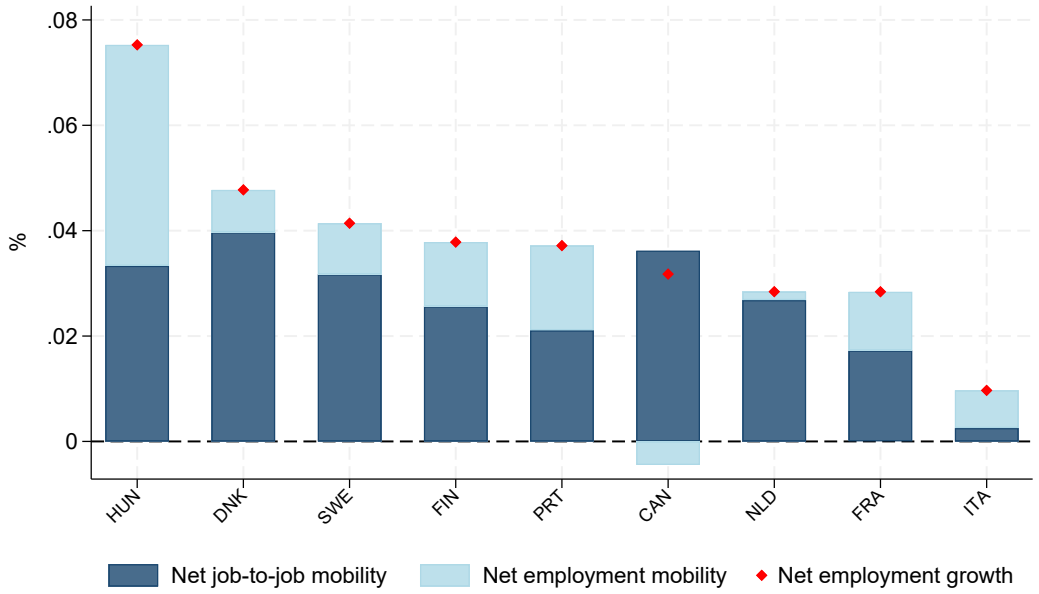
Table B.2: Gross Flows: Country-specific averages and time trends

Country	Flow	Trend
AUT	0.552	0.004
BEL	0.413	-0.001
CAN	0.713	-0.007
DEU	0.525	0.000
DNK	0.635	-0.017
ESP	0.624	0.008
EST	0.726	-0.004
FIN	0.645	0.001
FRA	0.559	-0.004
HUN	1.073	0.014
ITA	0.409	0.002
LTU	0.601	0.005
NLD	0.625	-0.012
NOR	0.580	-0.005
NZL	0.673	-0.007
PRT	0.615	0.004
SWE	0.525	0.001

Note: Average across countries. Observations not weighted.
Separate country regressions. Centered year: 2013.

C Additional Figures

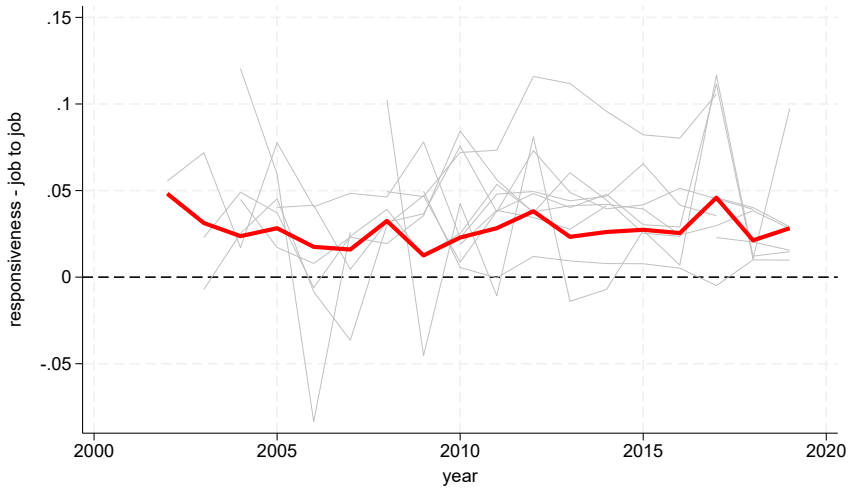
Figure C.1: Responsiveness (growth-enhancing reallocation) by country and contribution of the different types of flow, based on labour productivity



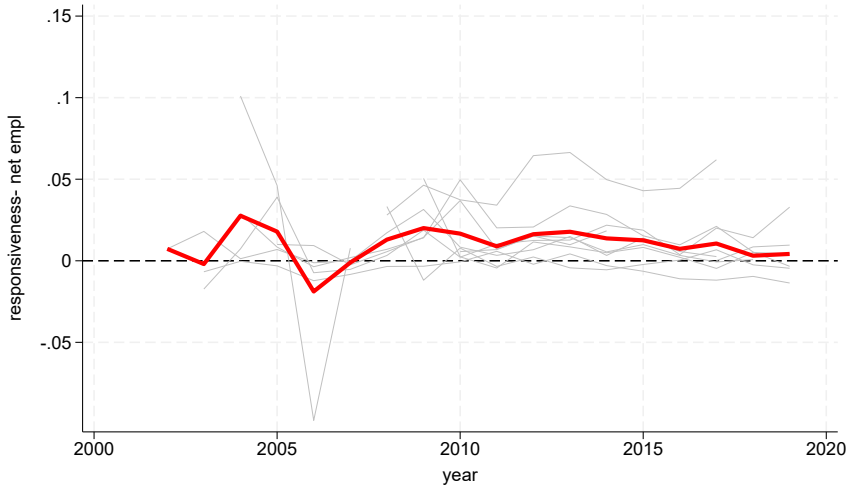
Net employment growth: average annual employment growth rate in deviation from aggregate employment growth rate. Net job-to-job mobility: contribution of workers changing employer from one year to the next in deviation from aggregate employment growth rate. Net employment mobility: contribution of workers entering or existing employment from year to the next in deviation from aggregate employment growth rate. Private sector non-agricultural dependent employment.

Figure C.2: Responsiveness (growth-enhancing reallocation) of job-to-job flows and net employment growth by time and average across countries (red line), based on labour productivity.

a. job to job flows



b. employment flows



Net employment growth: employment growth rate per year in deviation from aggregate employment growth rate. Net job-to-job mobility: contribution of workers changing employer from one year to the next in deviation from aggregate employment growth rate. Net employment mobility: contribution of workers entering or existing employment from year to the next in deviation from aggregate employment growth rate. Private sector non-agricultural dependent employment. Grey lines: country estimates; red line: unweighted average over 17 countries.

Figure C.3: Net employment growth among incumbent firms and its components due to net job-to-job and employment mobility by quintile of the firm-distribution of productivity, relative to average employment growth

Net job-to-job mobility: contribution due to workers changing employer from one year to the next in deviation from aggregate employment growth rate. Net employment mobility: contribution due to workers entering or existing employment from year to the next in deviation from aggregate employment growth rate. Private sector non-agricultural dependent employment. Quintiles of the employment-weighted distribution of firm productivity (value added per worker). Firms are ranked based on the moving average in productivity over the previous three years. Unweighted average across 9 countries.

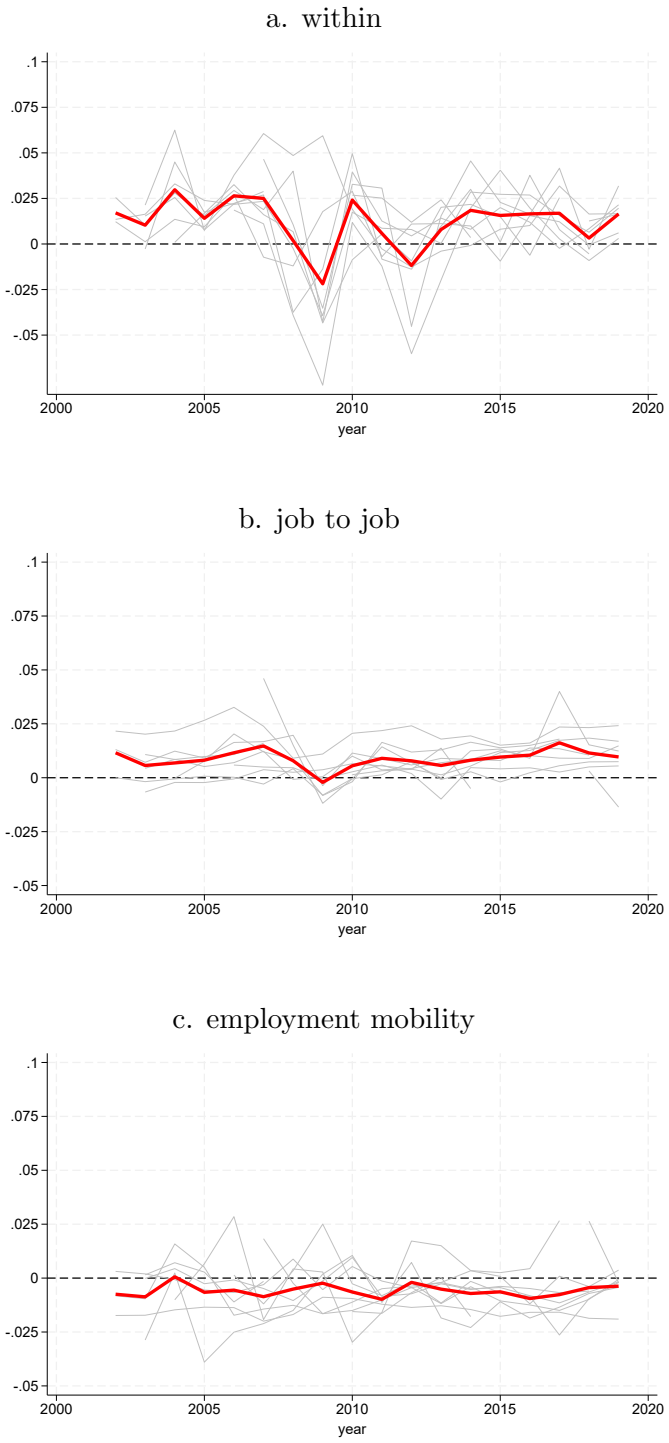
Figure C.4: Responsiveness (growth-enhancing reallocation) by type of flow and age group: unweighted averages only, based on labour productivity

Job-to-job mobility (net): contribution of workers changing employer from one year to the next. Employment mobility: contribution of workers entering or existing employment from year to the next (net). Private sector non-agricultural dependent employment. red and blue lines: unweighted averages over 17 countries.

Figure C.5: Within and between firm components: cross-country differences in aggregate productivity

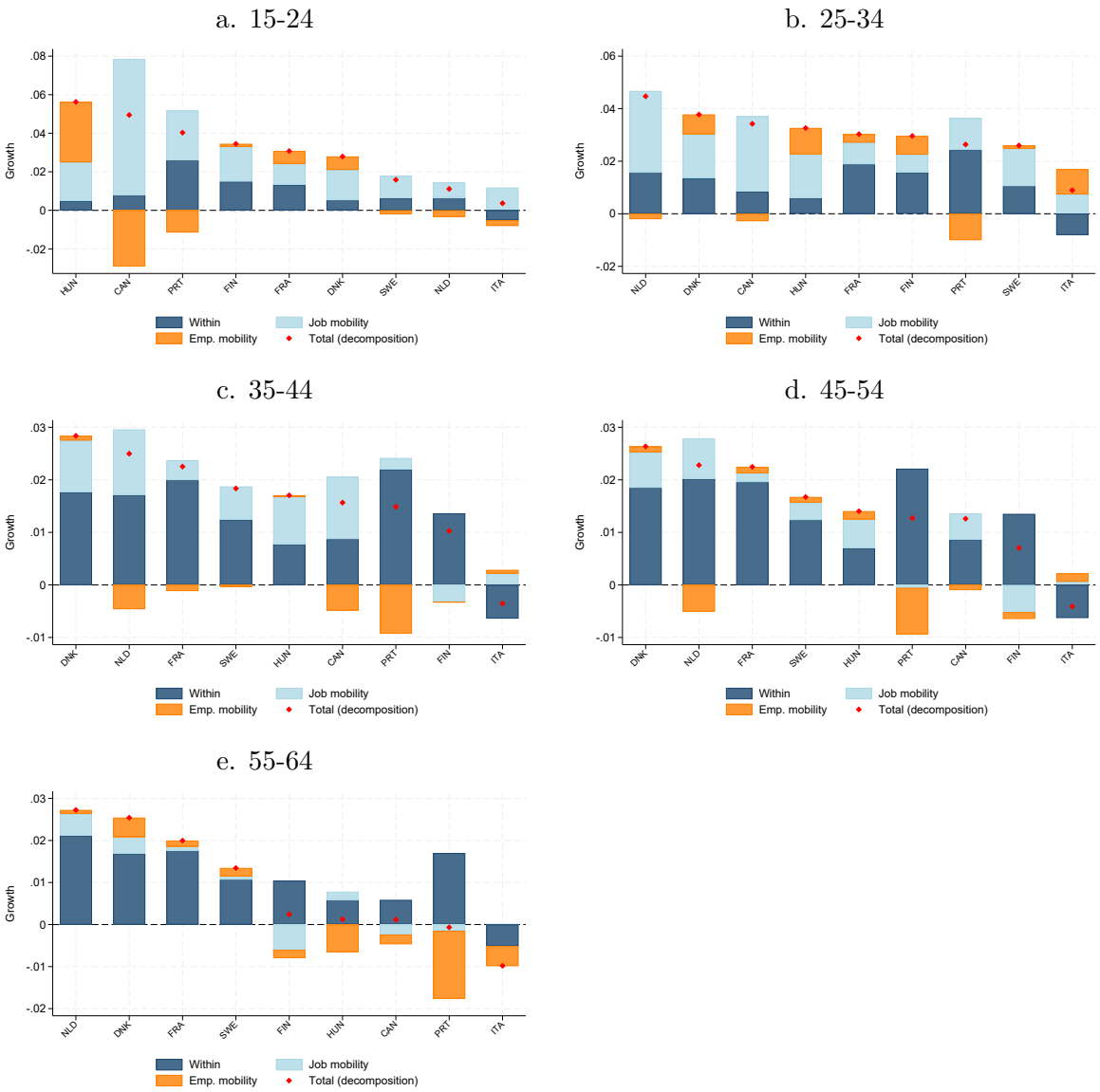
Total: average annual aggregate growth. Stayers: average annual aggregate growth associated among staying in the same firm. Job-to-job mobility: average annual between-firm growth due to the effect of net job-to-job mobility on the employment-weighted quality-composition of firms. Employment mobility: average annual between-firm growth due to the effect of net employment mobility on the employment-weighted quality-composition of firms. It includes also sample attrition, defined as the sum of flows of those never entered employment before time t or permanently exiting at time t.

Figure C.6: Contribution of the between and within component over time (red lines), labour productivity.



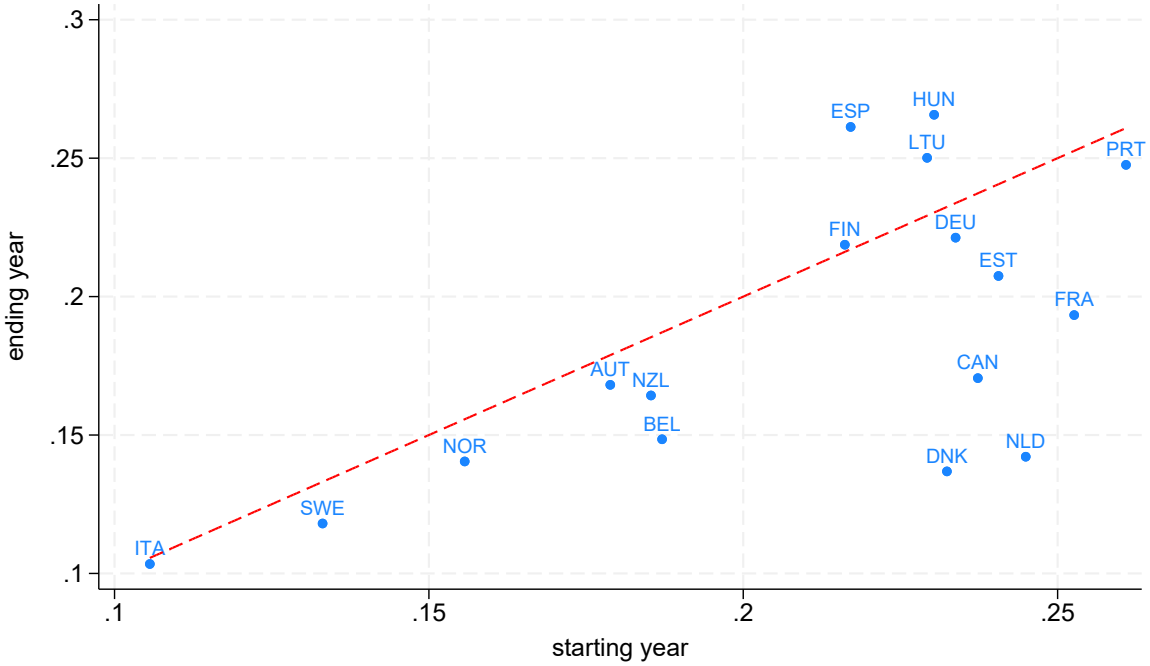
The contributions are calculated according to Equation 4. Grey lines: contribution of each country. Red line: unweighted average across 17 countries.

Figure C.7: Within and between firm components: cross-country differences in aggregate labour productivity growth. By age group



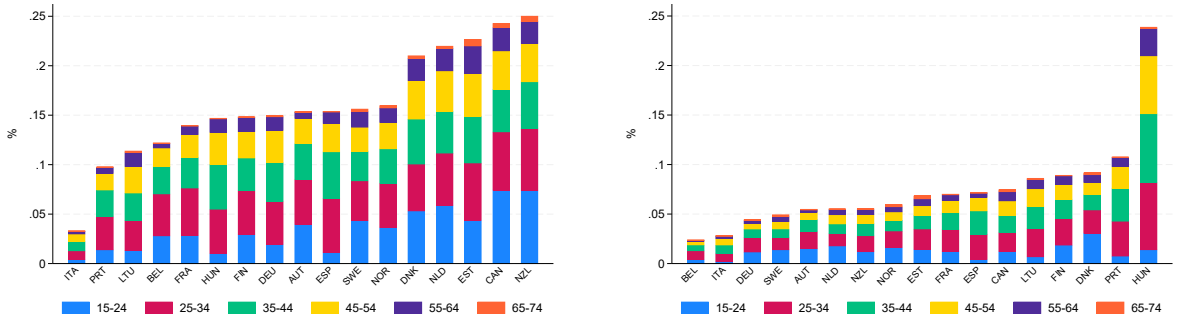
Total: average annual aggregate growth. Stayers: average annual aggregate growth associated among staying in the same firm. Job-to-job mobility: average annual between-firm growth due to the effect of net job-to-job mobility on the employment-weighted quality-composition of firms. Employment mobility: average annual between-firm growth due to the effect of net employment mobility on the employment-weighted quality-composition of firms. It includes also sample attrition, defined as the sum of flows of those never entered employment before time t or permanently exiting at time t. By age group.

Figure C.8: Change in gross job reallocation in the period under consideration



Differences in gross job reallocation between the first and the last available years. Three-year averages. 17 countries. 45-degree line in red.

Figure C.1: Job-to-job and employment flows as share of employees and contribution of age groups



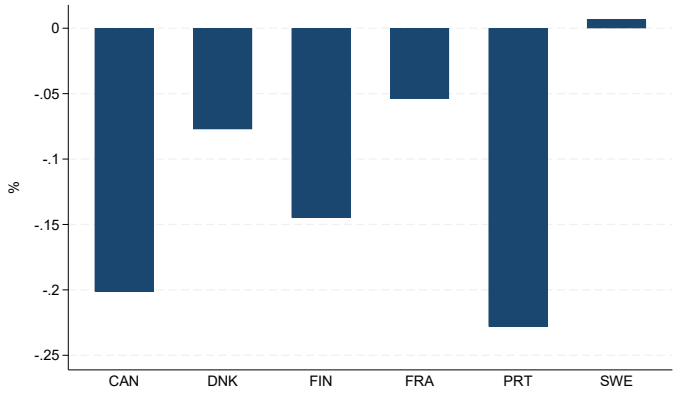
(a) Job-to-job flows

(b) Employment flows

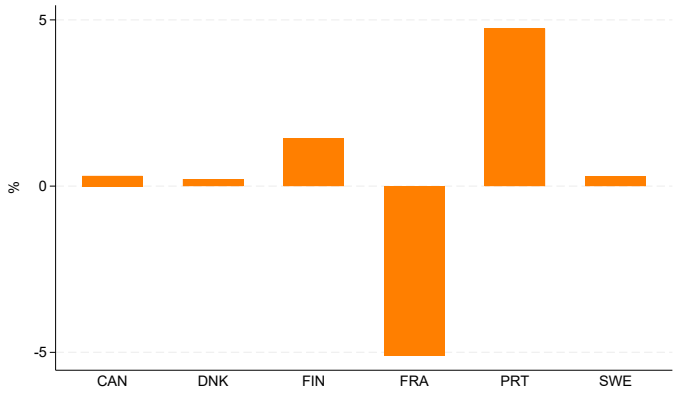
Contribution of each age group to the share of workers that each year change employer.

Figure C.2: Shift and share decomposition of the between component. Average productivity growth.

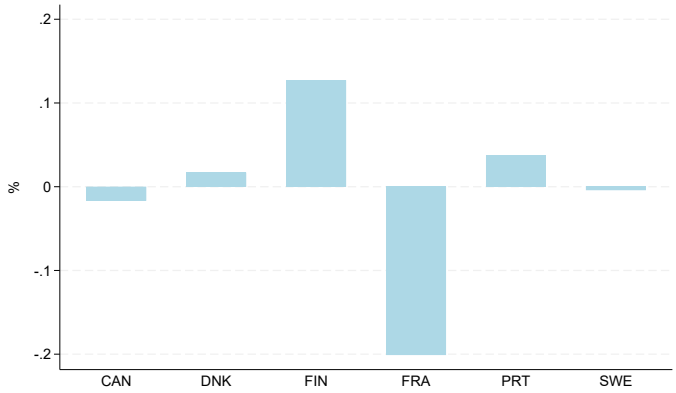
a. share component



b. Common shift component



c. Differential shift component



The contributions are calculated according to Equation 5.The average presented in the table is restricted to countries with sufficiently long and uninterrupted time series (2005-18, see Table 1).