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The dynamics of wage dispersion between firms: the role of firm entry and exit

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Abstract

Although wage inequality is an important and widely studied issue, the literature is vastly silent on the relationship between firm entry and exit and the wage dispersion between firms. Using a 50% random administrative sample of West German establishments over the period 1976–2017, I study wage dispersion dynamics between and within the groups of entering, exiting, and incumbent establishments by examining the distribution of average wages across establishments. The results show that entering establishments became increasingly unequal over time, thereby contributing to the rise in wage dispersion between establishments. However, exit rates of young and low-wage establishments have dampened this effect. These findings suggest considering the consequences for wage inequality when designing and assessing policy instruments for firm entry and exit.

Keywords: Firm entry, Firm exit, Wage dispersion, Firm dynamics, Germany

JEL Classification: L26, M13, J31

1 Introduction

Rising wage inequality as an important phenomenon across developed countries has attracted much attention in the economic and political debate of the last three decades. Apart from that, there is growing interest in the economic consequences of firm dynamics, particularly the entry of new firms and the exit of incumbent firms. Typically, their contribution to the creation and destruction of jobs and their role in fostering innovation and shaping structural change are at question (e.g. Haltiwanger et al. 2013; Schindele and Weyh 2011). However, the question of how firm entries and exits contribute to wage inequality has been largely neglected in scientific and public debates. Therefore, this paper examines the interaction between firm dynamics and wage inequality. The central question addressed here is how newly entering and exiting firms contribute to wage dispersion between establishments in West Germany. The analysis is further enriched by examining the evolution of wage dispersion within different entry cohorts as they grow older, the role of exiting firms in this process, and the relationship between a firm's exit and its wage level.

The dispersion of average wages between firms as an important factor in explaining trends in overall wage inequality has been studied by a large body of research (Davis and Haltiwanger 1991; Dunne et al. 2004; Barth et al. 2016; Card et al. 2018; Song et al. 2019). Also, for Germany, this phenomenon is well documented in the literature (Card et al. 2013; Baumgarten et al. 2020). In addition, a small strand of literature has developed around the question of how firm entry or entrepreneurship relates to inequality. Both empirical and theoretical approaches suggest that newly entering firms tend to increase wage inequality (Castellaneta et al. 2019; Lippmann et al. 2005; Atems and Shand 2018). Card et al. (2013) document an increasing heterogeneity between entering firms of different birth cohorts in Germany. Following the approach proposed by Abowd et al. (1999) (henceforth: AKM), they show that establishment-specific wage premiums became more dispersed, especially after 1995.

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In contrast, the specific question of how exiting firms contribute to wage dispersion has not been extensively studied even though the rich literature on the wage effects of plant closures and mass layoffs is closely related (e.g., Davis and Von Wachter 2011; Raposo et al. 2021). Malchow-Møller et al. (2011) conducted a noteworthy analysis examining how entering and exiting establishments contribute to the growth of average wages. They find that firm exits have a positive effect on the growth in average wages, suggesting that firms that exit are more likely to have previously operated in the low-wage sector.

This paper aims to contribute to the literature in three ways: First, it presents the evolution of the dispersion of average wages between the groups of entering, exiting, and incumbent establishments in West Germany. Second, I study the wage dispersion between and within different entry cohorts and analyze how establishment exits shape the evolutions. In addition, the interrelation between establishment entry and exit dynamics is analyzed. Third, I examine the relationship between establishment exits and the wage level to deepen our understanding of how firm exits contribute to wage dispersion.

It is important to note that this analysis is descriptive and should therefore be interpreted as such. Nonetheless, this research offers new insights, particularly with respect to policy implications. From a policy perspective, the entry of new firms is typically regarded as a desirable feature worthy of support. In contrast, the exit of incumbent firms tends to be seen as detrimental. While there is still a broad agreement on the former, the latter view has become controversial only in recent years, even though already Schumpeter (1942) emphasized the crucial role that exiting businesses play in the intrinsic functioning of capitalism. This shift in the public perception can likely be related to the popular zombification hypothesis that associates the low-interest-rate policy of the ECB with stalled firm exit. The inhibited exit of (unprofitable) firms is increasingly regarded as an adverse development as it decelerates structural change and impedes an effective allocation of resources (Banerjee and Hofmann 2018; Fackler et al. 2013). Against this background, this paper aims to contribute to a broader understanding of the consequences of firm entry and exit dynamics on the wage structure.

The paper is organized as follows. Section 2 synthesizes the related literature and derives the research questions. In Sect. 3, I introduce the dataset used in this study. Section 4 presents the results of the empirical analyses that aim to provide insights into the interrelations between establishment entry, establishment exit and the wage dispersion between establishments. Section 5 concludes.

2 Related literature and research questions

Rising wage inequality has been a general trend in many developed economies around the globe in the last few decades. However, this trend stalled in Germany in the 2010s (Bossler et al. 2020). Explanations that aim at assessing the resulting changes in the wage structure either emphasize the role of demand and supply factors through technical change (Autor et al. 1998; Acemoglu and Autor 2011) and globalization (Davis and Haltiwanger 1991; Goldschmidt and Schmieder 2017) or attribute the rising wage dispersion mainly to changing institutional conditions (Dustmann et al. 2009) and de-unionization (Biewen and Seckler 2019). Statistically, the overall variation in wages can be decomposed into variation of wages within firms and variation of average wages between firms. In this paper, only the latter variation is of interest. The view that some firms pay higher wages for equally skilled workers dates back to the work of Robinson (1933) and is grounded by her thoughts on the economics of imperfectly competitive markets, particularly the scope for employers to set wages in monopsonistic labor markets.

Davis and Haltiwanger (1991), Groshen (1991), and Dunne et al. (2004) have prominently emphasized the importance of between-firm wage dispersion. This strand of literature received renewed attention with the availability of high-quality matched employer–employee data and has been conducted in various countries, such as the United States (e.g., Barth et al. 2016; Song et al. 2019), Germany (Card et al. 2013; Baumgarten et al. 2020) and Portugal (Card et al. 2018). For instance, Davis and Haltiwanger (1991) find that more than 50% of the variance in wages can be explained by the dispersion of mean wages across plants. Card et al. (2013) show that establishment-specific wage premiums in West Germany vary with their birth cohort, with younger cohorts exhibiting greater dispersion (Card et al. 2013, p. 1008). Put differently, establishments became increasingly unequal regarding their wage premiums. Card et al. (2013) attribute this trend to a shrinking coverage of firms by collective bargaining agreements, a view that has been confirmed by recent studies of Hirsch and Mueller (2020) and Baumgarten et al. (2020). In a similar approach, Ohlert (2016) studies the contribution of establishment characteristics to the rise in wage inequality in Germany and finds that establishment size and workforce composition are the main contributors.

In contrast to these studies, my focus is on examining the wage dispersion of different groups of establishments—entering, exiting, and incumbents—to understand how newly founded firms and their exit

dynamics contribute to the overall wage dispersion. Since this analysis is confined to the establishment level, I cannot differentiate between within- and between-firm components of the wage dispersion. However, my approach allows to exploit rich establishment-level data, thereby distinguishing between different entry cohorts. In contrast to Card et al. (2013), who analyze establishment effects (i.e., AKM effects), I use average establishments' wages as the main variable, allowing me to use greater variation over time.

How are young firms characterized in terms of their wage and exit dynamics? In general, evidence regarding wages in young firms is mixed so far. An early generation of studies suggests that wages are higher in older establishments, even after controlling for observable characteristics, such as industry affiliation and size (Davis and Haltiwanger 1991) or size and location (Troske 1998). Brixy et al. (2007) follow an establishment cohort born in the years 1995 and 1996 in Germany and find that wages in these establishments are 8% lower than in similar incumbents. This wage differential, however, becomes insignificant after 5 years (Brixy et al. 2007, Table 1; Fig. 1). Nyström and Elvung (2014), Fackler et al. (2022) and Sorenson et al. (2021) supplement this view and find persistent drawbacks for employees entering a new establishment in terms of wages and employment stability. In contrast, Brown and Medoff (2003, p. 693) report a negative relationship between firm age and wages after controlling for observable worker characteristics, such as experience, tenure, education, or occupation. Recent studies of Babina et al. (2019), of Ouimet and Zarutskie (2014) and Burton et al. (2018) confirm this finding.

An interdisciplinary research field has grown around the impact of newly founded firms or entrepreneurship on income inequality. Country and regional-level evidence hints towards a positive link between the prevalence of new (entrepreneurial) firms and income or wage inequality (see, for instance, Lippmann et al. (2005) and Atems and Shand (2018)). Moreover, Åstebro et al. (2011) show that individuals entering self-employment are either high-ability or low-ability workers, leading to high earnings dispersion among the self-employed. These findings are consistent with the background that entrepreneurial activity can be driven by opportunity, but also by necessity (Bergmann and Sternberg 2007; Block et al. 2015). Against this backdrop, I would expect that the entry of new firms generally increases wage inequality.

Another performance indicator evaluating the success of newly entering firms is their survival chances. Correlations between establishment survival and a battery of establishment and environmental characteristics are well documented in the literature (see Manjón-Antolín and Arauzo-Carod (2008) for a survey). However, empirical assessments of the relationship between firm survival and the wage level are rather scarce. Noteworthy are the studies of Malchow-Møller et al. (2011) and of Faberman and Freedman (2016), both concluding that exit rates of firms decrease with their wage level.

From a theoretical perspective, what could we expect from the link between a firm's survival chances, the wages it pays, and wage inequality? Under perfect competition, we could infer from firms' wages to their productivity since each worker's wage is determined by her marginal productivity. Further, Schröder and Sørensen (2012, p. 581) theoretically show that introducing exogenous technological progress into the standard Melitz (2003) model can capture that high-productivity firms are likely to survive longer. Hence, we would expect survival rates to be positively correlated with the wages paid by the firm. Consequently, firm exits should reduce wage inequality because they shift the distribution of average wages rightwards.

In contrast, the framework of imperfect competition allows for search friction and rents in the labor market. Equilibrium search models can show that there exists a wage distribution where firms with low wages and firms with high wages reach the same profitability. Put simply, in the presence of search frictions firms face a trade-off between staying small and paying low wages and growing large and paying high wages and both variants are associated with equal profits (Rogerson et al. 2005; Albrecht and Axell 1984). Following this reasoning, it could be argued—even though it is not a necessary implication—that these two types of firms (high wage and low wage) are the most likely to survive if survival chances increase in profits. If firms choose a mixed strategy (paying mediocre wages), it may be that these wages are too high to maximize profits when staying small and too low to maximize profits when growing large, implying that their profits remain lower than optimal. This, in turn, would translate into lower survival chances, making the relationship between survival and wages rather polarized.

The seminal work of Jovanovic (1982) on the growth and survival of firms provides an additional theoretical ground for this paper. Firms learn about their efficiency as they operate in the market and efficient firms will grow and survive while inefficient firms will decline and exit (Jovanovic 1982, p. 649). One could argue that efficient firms pay higher wages, on average, because their efficiency translates into higher profitability. With positive profitability, there exist rents that can potentially be shared between the firm and its employees. In contrast, higher expected costs correspond to a lower value of staying in the market (Jovanovic 1982, p. 653). High costs could be partially rooted in high wages; thus, firm survival and wages could also be negatively correlated.

Hence, theoretical predictions about how patterns of firm survival (or, respectively, exit) relate to their wages and how firm exits shape wage inequality are unclear. Given these theoretical ambiguities, this study contributes to the literature by offering an empirical assessment of these exit patterns over time and how they impact the wage dispersion between firms.

3 Data

For the empirical analysis, I use an extensive and representative dataset describing the universe of establishments in Germany, namely, the Establishment History Panel (BHP). The data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and remote data execution. The BHP is a 50% random sample, drawn from the universe of German establishments, with at least one employee that is entitled to social security (hence, self-employed are not included). The data is structured as a yearly panel, each year reflecting the state of an establishment on June 30th and covering the years 1975–2018. For this study, I restricted the sample to West Germany and the years 1976–2017 since this enables me to identify entering, exiting, and incumbent establishments in every observation period. Further, it is possible to follow establishments over their life cycle since every establishment can be recognized by its unique identification number, which usually does not change over time (except in some cases of ownership change, business split up, or company merger events).[1] The BHP captures information on several characteristics of an establishment, such as the number of employees, workforce composition (in terms of gender, nationality, skill level, age, and occupation), industry, location, and wage structure. Ganzer et al. (2020) provide more information on the dataset. Note that both private and public sector establishments are included.

For this study, the variable of interest is the average gross daily wage of full-time employees, as it is a proxy for an establishment's wage level.[2] I use an imputed version of this wage variable, implemented by Card et al. (2015) since originally, earnings are right censored as they are only reported up to the upper limit for statutory pension insurance contributions. Consequently, a substantial share of the wage information (roughly 10%) is censored at the top (Ganzer et al. 2020, p. 15). Additionally, the average daily wage is adjusted for inflation with the consumer price index (CPI), as provided by the OECD (OECD 2021).[3] A central component of my analysis is the differentiation between newly entering, exiting, and incumbent establishments. An incumbent is defined as neither entering nor exiting in a given year.[4]

To consistently measure entries and exits, I draw on the work of Hethey and Schmieder (2010). They provide a classification that differentiates between true entries and exits and those that just reflect a change in ownership, a change in the identification number, or a spin-off. For this study, pulled spin-offs (defined as spin-offs whose parent companies continue to exist) are counted as true entries whereas pushed spin-offs (defined as spin-offs whose parent companies closed) are not counted as true exits.[5] Exits classified as "takeover/restructuring" are treated as incumbent establishments since I presume that no real exit has occurred. Moreover, entries and exits classified as "unclear" and those whose identification number changed are excluded from the sample.[6] Additionally, I exclude establishments with an average real daily wage of below 13.70 Euros which I regard as unreliable.[7] The share of establishments with such extreme values is very small; therefore they do not alter the results whatsoever. Ultimately, my sample consists of around 27.5 million observations, covering roughly 2.52 million establishments with an average employment size of 17.7 employees (of which nearly 13 are full-timers).

4 Empirical analysis

My empirical analysis aims to shed light on how establishment entries and exits relate to the dispersion of average wages between establishments in West

[1] Of all establishments in the panel, around 39% survive at least 5 years, 25% survive at least 10 years, 10% survive at least 20 years, 3% survive at least 30 years, and 0.45% survive at least 40 years. Note that only those establishments can be assigned an age that are at some point recognized as an entry. This applies to roughly 63% of the establishments in the sample.

[2] Using median wages instead of average wages does not change the observed patterns.

[3] The respective information is extracted from the OECD data on inflation. It is normalized to the year 2015 and includes food and energy.

[4] Note that there are establishments that enter and exit in the same year. Depending on the specific question at hand, I decided to treat these establishments differently. In Sects. 4.1 and 4.2, they are excluded to avoid inconsistencies regarding the group of establishments they would have to be assigned to. However, in Sects. 4.3–4.5, they are included since establishments that exit in their first year of existence are an informative part of the evolution of the wage dispersion within and between birth cohorts and the nexus between establishment exit and the wage level.

[5] Note that here I deviate from, for instance, Fackler et al. (2013), who also regarded pushed spin-offs as true exits. However, I suspect that in spin-offs whose parent companies stop operations, the old establishments partly continue to exist. Therefore, I decided not to count pushed spin-offs as true exits from the market. As a robustness check, I altered this classification and found no substantial differences.

[6] As the reasons for a change in the identification number of an establishment can be heterogeneous, I decided to exclude them from the sample to avoid inconsistent classifications.

[7] I did not drop outliers at the upper end of the distribution as a suitable threshold seems harder to determine. In contrast to unrealistically low wages, very high wages can in principle, be paid without an upper limit.

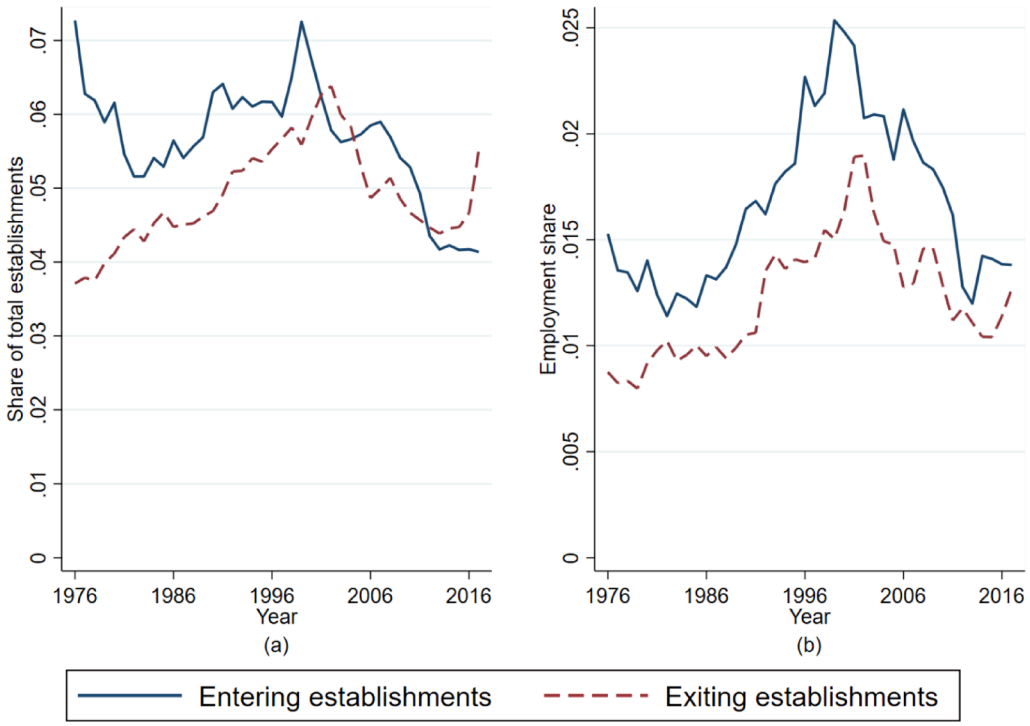

Fig. 1 Evolution of business entries and exits over time in West Germany

Germany. For that, I study wage dispersion dynamics between and within entering, exiting, and incumbent establishments and follow the life cycles of birth cohorts of establishments. Additionally, to further clarify the role of establishment exits, I study how exit rates of establishments vary with their wage level. To gain an understanding of the evolution of business dynamics over time in West Germany, I present the proportion of entering and exiting establishments as a share of total establishments in Fig. 1a and the employment share (in terms of full-time employees) of entering and exiting establishments in Fig. 1b. Figure 1a reveals that the share of entering establishments decreased during the late 1970s and early 1980s but increased afterward and reached a maximum at the turn of the millennium. In the early 2000s, a downward trend can be documented. The picture looks fairly similar regarding the proportion of exiting establishments. Their prevalence steadily rose until the early 2000s and began to decrease afterward. The employment shares of entering and exiting establishments depicted in Fig. 1b mirror this development. However, the relative increase in the employment shares is even more pronounced. Hence, business dynamism, both in terms of newly entering and exiting establishments, picked up speed during the 1990s and decelerated rapidly afterward.

4.1 Aggregate wage dispersion dynamics in establishments

The following analysis descriptively investigates wage (dispersion) dynamics in entering, exiting, and incumbent establishments. To provide an overview of the evolution of wage levels in establishments, Fig. 2 shows the yearly average of mean (real) wages in entering, exiting, and incumbent establishments.[8] It can be seen that mean establishments' wages follow a similar trend in every group. However, entering and exiting establishments pay lower average wages than incumbent ones. This holds particularly true for establishments exiting the market, suggesting a systematic relationship between exit and low wages. The gap between average wages in incumbent establishments and new or exiting establishments has widened over time, peaking in the downswing of the late 2000s. In recent years average wages have increased in all groups. Notably, this trend is most pronounced for newly entering establishments.

[8] In the Appendix, I provide an employment-weighted version (Fig. 9) to show that the general trend does not hinge on weighting establishments by their employment size. However, strong differences regarding the levels of the mean wages are visible, implying that Fig. 2 strongly understates actual mean wage levels in West Germany.

Fig. 2 Mean establishment's wages in real terms in West Germany

Fig. 3 Wage dispersion dynamics of entering, exiting, and incumbent establishments in West Germany, as measured by the coefficient of variation

Figure 3 displays aggregate wage dispersion dynamics as measured by the coefficient of variation.[9] In this study, I use the coefficient of variation (standard deviation divided by mean) as my preferred measure for dispersion since the group-specific distributions systematically vary, as can be seen in Fig. 2. By relating the standard deviations to their respective means, I aim to provide a higher level of comparability of the measured wage dispersion between the groups of entering, exiting, and incumbent establishments. As can be seen, in 1976, the dispersion of average wages within the three groups was comparably low. However, it grew steadily and reached its maximum around 2010. In recent years, the wage dispersion has been slowly decreasing.

This pattern is consistent with the findings of Möller (2016), who documents a trend reversal in wage inequality around 2011. Note, however, that in this specific year, the reporting procedure for part-time workers changed, which likely improved the information's reliability. The change in the reporting procedure was associated with a substantial increase in the share of part-time workers, suggesting that part-time workers were sometimes misclassified as full-time workers beforehand. This misreporting was most pronounced in the lower tail of the wage distribution, leading to an overstating of wage inequality in Germany (Fitzenberger and Seidlitz 2020). Hence, the average wages of full-timers could be understated when part-time workers with (naturally) low wages were coded as full-timers. Hence, part of the steep rise in average wages in (especially entering) establishments could be due to the change in the reporting procedure. However, both Fitzenberger and Seidlitz (2020) and Möller (2016) conclude that the rise in wage inequality until 2010 is not a consequence of the misreporting of hours worked and that a trend reversal can still be observed. Since I do not apply corrections on misclassifications of part-time work, I rely on these conclusions and argue that they also apply to the establishment-level data used here.

Figure 3 also shows that the groups of entering and exiting establishments are similarly dispersed and on a higher level than the group of incumbents. The rise in the dispersion of wages within the groups of entering and exiting establishments has been substantial, with a maximal increase of around 75%. This finding suggests that newly entering and exiting establishments are comparably heterogeneous regarding the average wages they pay.[10]

4.2 Wage dispersion dynamics in establishments by size, sector, and employment composition

In this section, I examine wage dispersion dynamics of establishments of different sizes, sectors, and employment compositions.[11] For more information on the

[9] Again, I provide the employment-weighted version in the Appendix (Fig. 10). The evolutions are fairly similar. Also, note that this study focuses on the heterogeneity of establishments' wage levels and not on the heterogeneity of workers' wages. Therefore, a very small establishment is as interesting to me as a very large establishment. Further, putting higher weights on large establishments would mask some of the variation I want to investigate. All following Figures, therefore, display non-weighted versions of the wage dispersion measures.

[10] This is robust to changing the measure for dispersion (ratio between 90 and 10th percentile, see Fig. 11 in the Appendix) and the use of average wages of high- and low-skilled employees instead of all full-time employees (see Fig. 12 in the Appendix).

[11] I base my sector variable on the 3-digit code of the WZ 1993 classification system and further aggregate such that I have five sectors: Agriculture, hunting and forestry, fishing; manufacturing; construction; services; and public administration, defense, social security. In terms of establishment size, I consider four size classes: 1–9 employees, 10–19 employees, 20–49 employees, and 50 or more employees.

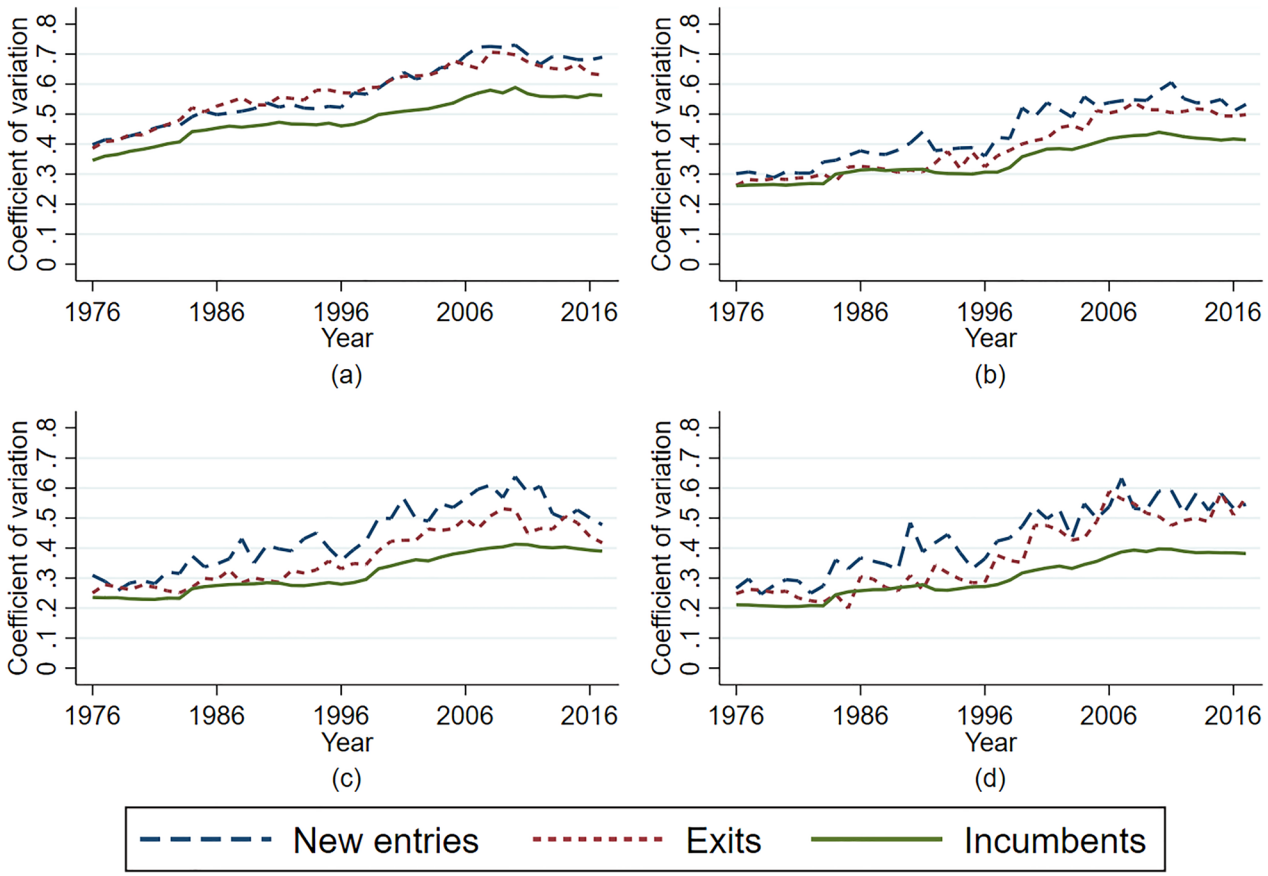

Fig. 4 Coefficient of variation of the average wage distribution in various establishment size classes. **a** 1–9 employees, **b** 10–19 employees, **c** 20–49 employees, **d** 50+ employees

industry classification system, see Eberle et al. (2011). I start by studying the wage dispersion within the four size classes in Fig. 4. As can be seen, the general pattern documented in the previous section can be confirmed for groups of establishments of different sizes. This holds true for all panels in Fig. 4, even though the dynamics are more volatile and less dispersed in larger establishments. This is a helpful finding, particularly regarding new establishments. Likely, a new establishment with, say, 25 employees in its birth year differs from a new establishment with just one employee. Additionally, large entrants could sometimes be newly established branch plants of existing firms rather than genuinely new firms (Fackler et al. 2016). The fact that the patterns depicted in Fig. 4a–d are roughly similar hints towards the generalizability of the aggregate dispersion dynamics.

Another concern could be that the observed evolution is specific to the service sector. Thus, the overall trend is simply driven by a sector shift towards a more service-based economy. Therefore, Fig. 5 depicts the evolution of the wage dispersion for the manufacturing sector and the service sector, as measured by the coefficient of variation. Inspection of Fig. 5 indicates that the trend is not specific to the service sector, as the general trend can be confirmed for both the service and the manufacturing sector.[12]

In addition, I use the information on employee composition provided in the BHP to study the robustness of the findings concerning the type of establishment considered. I classify these types based on the information on the skill, task, occupation, and age composition of an establishment's workforce. More information on the classification and the results can be found in the Appendix (Sect. A.2; Fig. 16). Overall, Fig. 16 confirms the general trend and suggests that specific types of establishments do not majorly drive the dynamics depicted here. Put differently, they do not solely reflect changes

[12] In the Appendix, I additionally provide Figures that show the 10th and 90th percentile of the distribution of average wages (Fig. 13) and Figures that depict the evolutions of the wage dispersion within sector *and* size (Figs. 14 and 15).

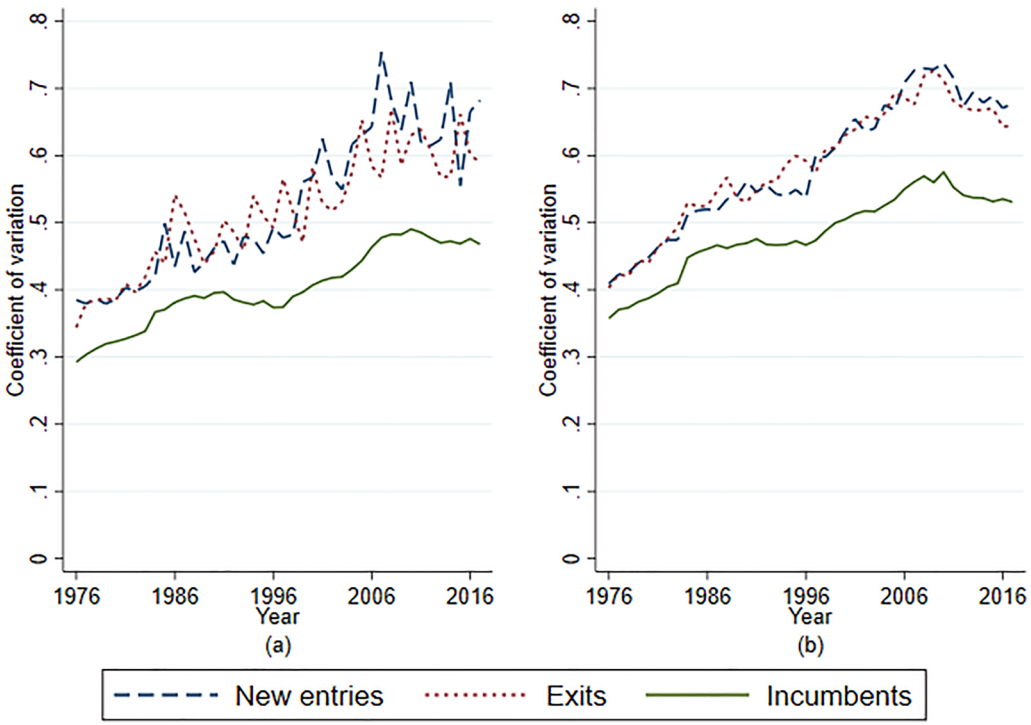

Fig. 5 Coefficient of variation of the average wage distribution by sector. **a** Depicts the manufacturing sector, **b** depicts the service sector

in the establishment and worker composition but rather describe a general trend that can be found for very different types of establishments at the same time.

Based on the findings presented in this section, the following can be concluded. In terms of entry, the market seems to offer high-wage and low-wage establishments the possibility to enter simultaneously, and it does so increasingly. Overall, the observed pattern suggests that entry and exit dynamics should impact the wage dispersion between establishments since they bring groups of establishments into and out of the market that are characterized by high levels of dispersion. This holds true for establishments of different sizes, sectors, and employment compositions. Note, however, that until now, I only studied new establishments in their birth year and did not follow the life cycles of the respective entry cohorts. Additionally, at this point, it is not clear how exits shape these life cycles and how exits relate to wages and wage dispersion.

4.3 Wage dispersion within and between entry cohorts

To address these open questions, I present the results of an in-depth examination of the wage dispersion within and between different entry cohorts in the following. For that, I aggregate the data on the level of the entry year (i.e., cohort) and establishment age and study dispersion measures of the resulting distribution.[13] By that means, it is possible to set up a model that describes both the life cycle of entry cohorts (within-cohort wage dispersion) and the differences between different entry cohorts (between-cohort wage dispersion). The model consists of the coefficient of variation as a dependent variable, representing the measure for dispersion, and age and entry year (i.e., cohort) dummies as explanatory variables.[14] The resulting estimation equation can be expressed as follows:

$$CV_{it} = \propto + \sum_{i=1}^{10} \beta_j Age_{ji} + \sum_{k=1976/1996}^{1995/2008} \gamma_k Cohort_{kt} + \epsilon_{it}$$

where i represents establishment age, t represents entry year (cohort), and CV stands for the coefficient of variation. Thus, the estimation is performed with data on the level of the entry year and establishment age (t × i). The objective of this exercise is to track entry cohorts as they grow older and study their wage dispersion evolution.

[13] The underlying sample is, therefore, an inflow sample and just considers establishments that entered during the observation period.

[14] As a robustness check, I also show models with the ratio between the 90th and 10th percentile as a measure of dispersion in Table 5 in the Appendix. The results of this exercise yield the same insights as the ones presented here.

The coefficients of the age dummies reflect the within-cohort wage dispersion (β_j's), while those of the entry year dummies reflect the between-cohort wage dispersion (γ_k's). I consider age dummies until the age of 10 which implies that only those establishments are considered that have been founded before 2009. To account for systematic differences between entry cohorts, I split the sample into two periods: 1976–1995 and 1996–2008. This is motivated by the finding of Card et al. (2013) who report an increasing dispersion between establishments founded after 1995. To investigate the role of exits in shaping the wage dispersion evolution, I additionally construct two separate samples: one containing all establishments and one containing only those that survived at least 10 years.

Before proceeding, the following should be noted. Separately identifying time, cohort, and age effects is considered a major challenge in the literature on wage evolutions and distributions as the linear dependency among these three variables (cohort + age = time) makes a clean identification impossible (e.g., Gosling et al. 2000; Karonen and Niemelä 2020). Concerning this challenge, my simple approach in this paper is to capture broad time effects by splitting the entry cohorts into two samples and studying their different trajectories. In addition, note that the age and cohort dummies were explicitly not intended to capture pure cohort or age effects (even if they were cleanly identifiable) since the aim of the regression is a description of the adjustment process of wage dispersion of entry cohorts. Therefore, it explicitly allows for firm selection to explain (parts of) the patterns. Put differently, I am agnostic about the source of the changes in wage dispersion as the cohorts grow old. Consequently, I do not include control variables that capture the composition of the cohorts in terms of size, sector, or workforce since these would capture firm selection aspects I want to be revealed in the age and cohort dummies.

Estimation results are presented in Table 1. The first column shows the results for all establishments born between 1996 and 2008. I refer to these cohorts as the more recent entry cohorts in the following. Starting with the coefficients of the age dummies in the first column, it is visible that more recent entry cohorts exhibit a dispersion of average wages that decreases with the age of the establishments. While entry cohorts in their second year after birth (age 3) exhibit a coefficient of variation that is 0.02 points lower than in their birth year, this difference increases to 0.07 points in their 10th year of existence. This corresponds to a decline in the wage dispersion by 12.5% (0.07/0.56) and indicates a convergence of average wages within these more recent cohorts. Put differently, establishments within entry cohorts become more similar (or equal) as they grow old. This is in line with the previous work of Card et al. (2013), who found that new establishments exhibit a wide distribution of establishment effects that narrows over time. They describe this evolution as "life cycle patterns in the measured heterogeneity of firms" (Card et al. 2013, p. 1008).

To study the role of exits, I replicate the estimation with the survivors' sample. The results of this exercise are presented in column (2). As can be seen, the coefficients of the age dummies differ from those of the previous model. In the first years of existence, there seems to be a small convergence process. However, the coefficients become smaller and insignificant as the cohorts age. As a result, there is no statistically significant difference in the wage dispersion of surviving establishments between their birth year and their 10th year of existence. This suggests that the convergence is largely driven by systematic establishment exit. Generally, this is consistent with exiting establishments being more heterogeneous than incumbents (or survivors), as presented in Figs. 3, 4 and 5.

Inspection of models (3) and (4) in Table 1 shows that patterns of within-cohort wage dispersion have changed over time. Older entry cohorts, i.e., those born before 1996, also exhibit a convergence pattern over time but on a substantially lower level, as suggested by the smaller coefficients. The coefficient of variation regarding the birth cohorts that entered between 1976 and 1995 is, on average, 0.02 points lower at age ten than in the birth year. This corresponds to a decline in wage dispersion by close to 5% (0.02/0.41). Interestingly, there is no change in the within-cohort wage dispersion after the third year. Model (4), which displays the results for the survivors' sample, indicates that the observed convergence is again rather driven by establishment exit as the coefficients turn insignificant and/or zero after 5 years. Notably, I rather detect divergence patterns after 10 years of existence within the survivors' sample, as suggested by the positive coefficient.

How can these patterns be explained? One explanation could be that in more recent years, a wider range of new establishments has entered the market. These increased dynamics are then followed by more systematic or frequent exit of those establishments that, in terms of Jovanovic (1982), learned that their true efficiency is insufficient to survive. One interpretation could be that these establishments have not been observed in the older cohorts because they did not enter in the first place. In other words, pre-entry opportunity dynamics and subsequent exit dynamics have been increasing, and the results suggest that their interaction is part of the evolution of the wage dispersion between establishments. The coefficients of the entry year dummies in Table 1 support this view as they continuously grow over time. For instance, establishments that entered in 1976, on average, exhibit a coefficient of variation (regarding their average wages)

Table 1 Within- and between-cohort wage dispersion

Dep. var.: coefficient of variation	(1) All 1996–2008	(2) Survivors 1996–2008	(3) All 1976–1995	(4) Survivors 1976–1995
Age 1 (reference)	–	–	–	–
Age 2 (dummy)	− 0.02 (0.01)	− 0.02 (0.01)	− 0.01* (0.01)	− 0.01* (0.01)
Age 3 (dummy)	− 0.02* (0.01)	− 0.02* (0.01)	− 0.02* (0.01)	− 0.02* (0.01)
Age 4 (dummy)	− 0.04*** (0.01)	− 0.03*** (0.01)	− 0.02*** (0.01)	− 0.02** (0.01)
Age 5 (dummy)	− 0.04*** (0.01)	− 0.03** (0.01)	− 0.02*** (0.01)	− 0.01** (0.01)
Age 6 (dummy)	− 0.05*** (0.01)	− 0.03** (0.01)	− 0.02*** (0.01)	− 0.01 (0.01)
Age 7 (dummy)	− 0.06*** (0.01)	− 0.02* (0.01)	− 0.02*** (0.01)	− 0.00 (0.01)
Age 8 (dummy)	− 0.06*** (0.01)	− 0.01 (0.01)	− 0.02*** (0.01)	0.00 (0.01)
Age 9 (dummy)	− 0.06*** (0.01)	− 0.01 (0.01)	− 0.02*** (0.01)	0.00 (0.01)
Age 10 (dummy)	− 0.07*** (0.01)	− 0.01 (0.01)	− 0.02** (0.01)	0.02** (0.01)
Entry year				
1976 (reference)	–	–	–	–
1977 (dummy)	–	–	0.01 (0.01)	0.01 (0.01)
1978 (dummy)	–	–	0.03** (0.01)	0.03** (0.01)
1979 (dummy)	–	–	0.03*** (0.01)	0.03*** (0.01)
1980 (dummy)	–	–	0.06*** (0.01)	0.05*** (0.01)
1981 (dummy)	–	–	0.08*** (0.01)	0.07*** (0.01)
1982 (dummy)	–	–	0.08*** (0.01)	0.07*** (0.01)
1983 (dummy)	–	–	0.08*** (0.01)	0.07*** (0.01)
1984 (dummy)	–	–	0.08*** (0.01)	0.07*** (0.01)
1985 (dummy)	–	–	0.08*** (0.01)	0.08*** (0.01)
1986 (dummy)	–	–	0.07*** (0.01)	0.06*** (0.01)
1987 (dummy)	–	–	0.08*** (0.01)	0.07*** (0.01)
1988 (dummy)	–	–	0.08*** (0.01)	0.07*** (0.01)
1989 (dummy)	–	–	0.08*** (0.01)	0.07*** (0.01)
1990 (dummy)	–	–	0.11*** (0.01)	0.08*** (0.01)
1991 (dummy)	–	–	0.09*** (0.01)	0.08*** (0.01)
1992 (dummy)	–	–	0.11*** (0.01)	0.09*** (0.01)
1993 (dummy)	–	–	0.10*** (0.01)	0.08*** (0.01)
1994 (dummy)	–	–	0.10*** (0.01)	0.08*** (0.01)
1995 (dummy)	–	–	0.12*** (0.01)	0.10*** (0.01)
1996 (reference)	–	–	–	–
1997 (dummy)	0.03** (0.01)	0.02* (0.01)	–	–
1998 (dummy)	0.04*** (0.01)	0.02 (0.01)	–	–
1999 (dummy)	0.05*** (0.01)	0.05*** (0.01)	–	–
2000 (dummy)	0.07*** (0.01)	0.07*** (0.01)	–	–
2001 (dummy)	0.09*** (0.01)	0.08*** (0.01)	–	–
2002 (dummy)	0.08*** (0.01)	0.05*** (0.01)	–	–
2003 (dummy)	0.08*** (0.01)	0.07*** (0.01)	–	–
2004 (dummy)	0.11*** (0.01)	0.09*** (0.01)	–	–
2005 (dummy)	0.09*** (0.01)	0.08*** (0.01)	–	–
2006 (dummy)	0.10*** (0.01)	0.09*** (0.01)	–	–
2007 (dummy)	0.11*** (0.01)	0.10*** (0.01)	–	–
2008 (dummy)	0.09*** (0.01)	0.09*** (0.01)	–	–
Intercept	0.56*** (0.01)	0.50*** (0.01)	0.41*** (0.01)	0.38*** (0.01)
R^2	0.75	0.71	0.81	0.77
N	130	130	200	200

West Germany, all sectors. 1976–2008, OLS estimations with the coefficient of variation (sd/mean) as a dependent variable in all specifications. Robust standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level. Age-cohort cells weighted with number of establishments per cell. Number of establishments per cell vary between 12,979 and 19,972 (mean 15,559) in columns (2) and (4) and between 14,632 and 64,468 (mean 25,661) in columns (1) and (3)

that is 0.12 points lower than in the year 1995, conditional on a given age, while the coefficient of variation for establishments entering in the year 2008 is 0.09 points higher than in the year 1996, ceteris paribus.[15]

Since this analysis has been conducted with entering establishments of every sector, I also provide the results for the manufacturing and service sector only (Tables 3 and 4 in the Appendix). The basic pattern can be confirmed for both the service and manufacturing sectors. However, the convergence is less pronounced in the manufacturing sector. As in Sect. 4.2, I provide results for different establishment types regarding skill, task, occupation, and age composition. To save space, I only show the point estimates of the age dummies for all four specifications. The results can be found in Fig. 17 in the Appendix. It can be seen that the pattern does vary by establishment type considered, however the direction of the dynamics is robust to an alteration of the sample regarding workforce composition. The same holds true for the evolution of the wage dispersion for establishments of different size classes (see Fig. 18 in the Appendix).[16]

4.4 The interaction of entry and exit dynamics

To further reinforce the finding that more recent entry cohorts exhibit stronger exit dynamics, I show the average ages of establishments at exit for every entry cohort and the fraction of new establishments of every entry cohort that exited within 10 years. If increased entry dynamics are associated with stronger exit dynamics, we should see declining average ages at exit since establishments would die younger, on average. At the same time, the fraction of new establishments per cohort that exited within 10 years should have increased. For the average age at exit, I set up a linear regression model that relates an establishment's age at exit to a full set of entry year dummies (1976–2008) and a set of establishment characteristics, including size, industry, wage level and employment composition (i.e., employment shares in terms of gender, nationality, skill level, age, and occupation) as further controls.[17] The estimation results of the respective model can be found in the Appendix in Table 6.[18] Figure 6 depicts the evolution of the two variables. On the left y-axis, I display the average ages at exit of exiting establishments (linear predictions based on the described model; connected line with diamond), while on the right y-axis, I show the fraction of new establishments that exited within 10 years (gray dotted line). As can be seen, the average age at exit decreased substantially since the beginning of the observation period. While this decline evolved slowly and was unstable until the beginning of the 1990s, it accelerated dramatically in the 1990s.

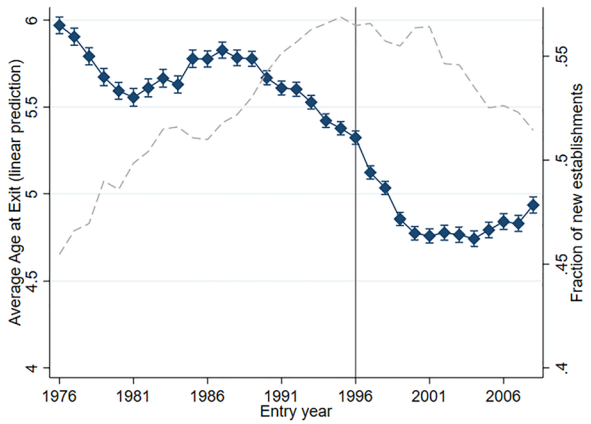

Fig. 6 Evolution of exit dynamics by entry year. Left y-axis: Average age at exit. Right y-axis: Fraction of new establishments that exited within 10 years. For the average age at exit only those establishments were considered that exited within their first 10 years of existence

Within these 10 years, the average age at exit declined by close to 1 year, from 5.66 years in 1990 to 4.77 years in 2000. The vertical line indicates the year 1996, which served as a cut-off year in the preceding analysis. During the 2000s, the average age at exit evolved constantly. However, from 2005 on, it slowly increased again. The fraction of new establishments per cohort that exited within 10 years increased over time, from a fraction of around 0.45 for establishments born in 1976 to a fraction of between 0.54 and 0.57 for establishments born between 1990 and 2003. In the mid-2000s, the fraction began to decline again. These combined findings further support previous evidence and highlight that rising exit dynamics translate into lower average ages at exit. Put differently, on average establishments born in more recent years die younger. This is consistent with the strand of explanation developed above, i.e., that rising entry opportunities are followed by stronger and faster

[15] Note that the reference year varies with the model. For the older cohorts, the reference year is 1976; for the more recent cohorts, the reference year is 1996.

[16] It should be noted that for large establishments with more than 49 employees, the results are inconclusive, possibly due to small cell sizes upon which the dispersion measure was calculated. The same applies to the evolution of the wage dispersion within size *and* sector. I do not show results for the latter robustness check. However, they are available upon request.

[17] Only those establishments are included in the model that exited within their first 10 years of existence to make different entry cohorts comparable. Hence, the model captures the age at exit, conditional on exiting; therefore, the number or ratio of surviving establishments does not impact the outcome.

[18] Note that I also estimated the parameters of a model without control variables. Estimation results can also be found in Table 6. Linear predictions are presented in Fig. 19.

Table 2 The correlation between entry and exit patterns per birth cohort

	(1) Average age at exit	(2) Fraction exiting within 10 years
New establishments	− 0.37*** (0.07)	0.33*** (0.04)
R^2	0.48	0.65
N	33	33

Bivariate regression of the logarithm of the average age at exit of exiting establishments (column 1) and of the logarithm of the fraction of new establishments exiting within 10 years (column 2) on the number of new establishments per birth cohort. Birth cohorts from 1976 to 2008 included. Standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level

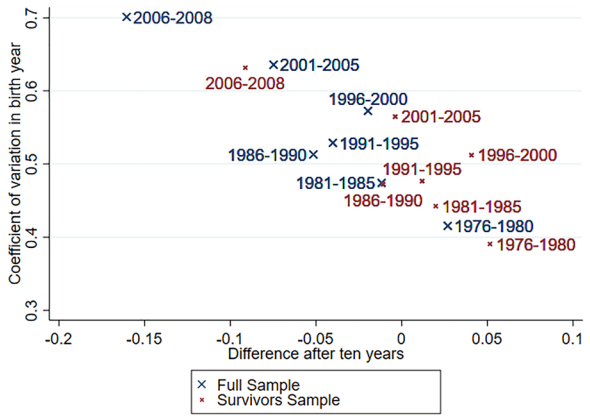

Fig. 7 The link between the wage dispersion in the birth year and the difference in the wage dispersion after 10 years, for chosen birth year clusters

exit behavior, reducing the age at exit and increasing the fraction of young establishments that exit.

To relate these exit dynamics to preceding entry patterns, I present correlations between the number of new establishments per birth cohort and the two variables from above. Table 2 shows the estimates from bivariate regressions, where the coefficients can be interpreted as an elasticity. As can be seen, the coefficients exhibit the expected signs in both columns. There exists a strong negative correlation ($R^2 = 0.48$) between the number of newly founded establishments and their average age at exit and a strong positive correlation ($R^2 = 0.65$) between the number of newly founded establishments and the fraction of these establishments that exited within the next 10 years. Accordingly, crowded entry cohorts with many new establishments are associated with more dynamic exit patterns in the following 10 years.

How do these interacting dynamics translate into the evolution of the wage dispersion of entry cohorts? To gain an understanding of this question, I study the link between the wage dispersion of entry cohorts in their year of birth and the subsequent decline in their wage dispersion as they grow old. Therefore, in Fig. 7, I relate the coefficient of variation in the birth year (y-axis) to the difference between the coefficient of variation after 10 years and the coefficient of variation in the birth year for both the full (large X) and the survivors' sample (small x).[19] Figure 7 provides two insights. First and foremost, the negative relationship implies that entry cohorts that start with high levels of wage dispersion experience strong declines in their wage dispersion after 10 years, while entry cohorts that start with rather low levels of wage dispersion experience moderate declines or even slight increases in their wage dispersion. The evidence presented in Fig. 7, therefore, hints toward the presence of sigma convergence (reduction of wage disparities between entry cohorts) and suggests that the evolution after entry compresses the wage dispersion. Second, the survivors' cohorts start with lower levels of wage dispersion and experience substantially lower declines in this wage dispersion after 10 years, again suggesting that most of the observed convergence is due to systematic establishment exit.

4.5 Establishment exits and the wage level

Despite existing theoretical ambiguities, the empirical literature is surprisingly silent on the nexus between establishment exits and wages. Exemptions are the studies of Faberman and Freedman (2016) and Malchow-Møller et al. (2011), both reporting a negative correlation. The following analysis aims to clarify this relationship and is guided by two questions. First, how do establishment exits relate to their wage level? Second, how does this relationship vary with the birth year? To examine these two questions, I estimate the parameters of a linear probability model (LPM), including a binary exit dummy as a dependent variable and a set of explanatory variables. I thereby closely follow the estimation strategy of Fackler et al. (2013) and include age, size, and industry dummies, as well as variables that capture the employment composition of an establishment. To address the first question, I include twenty dummies indicating the wage ventiles (each representing the wage intervals in 5 percentage points steps, i.e.,

[19] For greater clarity, I do not show every entry year but categorize the entry years into seven groups. The choice of these groups does not have any meaning, nor does it follow any specific reasoning, as the Figure is explicitly designed such that it transports the two key messages I want to raise here. Precise information on every entry cohort can be found in the Appendix in Table 7.

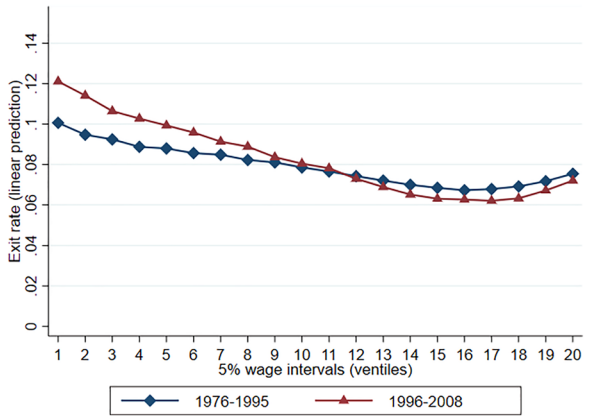

Fig. 8 Exit rates dependent on the wage level for different birth cohorts. The underlying model includes every establishment that has been recognized as an entry, and that can be assigned a specific entry year and age. Confidence intervals are omitted here as they are very small

up to 5%-quantile, 5- to 10%-quantile, etc.) that display the position of a given establishment within the (entry year-specific) wage distribution.[20] To address the second question, I interact the wage ventile dummies with an indicator that captures whether an establishment belongs to an older cohort (born between 1976 and 1995), a more recently born cohort (born between 1996 and 2008), or a most recently born cohort (born between 2009 and 2017). In terms of the age-cohort-time problem, I stick to my approach from Sect. 4.3, however, now I control for age and year and capture broad cohort effects by the inclusion of these three entry year clusters.

Figure 8 depicts the exit rates (as linear predictions from the model described above) dependent on the wage level for the older and the more recently born cohorts.[21] The regression results are provided in the Appendix in Table 8. It is evident that the exit rates generally decline with the wage level. Establishments that pay the lowest wages, compared to their peers in the same entry cohort, exhibit the highest risks of exit. This generally confirms the findings of Faberman and Freedman (2016) and of Malchow-Møller et al. (2011). For instance, establishments that entered between 1996 and 2008 (triangle) and belonged to the 5% of the worst paying establishments of their birth cohort (value 1 on the x-axis) exhibit an exit rate of around 0.12. Framed differently, roughly one out of eight of these establishments exits, conditional on the other factors considered in the model. In contrast, establishments that belong to the 70–75% wage ventile (value 15 on the x-axis) exhibit an exit rate of only 0.063, which corresponds to an almost halved exit risk for establishments born between 1996 and 2008. Within this wage ventile, only about one out of 16 establishments exit. However, the general decrease is not linear, as the exit rates increase for the best-paying establishments again. For both considered entry cohort clusters, we can observe a minimum at the 15th to 17th 5% ventile that is followed by an increase in the exit rates.

As can be seen, the curve representing establishments born between 1996 and 2008 is steeper than that representing establishments born between 1976 and 1995. Here, steepness indicates the magnitude of the wage dependency of exit rates. A steeper curve implies that establishment exit is more systematically related to the wage level and, accordingly, should have a higher impact on wage inequality. This is precisely what could be expected based on Table 1, where the exit of establishments of older cohorts only slightly changed the within-cohort evolution of the wage dispersion.

Hence, Fig. 8 indicates that exiting establishments reduce wage inequality since the market is cleared from the worst-paying establishments via the exit channel. Additionally, since the wage dependency of exits increased over time, its impact on the overall wage dispersion should have increased. Regarding theory, we can discard the hypothesis derived from equilibrium search models stating that high-wage and low-wage establishments are the least likely to exit.

5 Conclusion

Using a 50% random sample of all establishments operating in West Germany from 1976 to 2017, this paper has examined the relationship between establishment dynamics and wage dispersion between establishments. Even though this analysis is descriptive, I am able to unearth relevant patterns that, to my knowledge, have not yet been jointly studied in the literature. These patterns are:

(1) The wage dispersion between establishments within the groups of entering, exiting, and incumbent establishments generally increases over time.
(2) The wage dispersion between entering and exiting establishments is substantially higher than the wage dispersion of incumbent establishments. Hence, establishment dynamics impact the wage structure

[20] For robustness, I replicate the estimation with wage ventiles that also condition on establishment age and size and find no substantial difference. Estimation results are available upon request.

[21] I refrain from depicting the results for the most recent cohorts as they were not discussed in the previous sections. Also, their results are harder to interpret since they contain a larger fraction of very young establishments more prone to exit.

since they bring groups of establishments into and out of the market that are characterized by high levels of dispersion.

(3) The wage dispersion within cohorts of entering establishments is declining with age, and this convergence process is most pronounced for establishments born in more recent years (1996–2008).

(4) This decline is predominantly driven by systematic establishment exit that mechanically reduces the wage dispersion of the residual cohort. Moreover, highly dispersed cohorts of entering establishments exhibit the largest declines in their wage dispersion after 10 years.

(5) In more recent years, establishments exit at younger age, on average, and it seems that this faster exit behavior relates to preceding entry patterns. More specifically, crowded entry cohorts are associated with a lower average age at exit and a higher fraction of young exiting establishments.

(6) The exit rates of establishments decline with their position within the entry year-specific wage distribution. Hence, low-wage establishments predominantly exit the market.

Concerning my research questions, these patterns reveal the following insights. Most generally, (2) suggests that there is a relationship between establishment dynamics and wage dispersion between establishments. Moreover, (2) and (3) suggest that establishment entries increase the dispersion of average wages between establishments by supplementing the wage distribution with a highly dispersed group of establishments. This is in line with previous findings on the link between the prevalence of new firms and income inequality in the literature (e.g., Atems and Shand (2018); Lippmann et al. (2005)).

Additionally, (2), (4), and (6) suggest that establishment exits decrease the dispersion of average wages between establishments by eliminating a highly dispersed group of establishments from the wage distribution and by shifting the distribution rightwards. To my knowledge, this paper is the first to address how exits generally shape the wage distribution. Further, (4) suggests that new establishment's exit patterns dampen the initial adverse effect of new establishments on wage inequality and thus exert a stabilizing effect on the wage distribution. Lastly, (5) reveals an interrelation between firm entry dynamics and subsequent exit patterns. Hence, more crowded entry cohorts exhibit faster exit patterns associated with lower average ages of exiting establishments.

This paper also contributes to the clarification of theoretical ambiguities that prevail in the literature on firm exit and wages. My empirical results are consistent with predictions from perfect competition models and discard predictions from equilibrium search models since low-wage firms exit the market with a higher probability than firms that pay higher wages. Interestingly, my findings confirm both (implicit) predictions of Jovanovic (1982): the negative but non-linear relationship between exits and wages indicates that the most efficient firms are indeed operating in the high-wage sector. However, the growing exit rates at the highest wage ventiles indicate that high-wage firms can also be high-cost firms, putting them at a higher risk of exiting again.

The findings of this study can extend the political discussion over firm entry and exit by addressing their impact on the wage structure. So far, the discussion on firm entry is mostly led based on microeconometric evidence, stating that employment and wages in new establishments may not be as advantageous as desired, at least from the perspective of the individual worker. Most recently, Fackler et al. (2022) and Sorenson et al. (2021) found strong and persistent drawbacks for start-up employees, both regarding wages and employment stability. This paper provides an additional perspective on the evaluation of the economic benefits of new firms by showing that their entry rather increases wage inequality, thereby provoking possibly unwanted distributional effects. Therefore, from a policy perspective, it might be helpful to take these considerations into account when evaluating policy instruments, such as subsidies for start-ups. My focus on wage dispersion supports the skeptical view of some authors toward a policy that devotes more and more resources to fostering new business formation (Santarelli and Vivarelli 2007; Shane 2009).

Despite these potential drawbacks, Germany has a long tradition of programs to support new business formation that aim to facilitate the transition from unemployment into self-employment. Such a start-up subsidy program had existed since 1986 (*Überbrückungsgeld*) and was accompanied by an additional program in 2003 (*Ich-AG)* before both were merged into one subsidy program (*Gründungszuschuss)* (Noll and Wießner 2011; Pfeiffer 2005). Interestingly, the share of new establishments shown in Fig. 1 steeply rose during the second half of the 1980s and the 1990s. The existence of the program and the rising unemployment in Germany during the 1990s might have impacted the number of newly founded establishments and the rising heterogeneity of new establishments during this period since the subsidy presumably increased the pool of potential founders. However, the policy changes in 2003 and 2006 were not followed by rises in new

establishments, suggesting that their impact might have been negligible. Note, however, that a careful assessment of the consequences of these policy regimes is beyond the scope of this paper.

The costs and benefits of firm exit have mostly been discussed regarding their crucial role in reallocating resources and shaping structural change (Fackler et al. 2013). This paper shows that through firm exits, the market is cleared from the worst-paying establishments. As a consequence, establishment exits reduce the overall wage dispersion. Analogously to firm entry, these distributional effects are not yet put forward in the discussion regarding the economic costs and benefits of firm exit.

Finally, it should be noted that this paper predominantly contributes to the understanding of *how* firm entry and exit patterns relate to the wage dispersion between establishments. However, it is largely silent on the question of *why* this increasing heterogeneity of new and exiting establishments has occurred. Future research may tackle this question by combining this paper's findings with prevailing trends in the labor market, such as digitalization, institutional changes, or market concentration.

Appendix

A.1 Aggregate wage dispersion dynamics in establishments

Here, I show additional material for Sect. 4.1. Figure 9 displays the evolution of mean establishments' (real) wages, weighted by establishment size. Figure 10 shows wage dispersion dynamics, as measured by the coefficient of variation, weighted by establishment size. In Fig. 11 I show the evolution of the 10th and 90th percentile of the distribution of average wages as well as the ratio between

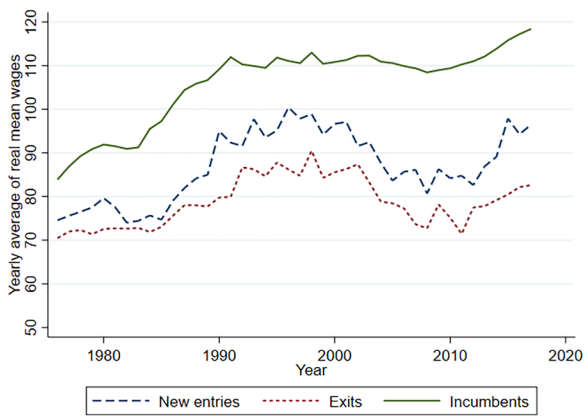

Fig. 9 Mean establishments' wages in real terms in West Germany, weighted by establishment size

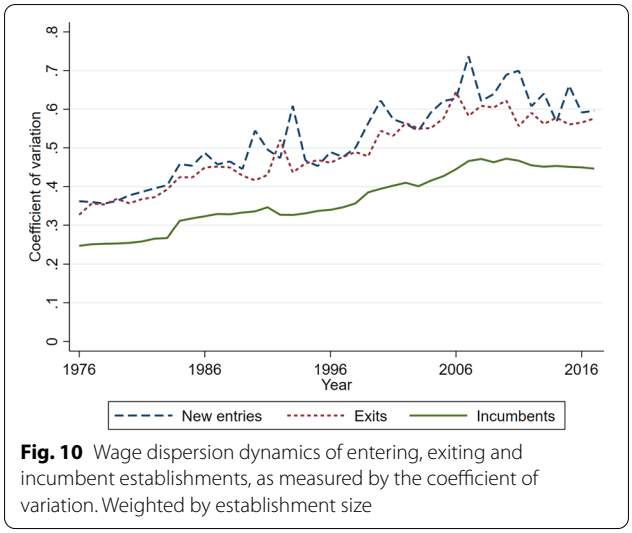

Fig. 10 Wage dispersion dynamics of entering, exiting and incumbent establishments, as measured by the coefficient of variation. Weighted by establishment size

90 and 10th percentile (both weighted and non-weighted version). Figure 12 presents the evolution of the coefficient of variation for the average wages of high-skilled and low-skilled employees.

A.2 Wage dispersion dynamics in establishments by size, sector and employment composition

Here I show additional material for Sect. 4.2. Figure 13 displays 10th and 90th percentile of the distribution of average wages (in real terms) and the ratio between those percentiles for both the manufacturing sector and the service sector. Figure 14 (15) displays the wage dispersion within four size classes in the manufacturing (service) sector.

In Fig. 16, I show wage dispersion dynamics, as measured by the coefficient of variation, for establishments with different employment compositions. Firstly, I analyze the evolution of the wage dispersion only for establishments with a comparably high share of high-skilled employees to approximate the human capital intensity and, to some extent, the productivity of an establishment (panel (a)). Secondly, I only consider establishments with a high share of employees with easy manual (panel (b)), easy service (panel (c)), and easy commercial tasks (panel (d)). Here, a high share rather speaks for low requirements regarding the tasks needed to produce a certain output, suggesting that the output consists of relatively simple products or services. Thirdly, only establishments with a high share of employees older than 50 are under consideration to study differences between establishments with different age structures of their workforce (panel e)). For the definition of a high share, I use the respective distributions of the employee shares and consider an establishment as having a high share when it lies above the 75% percentile

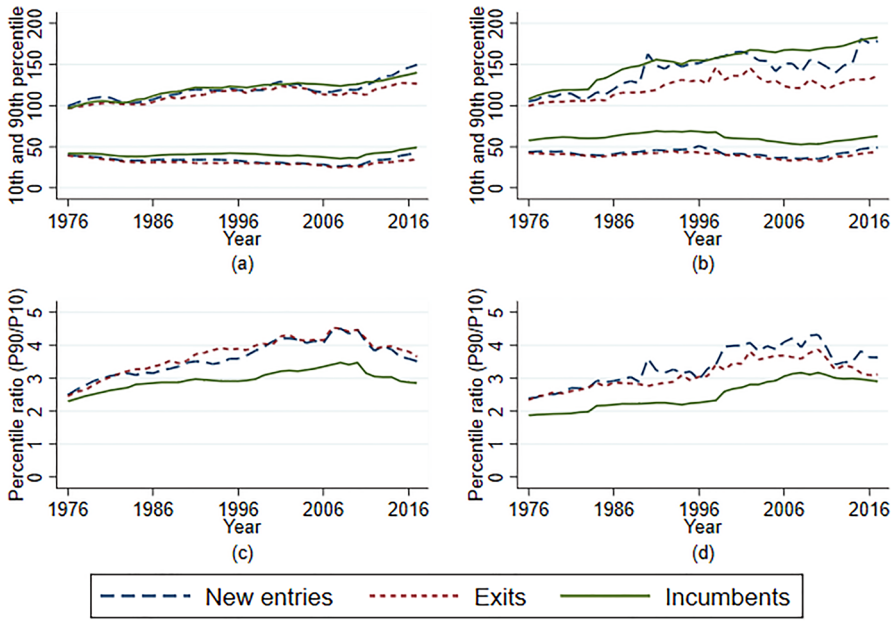

Fig. 11 Wage dispersion dynamics of entering, exiting and incumbent establishments. **a** Shows 10th and 90th percentile of the average wage distribution, not weighted by establishment size. **b** Shows the 10th and 90th percentile of the average wage distribution, weighted by establishment size. **c** Shows the ratio between 10 and 90th percentile, not weighted by establishment size. **d** Shows the ratio between 10 and 90th percentile, weighted by establishment size

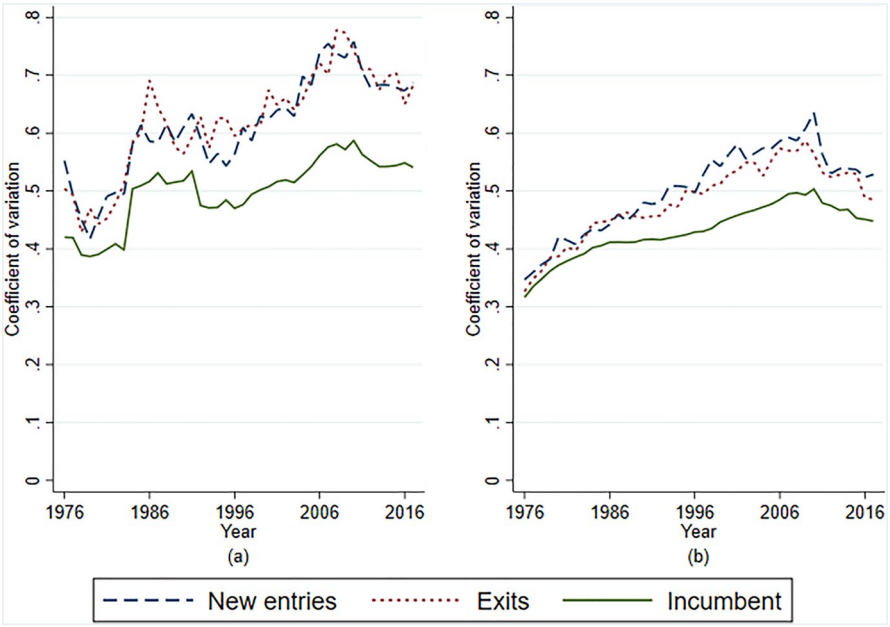

Fig. 12 Coefficient of variation of average real wages by skill group. Average real wages of high-skilled employees are depicted in (**a**) and average real wages of low-skilled employees are depicted in (**b**)

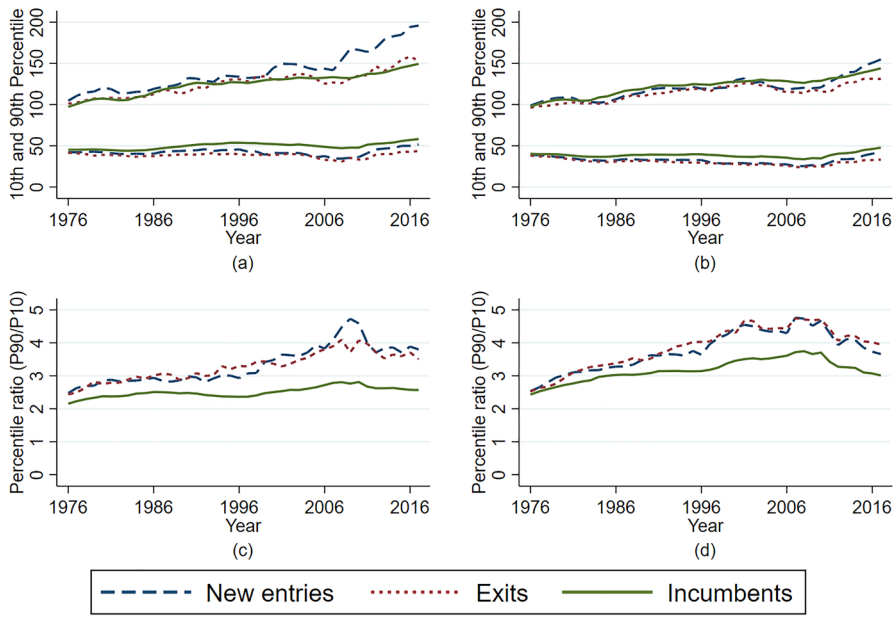

Fig. 13 10th and 90th percentile of the distribution of real average wages. **a** Depicts the manufacturing sector, **b** depicts the service sector. **c** Depicts the percentile ratio for the manufacturing sector, **d** depicts the percentile ratio for the service sector

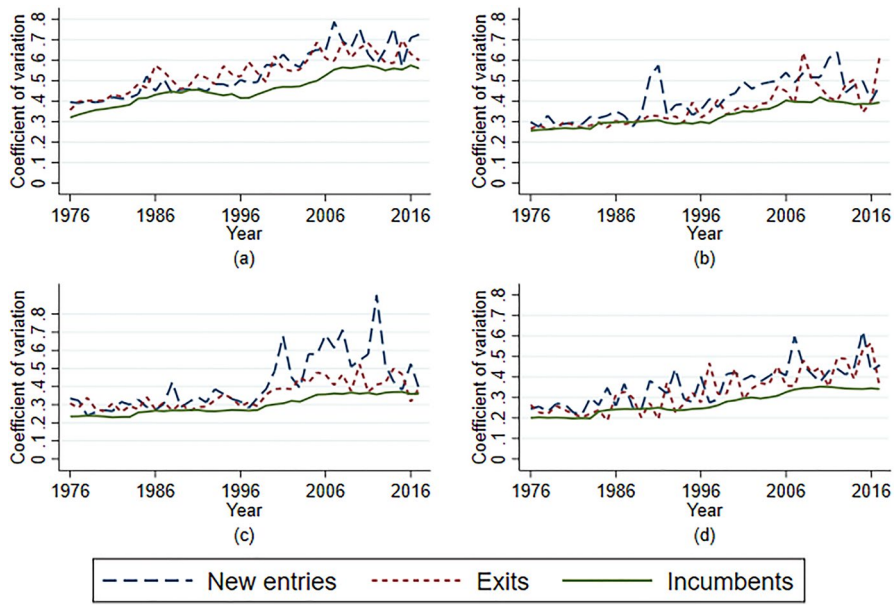

Fig. 14 Coefficient of variation within different establishment size classes for the manufacturing sector. **a** 1–9 employees, **b** 10–19 employees, **c** 20–49 employees, **d** 50+ employees

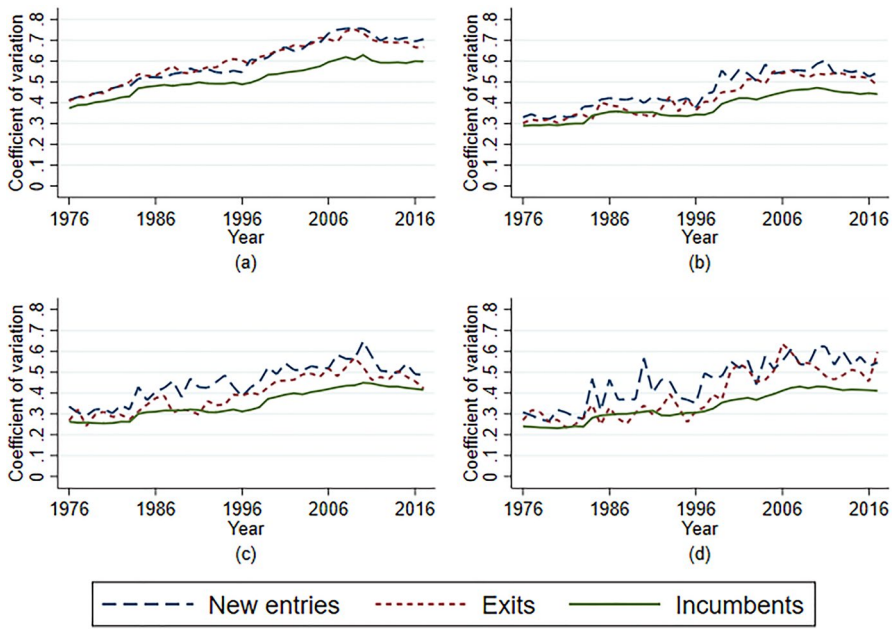

Fig. 15 Coefficient of variation within different establishment size classes for the service sector. **a** 1–9 employees, **b** 10–19 employees, **c** 20–49 employees, **d** 50+ employees

of the respective share distribution. Lastly, I specifically study establishments with at least one engineer and/or natural scientist, which can be regarded as a crude proxy for the technological sophistication of the establishments' products or services. Since only very few establishments have at least one such employee, I deviated from the procedure of splitting the sample according to the respective share to avoid low observation numbers.

A.3 Wage dispersion between and within entry cohorts

Here I provide additional material for Sect. 4.3. Table 3 shows the within- and between-cohort wage dispersion for the manufacturing sector, Table 4 for the service sector. Table 5 displays the within- and between-cohort wage dispersion with the ratio of 90th and 10th percentile (P90/P10) as a dependent variable. Figure 17 shows point estimates of all four specifications of the regressions that only consider establishments with certain employment composition characteristics. Figure 18 shows point estimates of all four specifications of the regressions that only consider establishments within different size classes.

A.4 Interaction of entry and exit dynamics

Here I provide additional material for Sect. 4.4. Table 6 depicts the estimation on which the linear predictions, shown in Fig. 6, are based. Figure 19 displays linear predictions from specification (1). Table 7 presents additional information on Fig. 7 and shows the coefficient of variation of every entry cohort in the birth year and the difference after 10 years.

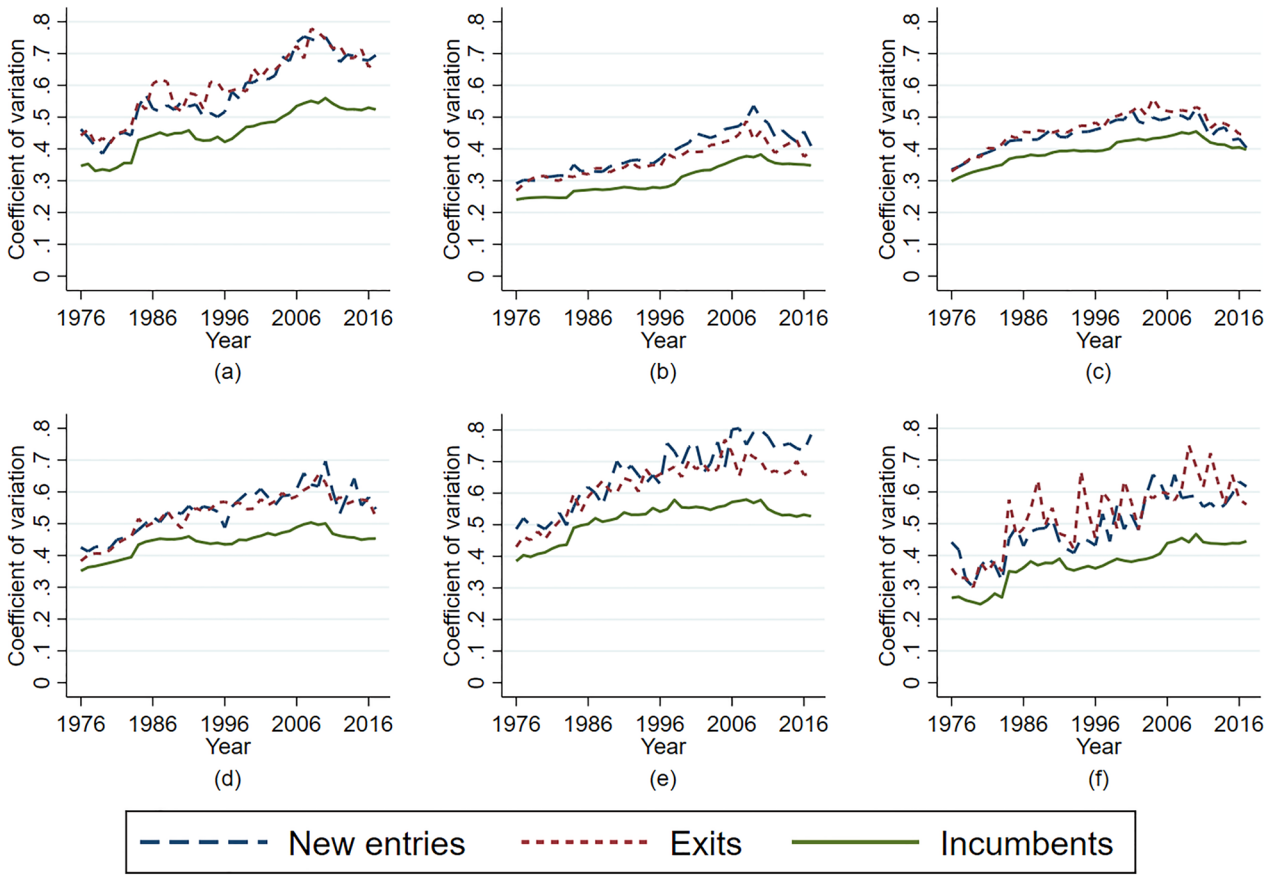

Fig. 16 Coefficient of variation for different types of establishments. **a** Contains only establishments belonging to the 25% of establishments with the highest share of high-skilled employees in the sample. **b** Contains only establishments belonging to the 25% of establishments with the highest share of employees performing easy manual tasks. **c** contains only establishments belonging to the 25% of establishments with the highest share of employees performing easy service tasks. **d** Contains only establishments belonging to the 25% of establishments with the highest share of employees performing easy commercial tasks. **e** Contains only establishments belonging to the 25% of establishments with the highest share of employees that are older than 50 years. **f** Contains only establishments with at least one engineer and/or natural scientist

Table 3 Within- and between-cohort wage dispersion in the manufacturing sector

Dep. var.: coefficient of variation	(1) All 1996–2008	(2) Survivors 1996–2008	(3) All 1976–1995	(4) Survivors 1976–1995
Age 1 (reference)	–	–	–	–
Age 2 (dummy)	− 0.04* (0.02)	− 0.04** (0.01)	− 0.01 (0.01)	− 0.02 (0.01)
Age 3 (dummy)	− 0.03 (0.02)	− 0.04** (0.02)	− 0.03** (0.01)	− 0.03** (0.01)
Age 4 (dummy)	− 0.04* (0.02)	− 0.04** (0.01)	− 0.03** (0.01)	− 0.03*** (0.01)
Age 5 (dummy)	− 0.05** (0.02)	− 0.04** (0.01)	− 0.03*** (0.01)	− 0.03*** (0.01)
Age 6 (dummy)	− 0.05** (0.02)	− 0.03** (0.01)	− 0.02* (0.01)	− 0.02 (0.01)
Age 7 (dummy)	− 0.06** (0.02)	− 0.03* (0.01)	− 0.03** (0.01)	− 0.02* (0.01)
Age 8 (dummy)	− 0.04* (0.02)	− 0.02 (0.02)	− 0.02** (0.01)	0.01 (0.01)
Age 9 (dummy)	− 0.05* (0.02)	− 0.01 (0.02)	− 0.03* (0.01)	− 0.01 (0.01)
Age 10 (dummy)	− 0.04* (0.02)	0.00 (0.02)	− 0.02 (0.01)	0.00 (0.01)
Entry year				
1976 (reference)	–	–	–	–
1977 (dummy)	–	–	0.00 (0.01)	− 0.01 (0.01)
1978 (dummy)	–	–	0.03 (0.02)	0.03 (0.02)
1979 (dummy)	–	–	0.01 (0.01)	0.01 (0.01)
1980 (dummy)	–	–	0.04* (0.02)	0.03** (0.01)
1981 (dummy)	–	–	0.05*** (0.01)	0.05*** (0.01)
1982 (dummy)	–	–	0.04** (0.01)	0.03* (0.01)
1983 (dummy)	–	–	0.04** (0.01)	0.03* (0.01)
1984 (dummy)	–	–	0.02 (0.01)	0.01 (0.01)
1985 (dummy)	–	–	0.04 (0.01)	0.03 (0.02)
1986 (dummy)	–	–	0.03* (0.01)	0.03 (0.01)
1987 (dummy)	–	–	0.05*** (0.01)	0.05*** (0.02)
1988 (dummy)	–	–	− 0.00 (0.01)	− 0.01 (0.01)
1989 (dummy)	–	–	0.02 (0.01)	0.00 (0.01)
1990 (dummy)	–	–	0.09*** (0.02)	0.05*** (0.01)
1991 (dummy)	–	–	0.06*** (0.01)	0.04*** (0.01)
1992 (dummy)	–	–	0.02 (0.01)	0.00 (0.01)
1993 (dummy)	–	–	0.07*** (0.01)	0.06*** (0.01)
1994 (dummy)	–	–	0.05*** (0.01)	0.03** (0.01)
1995 (dummy)	–	–	0.05*** (0.01)	0.03** (0.01)
1996 (reference)	–	–	–	–
1997 (dummy)	− 0.02 (0.01)	− 0.04* (0.01)	–	–
1998 (dummy)	0.00 (0.01)	− 0.02 (0.01)	–	–
1999 (dummy)	0.05** (0.02)	0.02 (0.01)	–	–
2000 (dummy)	0.10*** (0.01)	0.10*** (0.01)	–	–
2001 (dummy)	0.10*** (0.02)	0.09*** (0.02)	–	–
2002 (dummy)	0.11*** (0.02)	0.09*** (0.01)	–	–
2003 (dummy)	0.06*** (0.01)	0.03*** (0.01)	–	–
2004 (dummy)	0.17*** (0.01)	0.10*** (0.01)	–	–
2005 (dummy)	0.09*** (0.01)	0.10*** (0.01)	–	–
2006 (dummy)	0.12*** (0.02)	0.12*** (0.02)	–	–
2007 (dummy)	0.10*** (0.02)	0.07*** (0.02)	–	–
2008 (dummy)	0.14*** (0.02)	0.10*** (0.01)	–	–
Intercept	0.51*** (0.01)	0.49*** (0.01)	0.40*** (0.01)	0.39*** (0.01)
R^2	0.72	0.69	0.48	0.47
N	130	130	200	200

West Germany, manufacturing sector. 1976–2008, OLS estimations with the coefficient of variation (sd/mean) as a dependent variable in all specifications. Robust standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level. Age-cohort cells weighted with number of establishments per cell. Number of establishments per cell vary between 1176 and 2345 (mean 1678) in columns (2) and (4) and between 1269 and 5093 (mean 2498) in columns (1) and (3)

Table 4 Within- and between-cohort wage dispersion in the service sector

Dep. var.: coefficient of variation	(1) All 1996–2008	(2) Survivors 1996–2008	(3) All 1976–1995	(4) Survivors 1976–1995
Age 1 (reference)	–	–	–	–
Age 2 (dummy)	− 0.01 (0.01)	− 0.02 (0.01)	− 0.01* (0.01)	− 0.01* (0.01)
Age 3 (dummy)	− 0.02* (0.01)	− 0.02 (0.01)	− 0.01* (0.01)	− 0.01 (0.01)
Age 4 (dummy)	− 0.03*** (0.01)	− 0.03** (0.01)	− 0.02** (0.01)	− 0.01* (0.01)
Age 5 (dummy)	− 0.04*** (0.01)	− 0.03* (0.01)	− 0.02** (0.01)	− 0.01 (0.01)
Age 6 (dummy)	− 0.05*** (0.01)	− 0.02* (0.01)	− 0.02** (0.01)	− 0.01 (0.01)
Age 7 (dummy)	− 0.06*** (0.01)	− 0.02 (0.01)	− 0.01* (0.01)	0.00 (0.01)
Age 8 (dummy)	− 0.06*** (0.01)	− 0.01 (0.01)	− 0.02** (0.01)	0.00 (0.01)
Age 9 (dummy)	− 0.07*** (0.01)	− 0.01 (0.01)	− 0.02** (0.01)	0.01 (0.01)
Age 10 (dummy)	− 0.08*** (0.01)	− 0.01 (0.01)	− 0.01* (0.01)	0.02*** (0.01)
Entry year				
1976 (reference)	–	–	–	–
1977 (dummy)	–	–	0.02* (0.01)	0.01* (0.01)
1978 (dummy)	–	–	0.03** (0.01)	0.03*** (0.01)
1979 (dummy)	–	–	0.04*** (0.01)	0.03*** (0.01)
1980 (dummy)	–	–	0.06*** (0.01)	0.05*** (0.01)
1981 (dummy)	–	–	0.09*** (0.01)	0.08*** (0.01)
1982 (dummy)	–	–	0.08*** (0.01)	0.08*** (0.01)
1983 (dummy)	–	–	0.08*** (0.01)	0.07*** (0.01)
1984 (dummy)	–	–	0.09*** (0.01)	0.09*** (0.01)
1985 (dummy)	–	–	0.09*** (0.01)	0.09*** (0.01)
1986 (dummy)	–	–	0.08*** (0.01)	0.07*** (0.01)
1987 (dummy)	–	–	0.09*** (0.01)	0.08*** (0.01)
1988 (dummy)	–	–	0.10*** (0.01)	0.09*** (0.01)
1989 (dummy)	–	–	0.09*** (0.01)	0.08*** (0.01)
1990 (dummy)	–	–	0.12*** (0.01)	0.09*** (0.01)
1991 (dummy)	–	–	0.10*** (0.01)	0.09*** (0.01)
1992 (dummy)	–	–	0.13*** (0.01)	0.12*** (0.01)
1993 (dummy)	–	–	0.11*** (0.01)	0.09*** (0.01)
1994 (dummy)	–	–	0.12*** (0.01)	0.10*** (0.01)
1995 (dummy)	–	–	0.14*** (0.01)	0.12*** (0.01)
1996 (reference)	–	–	–	–
1997 (dummy)	0.04*** (0.01)	0.03** (0.01)	–	–
1998 (dummy)	0.05*** (0.01)	0.03* (0.01)	–	–
1999 (dummy)	0.06*** (0.01)	0.06*** (0.01)	–	–
2000 (dummy)	0.07*** (0.01)	0.07*** (0.01)	–	–
2001 (dummy)	0.09*** (0.01)	0.08*** (0.01)	–	–
2002 (dummy)	0.07*** (0.01)	0.05*** (0.01)	–	–
2003 (dummy)	0.09*** (0.01)	0.08*** (0.01)	–	–
2004 (dummy)	0.11*** (0.01)	0.09*** (0.01)	–	–
2005 (dummy)	0.09*** (0.01)	0.08*** (0.01)	–	–
2006 (dummy)	0.10*** (0.01)	0.09*** (0.01)	–	–
2007 (dummy)	0.11*** (0.01)	0.10*** (0.01)	–	–
2008 (dummy)	0.08*** (0.01)	0.08*** (0.01)	–	–
Intercept	0.58*** (0.01)	0.52*** (0.01)	0.42*** (0.01)	0.39*** (0.01)
R^2	0.73	0.68	0.84	0.81
N	130	130	200	200

West Germany, service sector. 1976–2008, OLS estimations with the coefficient of variation (sd/mean) as a dependent variable in all specifications. Robust standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level. Age-cohort cells weighted with number of establishments per cell. Number of establishments per cell vary between 9926 and 15,170 (mean 11,871) in columns (2) and (4) and between 11,275 and 50,0000 (mean 19,835) in columns (1) and (3)

Table 5 Within- and between-cohort wage dispersion with alternative measure

Dep. var.: P90/P10	(1) All 1996–2008	(2) Survivors 1996–2008	(3) All 1976–1995	(4) Survivors 1976–1995
Age 1 (reference)	–	–	–	–
Age 2 (dummy)	− 0.18 (0.09)	− 0.19*** (0.05)	− 0.11** (0.03)	− 0.13*** (0.02)
Age 3 (dummy)	− 0.23** (0.08)	− 0.25*** (0.05)	− 0.13*** (0.03)	− 0.14**(0.02)
Age 4 (dummy)	− 0.34*** (0.08)	− 0.28*** (0.05)	− 0.15*** (0.03)	− 0.15*** (0.02)
Age 5 (dummy)	− 0.49*** (0.08)	− 0.29*** (0.04)	− 0.17*** (0.03)	− 0.13*** (0.02)
Age 6 (dummy)	− 0.59*** (0.08)	− 0.30*** (0.04)	− 0.20*** (0.03)	− 0.13*** (0.02)
Age 7 (dummy)	− 0.68*** (0.08)	− 0.29*** (0.04)	− 0.21*** (0.03)	− 0.10*** (0.02)
Age 8 (dummy)	− 0.76*** (0.08)	− 0.28*** (0.05)	− 0.22*** (0.03)	− 0.08*** (0.02)
Age 9 (dummy)	− 0.84*** (0.09)	− 0.27*** (0.06)	− 0.24*** (0.03)	− 0.03 (0.02)
Age 10 (dummy)	− 0.92*** (0.09)	− 0.21** (0.07)	− 0.25*** (0.03)	0.05* (0.02)
Entry year				
1976 (reference)	–	–	–	–
1977 (dummy)	–	–	0.09 (0.06)	0.07** (0.03)
1978 (dummy)	–	–	0.14* (0.05)	0.10*** (0.02)
1979 (dummy)	–	–	0.18*** (0.05)	0.14*** (0.02)
1980 (dummy)	–	–	0.30*** (0.05)	0.23*** (0.02)
1981 (dummy)	–	–	0.38*** (0.05)	0.31*** (0.02)
1982 (dummy)	–	–	0.41*** (0.05)	0.33*** (0.02)
1983 (dummy)	–	–	0.38*** (0.05)	0.31*** (0.02)
1984 (dummy)	–	–	0.37*** (0.05)	0.29*** (0.02)
1985 (dummy)	–	–	0.38*** (0.05)	0.30*** (0.03)
1986 (dummy)	–	–	0.39*** (0.05)	0.29*** (0.03)
1987 (dummy)	–	–	0.43*** (0.05)	0.33*** (0.03)
1988 (dummy)	–	–	0.47*** (0.05)	0.35*** (0.03)
1989 (dummy)	–	–	0.52*** (0.05)	0.36*** (0.02)
1990 (dummy)	–	–	0.63*** (0.05)	0.40*** (0.02)
1991 (dummy)	–	–	0.65*** (0.06)	0.43*** (0.03)
1992 (dummy)	–	–	0.68*** (0.05)	0.44*** (0.03)
1993 (dummy)	–	–	0.68*** (0.05)	0.42*** (0.03)
1994 (dummy)	–	–	0.69*** (0.05)	0.41*** (0.03)
1995 (dummy)	–	–	0.76*** (0.05)	0.49*** (0.03)
1996 (reference)	–	–	–	–
1997 (dummy)	0.24*** (0.08)	0.17** (0.06)	–	–
1998 (dummy)	0.22** (0.07)	0.18** (0.05)	–	–
1999 (dummy)	0.37*** (0.08)	0.33*** (0.06)	–	–
2000 (dummy)	0.52*** (0.07)	0.45*** (0.05)	–	–
2001 (dummy)	0.54*** (0.07)	0.44*** (0.05)	–	–
2002 (dummy)	0.47*** (0.07)	0.29*** (0.05)	–	–
2003 (dummy)	0.44*** (0.07)	0.26*** (0.05)	–	–
2004 (dummy)	0.30*** (0.07)	0.22*** (0.05)	–	–
2005 (dummy)	0.30*** (0.07)	0.24*** (0.05)	–	–
2006 (dummy)	0.20** (0.08)	0.17** (0.06)	–	–
2007 (dummy)	0.27* (0.11)	0.16* (0.07)	–	–
2008 (dummy)	0.26* (0.12)	0.21** (0.08)	–	–
Intercept	3.85*** (0.09)	3.22*** (0.06)	2.79*** (0.06)	2.61*** (0.03)
R^2	0.73	0.68	0.84	0.81
N	130	130	200	200

West Germany, all sectors. 1976–2008, OLS estimations with the ratio of the 90th percentile and the 10th percentile as a dependent variable in all specifications. Robust standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level. Age-cohort cells weighted with number of establishments per cell. Number of establishments per cell vary between 12,979 and 19,972 (mean 15,559) in columns (2) and (4) and between 14,632 and 64,468 (mean 25,661) in columns (1) and (3)

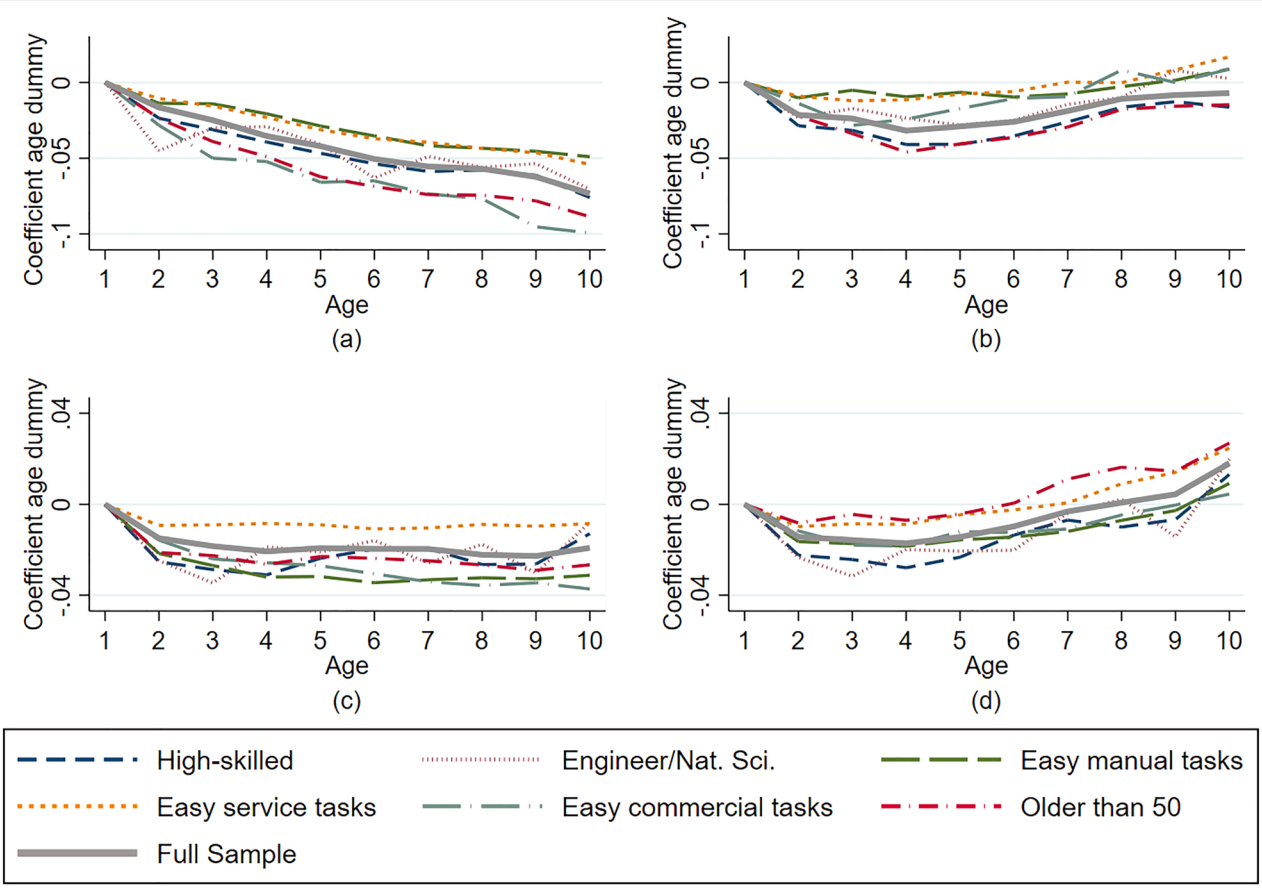

Fig. 17 Evolution of the within-cohort wage dispersion for different establishment types, as measured by the coefficient of the age dummies. In every panel I depict results from the full sample, the sample containing only establishments with a high share of high-skilled employees, the sample containing only establishments with a high share of easy manual, easy service and easy commercial tasks, the sample containing only establishments with a high share of employees that are older than 50 and the sample containing only establishments with at least one engineer and/or natural scientist. **a** Respectively displays the sample with surviving and exiting establishments that entered between 1996 and 2008 (referring to specification (1) in Table 1). **b** Respectively displays the sample with only surviving establishments that entered between 1996 and 2008 (referring to specification (2) in Table 1). **c** Respectively displays the sample with surviving and exiting establishments that entered before 1996 (referring to specification (3) in Table 1). **d** Respectively displays the sample with only surviving establishments that entered before 1996 (referring to specification (4) in Table 1). For the sake of clarity, I only show point estimates here. Age-cohort cells are weighted with number of establishments per cell

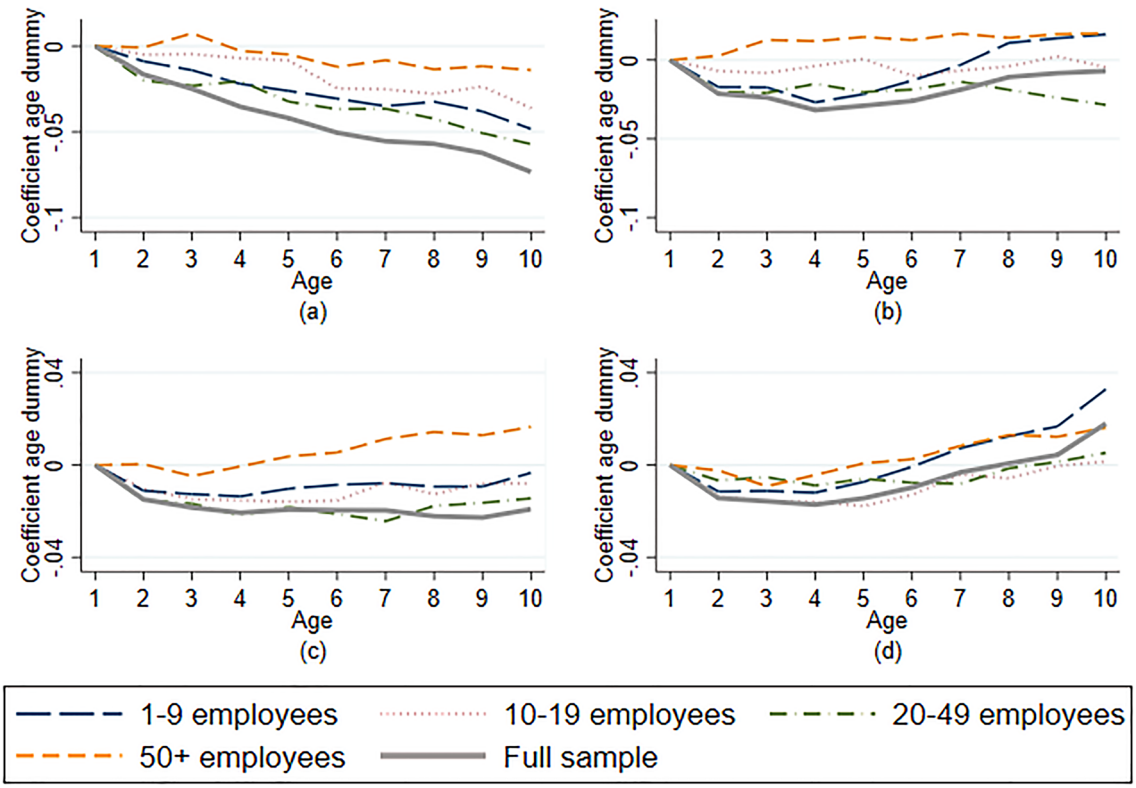

Fig. 18 Evolution of the within-cohort wage dispersion for different size classes, as measured by the coefficient of the age dummies. **a** Displays the sample with surviving and exiting establishments that entered between 1996 and 2008 (referring to specification (1) in Table 1). **b** Displays the sample with only surviving establishments that entered between 1996 and 2008 (referring to specification (2) in Table 1). **c** Displays the sample with surviving and exiting establishments that entered before 1996 (referring to specification (3) in Table 1). **d** Displays the sample with only surviving establishments that entered before 1996 (referring to specification (4) in Table 1). For the sake of clarity, I only show point estimates here. Age-cohort cells are weighted with number of establishments per cell

Table 6 Age at exit (1–10) as a function of the entry year, 1976–2008, OLS estimations

Explanatory variables	(1) Basic model	(2) Extended model
Entry year		
1976 (Reference)	–	–
1977 (dummy)	− 0.03 (0.04)	− 0.07 (0.04)
1978 (dummy)	− 0.15*** (0.04)	− 0.18*** (0.04)
1979 (dummy)	− 0.29*** (0.04)	− 0.30*** (0.04)
1980 (dummy)	− 0.35*** (0.04)	− 0.38*** (0.03)
1981 (dummy)	− 0.38*** (0.04)	− 0.41*** (0.04)
1982 (dummy)	− 0.33*** (0.04)	− 0.36*** (0.04)
1983 (dummy)	− 0.26*** (0.04)	− 0.30*** (0.04)
1984 (dummy)	− 0.28*** (0.04)	− 0.34*** (0.04)
1985 (dummy)	− 0.12** (0.04)	− 0.19*** (0.03)
1986 (dummy)	− 0.10** (0.03)	− 0.19*** (0.03)
1987 (dummy)	− 0.04 (0.03)	− 0.14*** (0.03)
1988 (dummy)	− 0.08* (0.03)	− 0.19*** (0.03)
1989 (dummy)	− 0.08* (0.03)	− 0.19*** (0.03)
1990 (dummy)	− 0.19*** (0.03)	− 0.30*** (0.03)
1991 (dummy)	− 0.27*** (0.03)	− 0.36*** (0.03)
1992 (dummy)	− 0.27*** (0.03)	− 0.37*** (0.03)
1993 (dummy)	− 0.31*** (0.03)	− 0.44*** (0.03)
1994 (dummy)	− 0.39*** (0.03)	− 0.55*** (0.03)
1995 (dummy)	− 0.40*** (0.03)	− 0.59*** (0.03)
1996 (dummy)	− 0.40*** (0.03)	− 0.65*** (0.03)
1997 (dummy)	− 0.56*** (0.03)	− 0.85*** (0.03)
1998 (dummy)	− 0.59*** (0.03)	− 0.94*** (0.03)
1999 (dummy)	− 0.68*** (0.03)	− 1.11**** (0.03)
2000 (dummy)	− 0.76*** (0.03)	− 1.19*** (0.03)
2001 (dummy)	− 0.74*** (0.03)	− 1.21*** (0.03)
2002 (dummy)	− 0.71*** (0.03)	− 1.19*** (0.03)
2003 (dummy)	− 0.69*** (0.03)	− 1.20*** (0.03)
2004 (dummy)	− 0.68*** (0.03)	− 1.23*** (0.03)
2005 (dummy)	− 0.62*** (0.03)	− 1.18*** (0.03)
2006 (dummy)	− 0.55*** (0.03)	− 1.13*** (0.03)
2007 (dummy)	− 0.59*** (0.03)	− 1.14*** (0.03)
2008 (dummy)	− 0.44*** (0.03)	− 1.03*** (0.03)
Establishment size	X	0.49*** (0.00)
Further controls	X	✓
Industry dummies (1-digit)	X	✓
Constant	5.72*** (0.02)	6.63*** (0.05)
R^2	0.01	0.07
N	2,683,482	2,665,313

West Germany, all sectors. Clustered standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level. Included control variables in column (2): average establishments' wage, within-establishment wage percentile ratio: P75/P25, employment share by gender, nationality, skill level, age and occupation

Table 7 Coefficient of variation in the birth year and the difference after 10 years

Entry year	All CV birth year	Diff. after 10 yesars	Survivors CV birth year	Diff after 10 years
1976	0.394	0.037	0.378	0.053
1977	0.412	0.023	0.386	0.048
1978	0.412	0.041	0.392	0.062
1979	0.425	0.014	0.394	0.045
1980	0.435	0.020	0.405	0.050
1981	0.449	0.032	0.416	0.066
1982	0.462	0.022	0.429	0.055
1983	0.462	− 0.018	0.428	0.017
1984	0.490	− 0.038	0.460	− 0.007
1985	0.507	− 0.058	0.480	− 0.031
1986	0.498	− 0.058	0.461	− 0.022
1987	0.503	− 0.053	0.476	− 0.026
1988	0.510	− 0.060	0.470	− 0.020
1989	0.516	− 0.039	0.468	0.009
1990	0.537	− 0.047	0.485	0.005
1991	0.533	− 0.068	0.479	− 0.014
1992	0.536	− 0.047	0.495	− 0.006
1993	0.525	− 0.038	0.470	0.018
1994	0.521	− 0.032	0.461	0.027
1995	0.529	− 0.016	0.478	0.035
1996	0.522	0.006	0.470	0.059
1997	0.570	− 0.029	0.501	0.040
1998	0.573	− 0.033	0.500	0.039
1999	0.588	− 0.010	0.535	0.043
2000	0.610	− 0.033	0.556	0.021
2001	0.643	− 0.072	0.584	− 0.012
2002	0.618	− 0.070	0.545	0.003
2003	0.619	− 0.072	0.545	0.002
2004	0.650	− 0.069	0.556	0.024
2005	0.648	− 0.090	0.594	− 0.036
2006	0.684	− 0.159	0.631	− 0.106
2007	0.709	− 0.158	0.634	− 0.083
2008	0.711	− 0.165	0.631	− 0.085

First and third column show the coefficient of variation with respect to average establishments wages of every cohort in the year of birth, both for the full sample of entering establishments (first column) and for those entering establishments that survived at least 10 years (third column). Second and fourth column show the difference between the coefficient of variation after 10 years and the coefficient of variation in the birth year, again for both samples

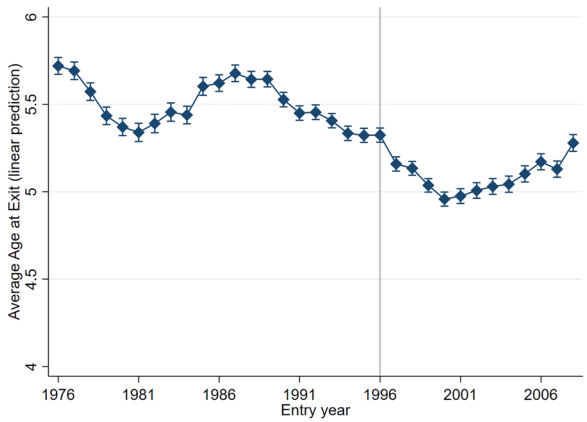

Fig. 19 Exit dynamics by entry year. Linear predictions from a model without control variables

A.5 Establishment exits and the wage level

Here, additional material to Sect. 4.5 are provided. Table 8 depicts the estimation on which the linear predictions, shown in Fig. 8, are based.

Table 8 Establishment exits as a function of the wage level, 1976–2017, linear probability model (LPM)

Explanatory variables	
Average wage percentile	
1–5 (reference)	–
6–10 (dummy)	− 0.01*** (0.00)
11–15 (dummy)	− 0.01*** (0.00)
16–20 (dummy)	− 0.01*** (0.00)
21–25 (dummy)	− 0.01*** (0.00)
26–30 (dummy)	− 0.02*** (0.00)
31–35 (dummy)	− 0.02*** (0.00)
36–40 (dummy)	− 0.02*** (0.00)
41–45 (dummy)	− 0.02*** (0.00)
46–50 (dummy)	− 0.02*** (0.00)
51–55 (dummy)	− 0.02*** (0.00)
56–60 (dummy)	− 0.03*** (0.00)
61–65 (dummy)	− 0.03*** (0.00)
66–70 (dummy)	− 0.03*** (0.00)
71–75 (dummy)	− 0.03*** (0.00)
76–80 (dummy)	− 0.03*** (0.00)
81–85 (dummy)	− 0.03*** (0.00)
86–90 (dummy)	− 0.03*** (0.00)
91–95 (dummy)	− 0.03*** (0.00)
96–100 (dummy)	− 0.03*** (0.00)
Entry: 1976–1995 (reference)	–
Entry: 1996–2008 (dummy)	0.02*** (0.00)
Entry: 2009–2017 (dummy)	0.05*** (0.00)
Wage percentile × entry year cluster	✓
Age dummies	✓
Establishment size dummies	✓
Industry dummies (1-digit)	✓
Year dummies	✓
Controls	✓
Constant	− 0.05*** (0.00)
R^2	0.07
N	14,725,558

West Germany, all sectors. Clustered standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level. Age dummies until the age of 25; establishments older than 25 are clustered together. Six establishment size dummies (in terms of total employees): 1; 2–9; 10–19; 20–49; 50–249; > 249. Included control variables: employment share by gender, nationality, skill group, occupations and age; average age of employees, within-establishment wage percentile ratio: P75/P25

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Availability of data and materials
The paper uses the BHP 7519 v1. Data access was provided via on site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently via remote data access.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The author declares that he has no competing interests.

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