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

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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 a prominent 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 the wage dispersion between establishments. However, stronger exit dynamism of young and low-wage establishments has dampened this effect. These findings suggest taking the consequences for wage inequality into consideration when designing and assessing policy instruments for firm entry and exit.

Zusammenfassung: Obwohl Lohnungleichheit ein bedeutendes und umfassend untersuchtes Thema ist, bleibt der Zusammenhang zwischen Firmengründungen und -schließungen und der Lohnstreuung zwischen Firmen in der Literatur weitgehend unerwähnt. Anhand einer 50%igen administrativen Zufallsstichprobe westdeutscher Betriebe im Zeitraum 1976-2017 studiere ich die Dynamik der Lohnstreuung zwischen und innerhalb neu gegründeter, schließender und etablierter Betriebe, indem ich die Verteilung der betrieblichen Durchschnittslöhne untersuche. Die Ergebnisse zeigen, dass die Ungleichheit zwischen den neu gegründeten Betrieben im Laufe der Zeit zugenommen hat, was zum Anstieg der Lohnstreuung zwischen den Betrieben beigetragen hat. Eine stärkere Schließungsdynamik bei jungen Niedriglohnbetrieben hat diesen Effekt jedoch gedämpft. Diese Ergebnisse legen nahe, die Folgen für die Lohnungleichheit bei der Gestaltung und Bewertung von politischen Maßnahmen zu Firmengründungen und -schließungen zu berücksichtigen.

Keywords: Firm entry, Firm exit, Wage dispersion, Firm Dynamics, Germany
JEL classifications: L26, M13, J31

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1 Introduction

Rising wage inequality as a prevalent phenomenon across developed countries around the globe has received a lot of attention in the economic and political debate of the last three decades. Apart from that, there is increased 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, Jarmin, & Miranda, 2013; Schindele & Weyh, 2011).

However, the question of how firm entries and exits contribute to wage inequality has not yet been part of scientific and public debates. Therefore, this paper aims to examine the interaction between firm dynamics and wage inequality. The central question is how newly entering and exiting firms contribute to the wage dispersion between establishments in West Germany. The analysis is further enriched by specifically examining the evolution of the wage dispersion within different entry cohorts as they grow older, the role of exiting firms in this process, and the relationship between the exit of an establishment and its wage level.

The dispersion of average wages between firms as an important factor in explaining trends in the overall wage inequality has been studied by a large body of research (Davis & Haltiwanger, 1991; Dunne, Foster, Haltiwanger, & Troske, 2004; Barth, Bryson, Davis, & Freeman, 2016; Card, Cardoso, Heining, & Kline, 2018; Song, Price, Guvenen, Bloom, & Von Wachter, 2019). Also, for Germany, this phenomenon is well documented in the literature (Card, Heining, & Kline, 2013; Baumgarten, Felbermayr, & Lehwald, 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 conclude that newly entering firms rather increase wage inequality (Castellaneta, Conti, & Kacperczyk, 2019; Lippmann, Davis, & Aldrich, 2005; Atems & Shand, 2018). Card et al. (2013) document an increasing heterogeneity between entering firms of different birth cohorts for Germany. They show that establishments became more heterogeneous in terms of their wages, especially after the year 1995. In contrast, the question on how exiting firms contribute to the wage dispersion has received very little attention in the literature. Malchow-Møller, Schjerning, and Sørensen (2011) conducted a noteworthy analysis as they studied how entering and exiting establishments contribute to the growth in average wages. They find that firm exits have a positive effect on the growth in average wages and therefore infer that firms that exit the market rather operated in the low-wage sector beforehand.

This paper aims to contribute to the literature in three ways: First, it depicts aggregate yearly wage dynamics and the evolution of the dispersion of average wages between the groups of entering, exiting and incumbent establishments. Second, I study the wage dispersion between and within different entry cohorts and analyze how the evolutions are shaped by establishment exits. In addition, the interrelation between firm entry and exit dynamics is analyzed. Third, I examine the fundamental relationship between establishment exits and the wage level to further deepen our understanding of how firm exits contribute to the wage dispersion. It is important to note that this analysis is descriptive in nature and hence, should also be interpreted that way.

Nonetheless, this investigation offers new insights, especially regarding its policy implications. From a policy perspective, the entry of new firms is typically regarded as a desirable feature that is worth fostering, whereas the exit of incumbent firms is something that should be rather avoided. 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 beginning shift in the public perception can likely be related to the popular zombification hypothesis that associates the low-interest-rate policy of the ECB to stalled firm exit. This is increasingly regarded as an adverse development as it is thought to decelerate structural change and inhibit an effective allocation of resources (Banerjee & Hofmann, 2018; Fackler, Schnabel, & Wagner, 2013). Moreover, it is argued that the economic policy tackling the Covid-19 crisis, particularly the COVID-19 Insolvency Suspension Act (*COVID-19-Insolvenzaussetzungsgesetz*), will exacerbate this problem in Germany (Dörr, Murmann, & Licht, 2021). Against this background, this paper aims to contribute to a broader understanding and a more profound evaluation of firm entry and exit dynamics by introducing a new, most relevant aspect, namely their impact on the wage dispersion between firms.

The paper is organized as follows. Section 2 provides a synthesis of the related literature and derives the research questions. In section 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 fundamental characteristic of developed economies around the globe in the last few decades. 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, Katz, & Krueger, 1998; Acemoglu & Autor, 2011) and globalization (Davis & Haltiwanger, 1991; Goldschmidt & Schmieder, 2017) or attribute the rising wage dispersion mainly to changing institutional conditions (Dustmann, Ludsteck, & Schönberg, 2009). Statistically, the overall variation in wages can simply be decomposed into variation of wages within firms and variation of average wages between firms. 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. Among others, Slichter (1950) provided early empirical evidence of existing wage differentials between plants that persist after controlling for location and occupation.

At first, it is useful to bring to mind that a changing magnitude and distribution of firm pay premiums could potentially reflect different developments, each with distinct policy implications. For instance, rising variation of wages between firms could be rooted in a changing underlying productivity distribution and, accordingly, in the emergence of superstar firms (see Andrews, Criscuolo, and Gal (2016) for an overview). Additionally, changes in the patterns of rent sharing between employers and workers or changing worker composition within firms could contribute to the rise in wage inequality between firms. This, in turn, would rather relate to institutional changes, such as a decline in union power, or changes in pay setting norms by employers. A trend towards a more homogeneous worker composition within firms would give rise to questions about patterns of sorting and segregation at the workplace, with potential links towards outsourcing and specialization.

The importance of between-firm wage dispersion has been prominently put forward by Davis and Haltiwanger (1991), Groshen (1991) and Dunne et al. (2004). 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). Davis and Haltiwanger (1991), for instance, find that more than 50 % of the variance in wages can be explained by the dispersion of mean wages across plants. Further, observable plant characteristics, such as age, region, industry affiliation, and most importantly, size can largely explain

wage dispersion between firms (Davis & Haltiwanger, 1991, p. 173). Song et al. (2019) provide evidence that rising between-firm wage dispersion accounts for two-thirds of the rise in the overall wage dispersion between 1981 and 2013 in the United States (Song et al., 2019, p. 46). Further, they find that employee sorting and segregation are the sole drivers of this increase. Card et al. (2013), who focused on the West German labor market, provide a particularly important ground for this paper by showing that establishment wage premiums vary with their birth cohort, with younger cohorts exhibiting greater wage dispersion (Card et al., 2013, p. 1008). Put differently, establishments born in more recent years became increasingly unequal in terms of the wages they pay. Card et al. (2013) assign 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).

Against this backdrop, this paper aims to offer an explicit analysis of how newly founded firms and their exit dynamics contribute to the overall wage dispersion, with the limitation that this analysis is confined to the establishment level and does not account for worker sorting. This approach, however, allows to exploit rich establishment-level data, and thereby, distinguish between different entry cohorts. Based on the findings of Card et al. (2013), I would expect that more recent birth cohorts of establishments contribute positively to a rising wage dispersion.

For this to comprehensively elaborate, it is helpful to know how young firms are characterized in terms of their wage and exit dynamics. The performance of young firms has become a popular field of empirical research in the area of industrial organization and labor economics in the past 20 years. This strand of literature assesses the economic dynamics that come into the market through the entry of new firms. Concerning the labor market, there are two broad aspects under investigation: On the micro level, studies predominantly focus on wages, employment growth and survival rates in newly founded firms while on the macro level, their contribution to overall employment growth, job creation, innovation and the process of creative destruction is at question[1]. Close to this study is the work of Malchow-Møller et al. (2011), who, among other things, analyze how newly founded establishments contribute to overall average wage growth. They find that newly entering establishments have little impact on growth in average wages. Moreover, exiting establishments are found to contribute positively to the growth in average wages, implying that systematic exit patterns related to the establishments' wages are at play (Malchow-Møller et al., 2011, p. 30).

[1]Since I am interested in wages and their dispersion across firms, I refrain from discussing the literature on employment growth and job creation by young firms. For an analysis for the United States, see, for instance, Haltiwanger et al. (2013) and for Germany, for instance, Schindele and Weyh (2011) and Fritsch and Weyh (2006).

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 & Haltiwanger, 1991) or size and location (Troske, 1998). Brixy, Kohaut, and Schnabel (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 five years (Brixy et al., 2007, Table I; Fig. 1). This view is supplemented by a recent paper of Fackler, Hölscher, Schnabel, and Weyh (2021) who find persistent drawbacks for employees of entering a newly founded establishment in terms of wages and employment stability. A study among the population of Swedish establishments analyzes wage gaps between newly founded establishments and incumbents for labor market entrants. Applying a propensity score matching approach, a wage penalty of 2.9 % for labor market entrants in young establishments persists (Nyström & Elvung, 2014, p. 409). Sorenson, Dahl, Canales, and Burton (2021) analyze danish registry data and find that startup employees earn substantially less (roughly 17 %) than employees in large and incumbent firms over the next ten years. In contrast, Brown and Medoff (2003, p.693) report a negative relationship between firm age and wages after controlling for observable workers characteristics, such as experience, tenure, education, or occupation. Recent studies of Babina, Ma, Moser, Ouimet, and Zarutskie (2019), of Ouimet and Zarutskie (2014) and of Burton, Dahl, and Sorenson (2018) confirm this finding.

A small and interdisciplinary research field has grown around the impact of newly founded firms or entrepreneurship on income inequality. There is rough macro-level evidence that hints towards a positive link between the prevalence of new (entrepreneurial) firms and income or wage inequality. For instance, Lippmann et al. (2005, Fig. 1) correlate income inequality (as measured with the Gini coefficient) with entrepreneurial activity in a cross-country analysis and report a positive relationship ($R^2 = 0.41$). Atems and Shand (2018) analyze the relationship between entrepreneurship and income inequality based on all US states for the years 1989-2013. Using the system GMM estimator, they find a strong positive relationship between entrepreneurship and income inequality (Atems & Shand, 2018, p. 919). Åstebro, Chen, and Thompson (2011) show that individuals entering self-employment are either high-ability or low-ability workers which leads to high earnings dispersion among the self-employed. These findings are consistent with the background that entrepreneurial activity of any kind can be driven by opportunity, but also by necessity (Bergmann & Sternberg, 2007; Block, Kohn, Miller, & Ullrich, 2015). Additionally, in a recent paper, Castellaneta et al. (2019) develop a model of competition for talent in which incumbents react to the entry of start-ups by

dis-proportionally compensating their top employees with wage increases for the greater pool of employment options outside the current establishment. 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. For this study it is particularly important to understand patterns of firm survival, its time trends and how they relate to the wages paid at the establishment-level. Correlations between establishment survival and a battery of establishment and environmental characteristics are well documented in the literature. For instance, the survival of an establishment is found to positively correlate with its age and size (Fackler et al., 2013) and the macroeconomic conditions it is born into and operates in (Box, 2008). Hence, younger establishments are found to exhibit higher exit rates. 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 and the wages it pays, and ultimately, wage inequality? Within the framework of perfect competition, we could infer from firms' wages to their productivities since the wage of each worker is determined by its marginal productivity. Further, Schröder and Sørensen (2012, p. 581) theoretically show that when introducing exogenous technological progress into the standard Melitz (2003) model, it can capture that high productivity firms are likely to survive longer. By combining these two theoretical predictions, we would expect survival rates to be positively correlated with the wages paid by the firm. As a consequence, 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 imply that there exists a wage distribution where firms with low wages as well as firms with high wages reach the same profitability (Rogerson, Shimer, & Wright, 2005, p. 977). Against this background, it could be expected that these two types of firms are the most likely to survive, and hence, that the relationship between survival and wages is rather polarized. This model allows the unambiguous prediction that firm exits increase wage inequality because exiting firms would be predominantly found in the middle of the distribution, thereby increasing dispersion.

The seminal work of Jovanovic (1982) on the growth and survival of firms provides an additional theoretical ground for this paper, even though it takes no stance on wages. 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 are the ones that 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 and 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 not clear. Given these theoretical ambiguities, this study aims to contribute to the literature by offering an empirical assessment of these exit patterns and how they shape the overall wage distribution. Generally, analyzing the interaction between firm dynamics and wage dispersion supplements our knowledge of the channels through which a rising wage dispersion works itself through the economy.

3 Data

For the following 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 establishments operating in Germany, with at least one employee that is entitled to social security. The data is structured as annually repeated cross-sections, with each year reflecting the state of the establishments on June 30th and covers the years 1975-2018. For the purpose of 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 in most cases does not change over time. Thus, the data allows to study dynamics within and between establishments. 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 the wage structure. More information on the dataset is provided by Ganzer, Schmidtlein, Stegmaier, and Wolter (2020).

For this study, the variable of interest is the average gross daily wage of full-time employees as it serves as a proxy for the wage level of an establishment.[2] I use an imputed version of this wage variable since originally, earnings are right-censored as they are only reported up to the upper limit for statutory pension insurance contributions. As a consequence, a substantial share of the wage information (roughly 10 %) is censored at the top (Ganzer et al., 2020, p.15). This issue can be evaded by using imputed wages, as implemented by Card, Heining, and Kline (2015). Additionally, the average daily wage is adjusted for inflation with the consumer price index (CPI).[3] A central component of the following analysis is the presentation of dynamics regarding the wage level of an establishment, depending on it being either newly entering, exiting or incumbent. An incumbent (or, in other words, a continuing establishment) is defined as neither entering nor exiting in a given year. Note that there are establishments that enter and exit in the same year. I decided to treat these establishments differently, depending on the specific question at hand. In sections 4.1 and 4.2 they are excluded to avoid inconsistencies with regards to the group of establishments they would have to be assigned to (entering, exiting, or both). However, in sections 4.3 and 4.4 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 as well as of the nexus between establishment exit and the wage level, which is studied conditional on age.

To consistently measure entries and exits, I draw on the work of Hethey and Schmieder (2010) who provided a classification that aims to differentiate between true entries and exits, and those that just reflect, for instance, a change in ownership or a change in the identification number. They base their procedure on the analysis of worker flows between establishments and thus, are able to classify newly entering and exiting establishments into seven categories each, including pushed and pulled spin-offs. Since this classification system is well-established in the literature, I refrain from explaining it in greater detail and refer to the technical report of Hethey and Schmieder (2010) in case of interest. For the purpose of this study, pulled spin-offs are counted as true entries whereas pushed spin-offs are not counted as true exits [4]. In addition to the previously described data preparations, I exclude establishments with an average real daily wage of below 14 Euros which I regard as unreliable. However, the share of establishments with such extreme values is very small, therefore they do not alter the results, whatsoever.

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

[3]The respective information is extracted from the OECD data on inflation. It is normalized to the year 2015 and includes food and energy. For more information see OECD (2021).

[4]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 to not count pushed spin-offs as true exits from the market. As a robustness check, I altered this classification and found no substantial differences.

4 Empirical Analysis

My empirical analysis aims to shed light on how firm entries and exits relate to the dispersion of average wages between establishments in West Germany. To achieve that, I first study overall wage (dispersion) dynamics along the wage distribution to provide a first glimpse into the evolution of wages and wage dispersion between and within entering, exiting and incumbent establishments. Next, the wage dispersion within and between entry cohorts is under investigation to gain a better understanding of how wages of entering establishments evolve over time and how exiting establishments shape this evolution. Finally, I study the nexus between establishment exits and average wages to further strengthen the arguments gained from the preceding analyses, and to contribute to the clarification of existing theoretical ambiguities that prevail in the literature. As a preliminary point, I should note that this analysis is confined to average wages of establishments, hence I am not able to address issues regarding the sorting of workers between establishments, or any other aspect that specifically relates to the level of the individual worker.

4.1 Wage dispersion dynamics in establishments along the wage distribution

The following analysis descriptively investigates wage dynamics in establishments along the average wage distribution. Therefore, the wage distribution is examined for three different groups of establishments: newly entering, exiting and incumbent ones. Figure 1 shows the yearly average of real average wages in establishments, depending on the respective groups. As can be seen, the evolution follows a similar trend in every group. However, entering and exiting establishments pay lower average wages than incumbent ones, over the whole observation period. This holds true especially for establishments that exit the market, hinting towards a systematic relationship between exit and low-wage strategies in establishments. The gap between average wages in incumbent establishments and new or exiting establishments has widened over time, reaching its maximum in the downswing of the late 00s. The most recent years are characterized by a sharp increase in average wages across every group, however, this trend is most pronounced for newly entering establishments.

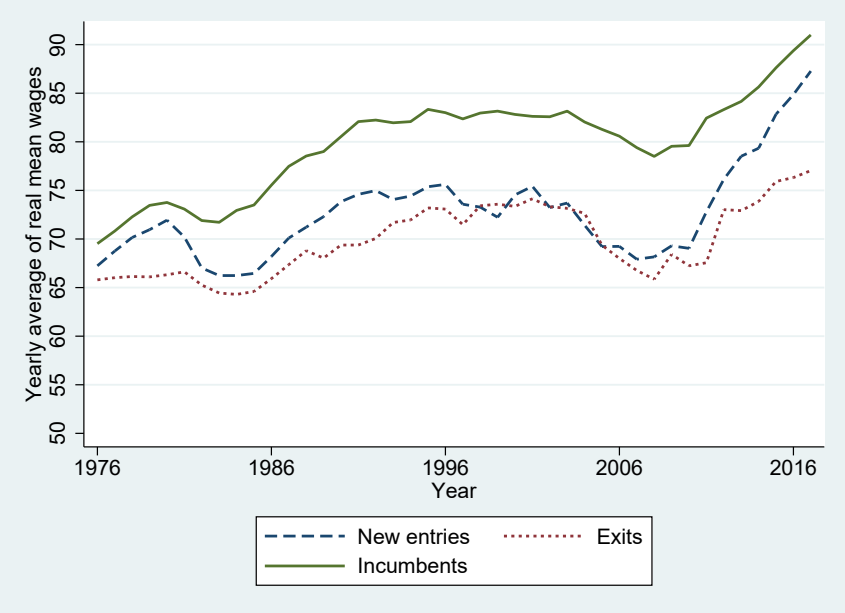
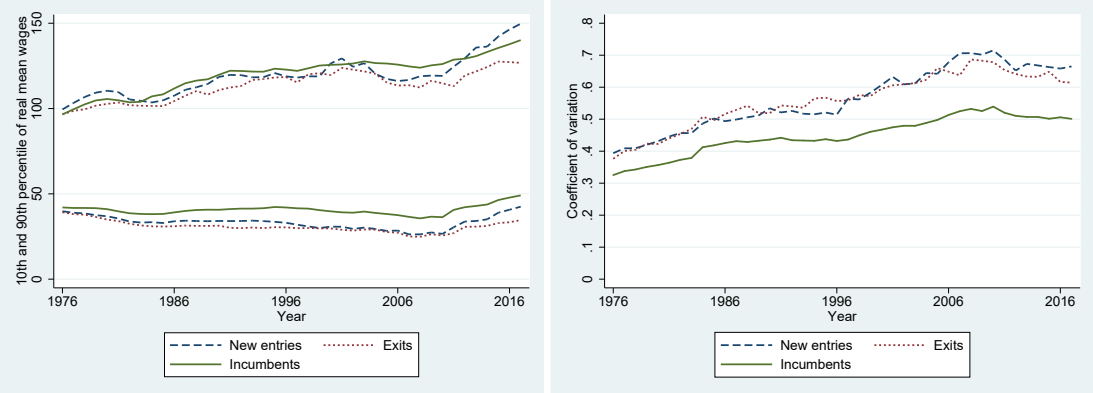


Figure 1: Average wage dynamics of entering, exiting and incumbent establishments in West Germany.



(a) 90th and 10th percentile

(b) Coefficient of variation

Figure 2: Wage dispersion dynamics of entering, exiting and incumbent establishments in West Germany

In this paper, I mainly focus on wage dispersion between and within these groups of establishments. Hence, it is useful to study other points of the wage distribution as well, such as the 10th and 90th percentile. Figure 2 displays dynamics of aggregate wage dispersion, as measured by the 90th and 10th percentile and by the coefficient of variation.[5] Panel (a) reveals a divergent development between high-wage and low-wage establishments that has emerged across all groups. While the 10th percentile experienced

[5]The coefficient of variation is the ratio between standard deviation and mean of a variable's distribution. It is therefore considered as a *relative* measure of dispersion.

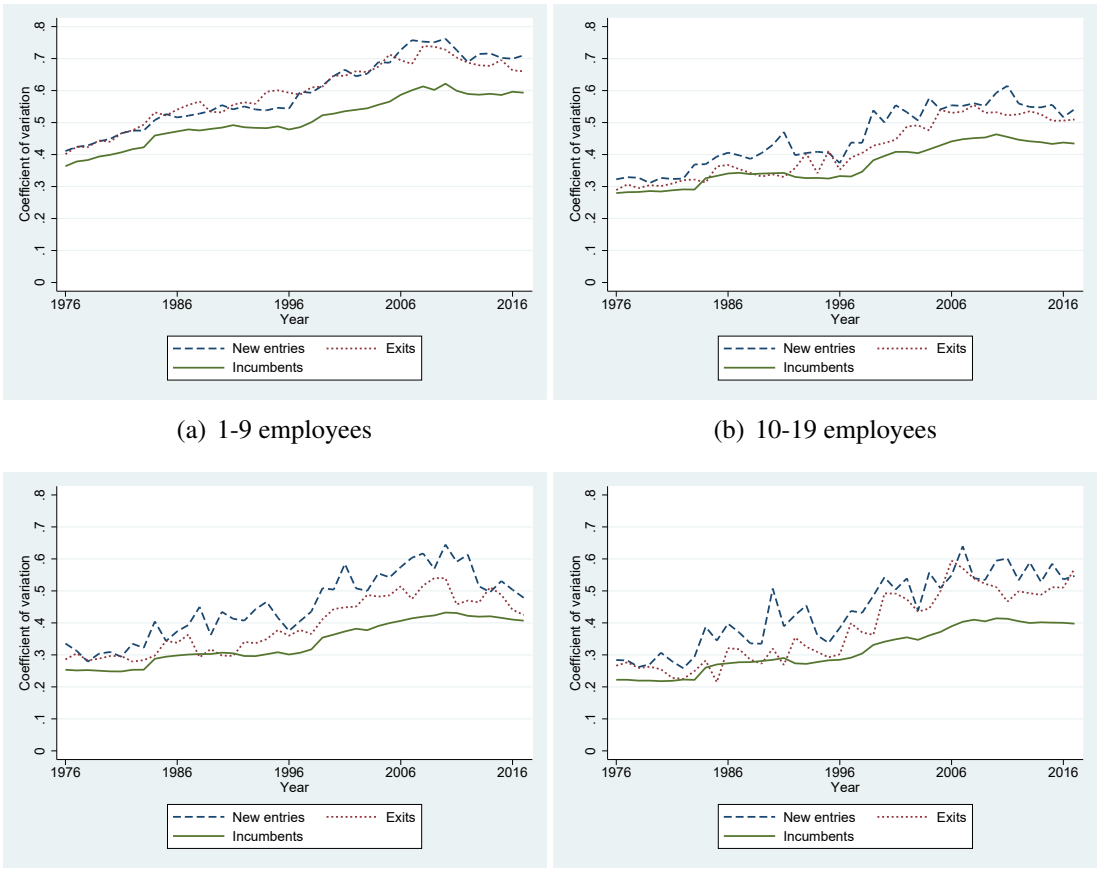
a substantial decline in the case of new and exiting establishments and a moderate decline in the case of incumbents until 2010, the 90th percentile increased rather steadily across all groups. Put differently, the average wages of the best-paying and worst-paying establishments diverged until the year 2010. Again, this development was most pronounced for newly entering establishments. The most recent years are characterized by an upward shift of the whole distribution which lets the dispersion decrease again. Inspection of Figure 2 (a) also reveals that the dispersion of average wages between establishments within the group of entering and exiting establishments is substantially larger than within the group of incumbents. In Figure A.3 in the appendix, I additionally examine the distribution of average wages by depicting the evolution of the 10th, 50th, 90th, 95th and 99th percentile for each group of establishments.

Panel (b) of Figure 2 depicts the coefficient of variation as a measure of dispersion. In 1976, the dispersion of average wages within and between the three groups is on a comparably low level, however, it grows steadily, and reaches its maximum around 2010. As can be seen, the groups of entering and exiting establishments are similarly dispersed and on a higher level than the group of incumbents. Note that 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 as well as exiting establishments are comparably heterogeneous in terms of the average wages they pay. In addition, I studied the average wages of high- and low-skilled employees within an establishment. The results are presented in the appendix (Figure A.1 for high-skilled and Figure A.2 for low-skilled employees) and show that also within these skill groups, the wage dispersion evolved fairly similar to the evolution depicted here. Hence, these patterns do not only affect specific parts of the workforce but seem to reflect a rather general trend.

As a consequence, the market seems to simultaneously offer high-wage and low-wage establishments the possibility to enter in the first place, and it does so increasingly. This is in line with the theoretical predictions of Jovanovic (1982): the consideration that firms learn about their true efficiency as they enter the market implies that initially there is a wider range of firms in the market than at any point in time in the future when firms have already learned about themselves and either exited or continued to operate. Overall, the observed pattern suggests that entry and exit dynamics should have an impact on 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. However, note that up to this point new establishments are only observed in their year of birth and thus, their life cycles are not explicitly followed. Additionally, all kinds of establishments that differ in size, sector, and other characteristics are pooled together.

4.2 Wage dispersion dynamics in establishments by size and sector

Therefore, I further examine the wage dynamics within establishment size categories and sectors.[6] Wages of establishments are known to differ substantially by industry and size; therefore it is reasonable to presume that this also holds true for the dispersion of average wages between establishments. I start by studying the wage dispersion within the four size classes in Figure 3. As can be seen, the general pattern raised in the previous section can be confirmed for groups of establishments of different sizes. The positive evolution of the wage dispersion across all groups of establishments as well as the growing divergence between establishments that enter respectively exit the market



(a) 1-9 employees

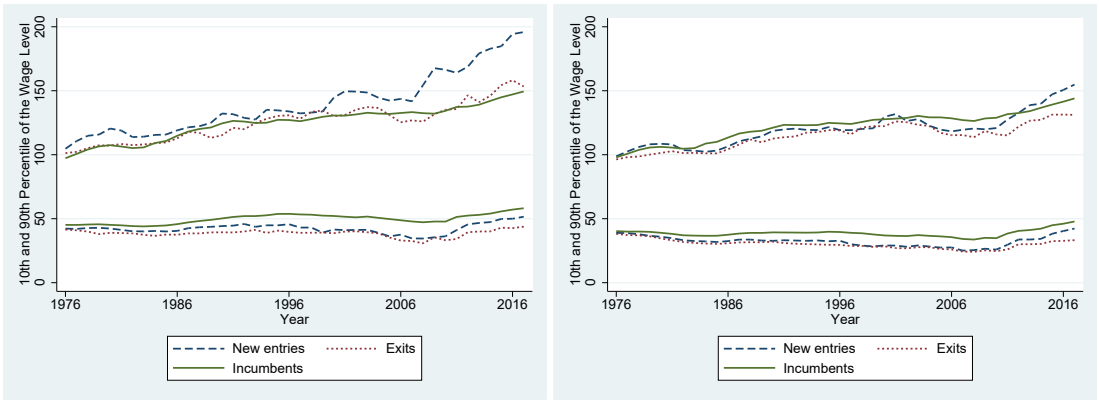
(b) 10-19 employees

(c) 20-49 employees

(d) 50+ employees

Figure 3: Coefficient of variation of the average wage distribution in various establishment size classes

[6] I base my sector variable on the 3-digit code of the WZ 1993 classification system and further aggregate such that I am left with five sectors: Agriculture, hunting and forestry, fishing; manufacturing; construction; services; and public administration, defence, social security. For more information on the industry classification system, see Eberle, Jacobebbinghaus, Ludsteck, and Witter (2011). In terms of establishment size, I consider four size classes: 1-9 employees, 10-19 employees, 20-49 employees and 50 or more employees.



(a) Manufacturing (b) Service

Figure 4: 10th and 90th percentile of the average wage distribution in the manufacturing and service sector

and incumbents persist when comparing similar sized establishments. This holds true for all panels in Figure 3 even though at higher sizes the trend is more volatile and on a lower level of dispersion. This is a helpful finding, particularly with regards to new establishments. Likely, a new establishment with, say, 25 employees in its year of birth is in many aspects very different from a new establishment with just one employee. Additionally, it is conceivable that large entrants are, in fact, rather newly established branch plants of existing firms than new firms (Fackler, Schnabel, & Schmucker, 2015). The fact that the patterns depicted in Figure 3(a)-3(d) are roughly similar hints towards the generalizability of the aggregate wage dynamics.

One additional concern could be that the observed evolution is only occurring within the service sector and thus, the overall trend is simply driven by a sector shift towards a more service-based economy. For that to evaluate, in Figure 4 I depict the evolution of the wage dispersion for the manufacturing sector as well as for the service sector. Here, I present the 10th and 90th percentile of the distribution of average wages.[7] Inspection of Figure 4 indicates that the trend is not specific to the service sector. The divergent evolution can be confirmed for both the service and the manufacturing sector. Moreover, in the 90th percentile of the manufacturing sector, there seems to be a decoupling between newly entering establishments and the rest in recent years, implying that new, high-wage establishments in the manufacturing sector are particularly strong.

Finally, I show linear predictions of a model that includes both size and sector dummies and an interaction term between establishment status (i.e. entry, exit or incumbent) and year to predict the evolution of the coefficient of variation in terms of

[7] In the appendix, Figure A.6 depicts the evolution of the coefficient of variation. The findings hold for this measure as well.

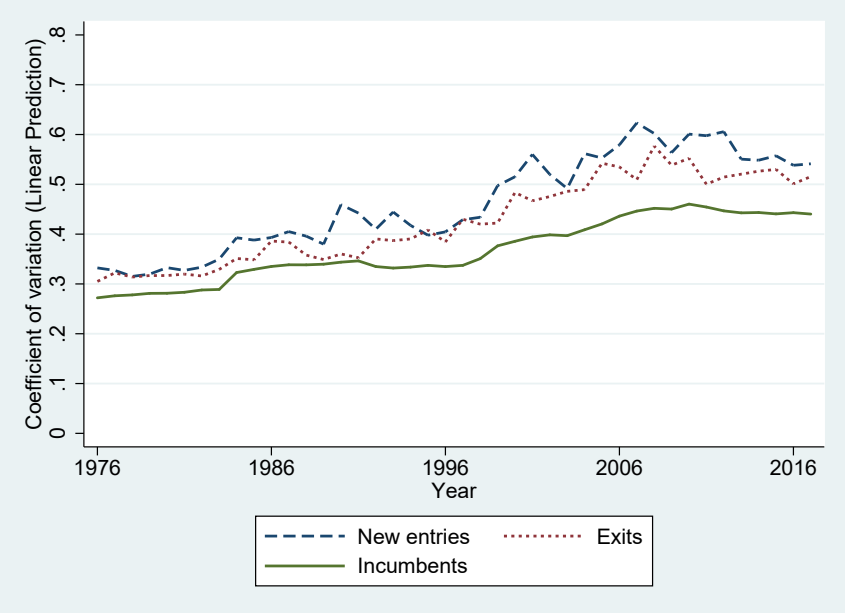


Figure 5: Predicted coefficient of variation. *Notes:* the values are linear predictions from a regression using aggregate data on the size class, sector, status and year level. The coefficient of variation is regressed on the full set of dummies and the interaction between status and year. Confidence intervals are omitted here for the sake of greater clarity.

average wages. The estimation results for the underlying model can be found in Figure A.1 in the appendix. The corresponding linear predictions are presented in Figure 5. As can be seen, the evolution clearly resembles the evolution displayed in Figure 2(b). Hence, even after controlling for broad size *and* sector categories (i.e. manufacturing or service), the general trend documented in this section persists. [8]

Based on the findings presented in this section, the following can be concluded. First, the dispersion of average wages in establishments has been growing over time, this holds true for establishments of different sizes and sectors. Second, for both entering and exiting establishments, this increase has been most pronounced, leading to the conclusion that establishment dynamics should have an impact on the overall wage dispersion between establishments. Third, especially entering establishments became increasingly heterogeneous in terms of the average wages they pay. However, note that until now I only studied new establishments in their year of birth and did not follow the life cycles of the respective entry cohorts. Additionally, at this point it is not clear how these life cycles are shaped by exiting establishments.

[8] In the appendix, I provide Figures that depict the evolutions of the wage dispersion within sector and size for all considered size and sector classifications (Figures A.4 and A.5). Overall, they all confirm the general trend and show that the rise in the dispersion of average wages has been particularly pronounced in case of newly entering establishments.

4.3 Wage dispersion within and between entry cohorts

To tackle 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. In addition, the role of exits in shaping this dispersion is studied. 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. By that means, it is possible to set up a model that describes the life cycle of entry cohorts (within-cohort wage dispersion) as well as 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.[9] The resulting estimation equation can be expressed as follows:

$$CV_{i,t} = \alpha + \sum_{i=1}^{>10} \beta_j Age_{ji} + \sum_{t=1976/1996}^{1995/2008} \gamma_k Cohort_{kt} + \epsilon_{i,t}$$

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 x i). This exercise aims to track entry cohorts as they grow older and to study the evolution of their dispersion. The coefficients of the estimated parameters reflect the within-cohort wage dispersion in case of the age dummies (β_j's) and the between-cohort wage dispersion in case of the entry year dummies (γ_k's). I consider age dummies until the age of ten and cluster all older establishments into an additional dummy that represents every age greater than ten. This however implies that only those establishments are considered that have been founded before 2009. Thus, I am not able to make a statement about the evolution in the years 2009-2017.[10] To specifically 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 wage dispersion between establishments that have been founded after the year 1995. Moreover, the choice of this cut-off year roughly coincides with breaks in the overall wage dispersion between establishments (steady, but stalled growth until the mid-90ies, more rapid growth until the late 00s and a slight decline

[9] As a robustness check, I also show models with the ratio between the 90th and 10th percentile as a measure of dispersion in Table A.4 in the appendix. The results of this exercise yield the same insights as the ones presented here.

[10] Note that here I am facing a trade-off between providing a most comprehensive picture of the life cycle patterns of entry cohorts and the inclusion of as many entry cohorts as possible. I argue that the year 2008 marks a structural break in the evolution of the wage dispersion and an age of 10 is a sufficiently large observation period for studying the within-cohort wage dispersion.

afterwards). Additionally, two separate samples are constructed: one that contains all establishments and one that contains only those establishments that survived at least ten years. The underlying rationale of this approach is to specifically investigate the role of exits.

Before discussing the results presented in Table 1, there are two important notes to make. First, the underlying sample here is different from the sample used previously in the sense that now it is an inflow sample: only those establishments are considered that entered during the observation period. Therefore, all establishments born before 1976 are naturally excluded. Second, note that the coefficient of variation and the explanatory variables age and cohort are interrelated *by construction* since I first condition the distribution of average wages on age and cohort and then regress a measure describing this (conditional) distribution on the two conditions.

Estimation results are presented in Table 1. The first column shows the results for all establishments born between 1996 and 2008. In the following, I refer to these cohorts as the more recent entry cohorts. 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 clearly decreases with the age of the establishments. Whilst entry cohorts in their second year after birth (age 3) exhibit a coefficient of variation that is 0.02 points lower than in their year of birth, this difference increases to 0.07 points in their 10th year of existence. This indicates that there is 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).

Table 1: Within- and between-cohort wage dispersion, 1976-2008, OLS estimations with the coefficient of variation (sd/mean) as a dependent variable in all specifications

	(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)	0.01* (0.01)
Age > 10 (dummy)	-0.09*** (0.01)	-0.03** (0.01)	-0.02** (0.01)	0.01* (0.01)
Entry Year				
1976 (reference)	-	-	-	-
1977 (dummy)	-	-	0.01 (0.01)	0.01 (0.01)
1978 (dummy)	-	-	0.03* (0.01)	0.02** (0.01)
1979 (dummy)	-	-	0.03*** (0.01)	0.03*** (0.01)
1980 (dummy)	-	-	0.05*** (0.01)	0.05*** (0.01)
1981 (dummy)	-	-	0.08*** (0.01)	0.07*** (0.01)
1982 (dummy)	-	-	0.07*** (0.01)	0.07*** (0.01)
1983 (dummy)	-	-	0.07*** (0.01)	0.07*** (0.01)
1984 (dummy)	-	-	0.07*** (0.01)	0.07*** (0.01)
1985 (dummy)	-	-	0.07*** (0.01)	0.07*** (0.01)
1986 (dummy)	-	-	0.06*** (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)	-	-	0.10*** (0.01)	0.08*** (0.01)
1991 (dummy)	-	-	0.09*** (0.01)	0.07*** (0.01)
1992 (dummy)	-	-	0.10*** (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)	-	-	0.11*** (0.01)	0.10*** (0.01)
1996 (reference)	-	-	-	-

	(1)	(2)	(3)	(4)
	All	Survivors	All	Survivors
	1996-2008	1996-2008	1976-1995	1976-1995
1997 (dummy)	0.03* (0.01)	0.02 (0.01)	-	-
1998 (dummy)	0.03** (0.01)	0.02 (0.01)	-	-
1999 (dummy)	0.05*** (0.01)	0.04*** (0.01)	-	-
2000 (dummy)	0.07*** (0.01)	0.06*** (0.01)	-	-
2001 (dummy)	0.08*** (0.01)	0.07*** (0.01)	-	-
2002 (dummy)	0.07*** (0.01)	0.05*** (0.01)	-	-
2003 (dummy)	0.08*** (0.01)	0.06*** (0.01)	-	-
2004 (dummy)	0.10*** (0.01)	0.08*** (0.01)	-	-
2005 (dummy)	0.08*** (0.01)	0.07*** (0.01)	-	-
2006 (dummy)	0.09*** (0.01)	0.08*** (0.01)	-	-
2007 (dummy)	0.10*** (0.01)	0.08*** (0.01)	-	-
2008 (dummy)	0.09*** (0.02)	0.08*** (0.01)	-	-
Intercept	0.56*** (0.01)	0.51*** (0.01)	0.41*** (0.01)	0.39*** (0.01)
R^2	0.75	0.66	0.80	0.78
N	142	142	220	220

Notes: West Germany, all sectors. Robust standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level.

The follow-up question addresses the reasons for this observed pattern. On the one hand, it could be that establishments become more similar in terms of their wage structure as they grow old. This could, for instance, be connected to patterns of knowledge or technology diffusion, facilitating learning and convergence processes, that might also translate into more similar wage structures between firms or establishments. However, the literature rather reports stalled diffusion processes and a growing divergence between firms (Andrews et al., 2016). On the other hand, it could be rooted in systematic establishment exit that acts on the wage dispersion of the surviving cohort. To address this open question, I replicate the estimation with a sample that only considers establishments that survived at least ten years after their birth. If the first line of explanation is true, we would expect to see a similar pattern within the sample of the surviving establishments, however, if the second line of explanation is accurate, we would expect to see a pattern that is distinct from that of column (1). The results of this exercise are presented in column (2). As can be seen, the coefficients of the age dummies are different from those of the previous model. In the first years of existence, there seems to be a small convergence process, even within the group of surviving establishments. However, the coefficients become smaller and turn insignificant as the cohorts grow old.

As a result, there is no statistically significant difference in the wage dispersion of surviving establishments between their year of birth and their 10th year of existence.[11] This allows the conclusion that the convergence observed in model (1) seems to be heavily driven by systematic establishment exit and not by intrinsic wage convergence processes within the cohort of surviving establishments, at least for the sample of the more recent cohorts. Generally, this is consistent with exiting establishments being more heterogeneous than incumbents (or survivors), as presented in Figures 2-5. Inspection of the models (3) and (4) in Table 1 shows that there has been a change over time in the observed patterns of the within-cohort wage dispersion. It is visible that the 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 an age of ten than in the year of birth. Interestingly, there is no change in the within-cohort wage dispersion after the third year of existence. Model (4), which displays the results for the survivors' sample, indicates that the observed convergence is again rather driven by establishment exit. This particularly holds in the long run as the coefficients become insignificant or close to respectively exactly zero once the cohorts turn six. Note that this analysis has been conducted with entering establishments of every sector.[12]

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 more frequent exit of those establishments that, in terms of Jovanovic (1982), learned that their true efficiency is not sufficient 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 as well as post-entry exit dynamics have been increasing in the west german establishment landscape, 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 generally support this view as they are continuously growing over time. As already seen in the previous analyses, there has been a substantial increase in the wage dispersion between different entry cohorts. This finding can be further corroborated here. For instance, establishments that entered in

[11] Note that this does not hold for the coefficient of the dummy that captures all ages above ten. The wage dispersion between surviving establishments that are older than ten is significantly lower (0.03 points) than in their year of birth.

[12] In the appendix, I also provide the results for the manufacturing and service sector only (Table A.2 and Table A.3, respectively). The basic patterns can be confirmed when only including establishments from the manufacturing or service sector.

the year 1980 exhibit a coefficient of variation (regarding their average wages) that is 0.11 units smaller than in the year 1995, conditional on a given age, while the coefficient of variation for establishments entering in the year 2008 is 0.08 higher than in the year 1996, ceteris paribus.[13]

To further reinforce the finding that more recently born entry cohorts indeed exhibit stronger exit dynamics, I additionally show average ages of establishments at exit for every entry cohort. 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. For that to achieve, I set up a linear regression model that relates an establishments' age at exit to a full set of entry year dummies (1976-2008) as well as 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. The rationale behind this approach is to make the evolution of this variable more meaningful by controlling for other factors that might impact an establishments' age at exit, such as its size. For it is well known that smaller firms are more likely to exit (Fackler et al. (2013)), it can be expected that smaller establishments exhibit lower ages at exit, on average. Note that only those establishments are included in the model that exited within their first ten years of existence to make different entry cohorts comparable. Hence, the model captures the age at exit, conditional on exiting, and therefore, the number or ratio of surviving establishments does not impact the outcome. The estimation results of the respective model can be found in the appendix in Table A.5. As a robustness check, I provide the results of a more basic model in the appendix (Figure A.7) where the age at exit is only regressed on the full set of entry year dummies.

Figure 6 depicts linear predictions based on this model where the values can be interpreted as average ages at exit of exiting establishments born in a given entry year. As can be seen, the average age at exit decreased substantially since the beginning of the observation period. While this decline evolved fairly slow and unstable until the beginning of the 1990s, it accelerated dramatically in the 1990s. Within these ten years, the average age at exit declined by close to one 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. It is clearly visible that there is a sharp drop in the average age at exit in the years following 1996, which further strengthens the choice of the sample split. During the 2000s, the average age at exit evolved fairly constant, however, from 2005 on, it slowly increased again. This finding further supports the evidence gained

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

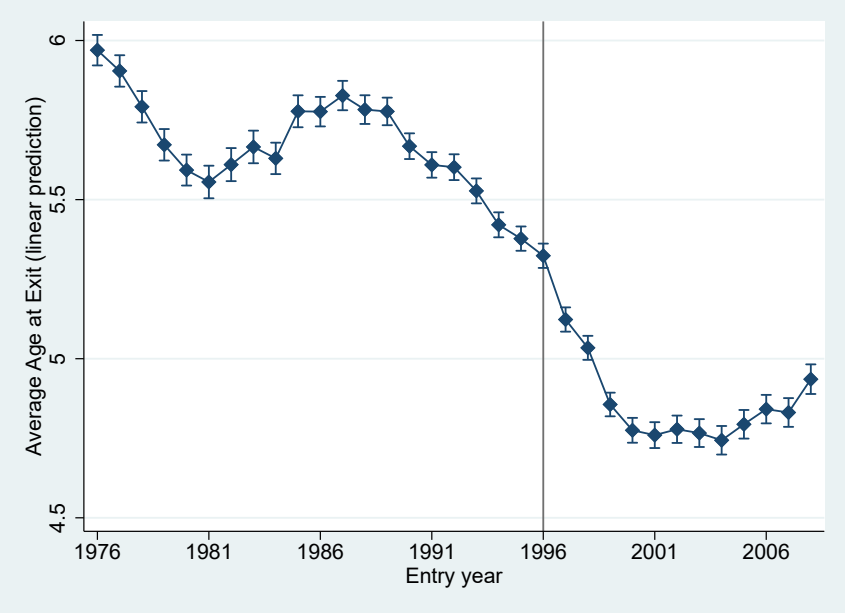


Figure 6: The average age at exit of establishments that exited within ten years, by entry year.

previously and highlights that rising exit dynamics translate into lower average ages at exit. Put differently, establishments that are born in more recent years die younger, on average. This would also be consistent with the strand of explanation developed above, i.e that rising entry opportunities are followed by stronger and faster exit behavior which reduces the age at which establishments exit.

To provide further evidence that there is indeed a connection between exit dynamics and preceding entry patterns, I additionally present a scatter plot that relates the variable displayed above, namely the average age at exit within a given entry year to the number of establishments that entered in the respective year. Figure 7 presents the relationship between these two variables and highlights the entry years to which the data points refer. It is visible that there exists a strong negative correlation (R^2=0.47) between the number of newly founded establishments in a given year and the subsequent exit patterns, as measured with the average age at exit. Accordingly, crowded entry cohorts with many new establishments are associated with more dynamic exit patterns in the following ten years. Although this finding fits well into the developed explanations, it should be treated carefully as this correlation might also be driven by third factors that are not considered here. However, the finding is consistent with, for instance, Bartelsman, Scarpetta, and Schivardi (2005) who show that entry and exit rates of firms are positively correlated across industries in different countries and assign this association to the process of creative destruction.

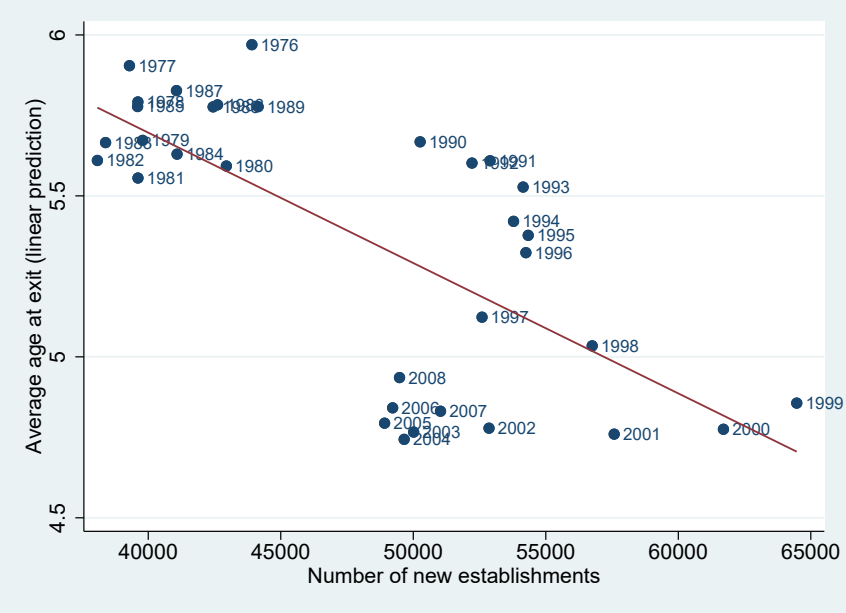


Figure 7: The correlation between the average age at exit and the number of new establishments in a given entry year.

Let me conclude this analysis with a summary of the findings and their integration into the (theoretical) context of this study. First, the wage dispersion within entry cohorts generally decreases with age. This pattern has been substantially increasing over time and plays a particularly important role for establishments born between 1996 and 2008. Second, the observed convergence towards a lower wage dispersion seems to be largely driven by systematic establishment exit that mechanically decreases the dispersion between the residual establishments within their cohorts. Therefore, we can conclude that exits reduce the overall wage dispersion. However, the probable interaction of these exit dynamics with the preceding entry patterns in the respective birth years makes it hard to generate a clear take-away. I presented evidence that increasing entry dynamics indeed translate into a more dynamic and faster exit behavior of young establishments. Assessing these interrelations and their impact on the wage structure more profoundly, is, in my view, an attractive avenue for further research. Third, conditional on a given age, entry cohorts become more dispersed the later they are born. Hence, newly entering establishments became increasingly heterogeneous in terms of their wage level. This generally contributes positively to the rise in wage inequality. However, this effect is dampened by stronger corresponding exit dynamics that reduce wage inequality again. Therefore, examining the relationship between establishment exits and wages more profoundly can further clarify the role that exiting establishments play.

4.4 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 of 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 and second, how does this relationship vary with the year of birth? 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 additionally include twenty wage dummies (each representing a 5 % quantile) that display the position of a given establishment within the (entry year-specific) wage distribution. To address the second question, the model is enriched by interacting the wage quantile 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).

Figure 8 depicts the exit rates in dependence of the wage level for the three different entry clusters. These are presented as linear predictions from the model described above. The regression results are provided in the appendix in Table A.6. 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 Malchow-Møller et al. (2011). For instance, establishments that entered between 1996 and 2008 (triangle) and belong to the 5% of the worst paying establishments of their birth cohort (value 1 on the x-axis) exhibit an exit rate of 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 quantile (value 15 on the x-axis) exhibit an exit rate of only 0.07, which corresponds to a decline in the exit risk of over 40 %. Within this wage quantile only one out of 14 establishments exits. Hence, at this point we can discard the hypothesis derived from equilibrium search models stating that both high-wage and low-wage establishments are the least likely to exit. It is clearly visible that it is the low-wage establishments that are the most likely to exit. This further strengthens the argument that exiting establishments rather reduce the wage inequality since via that channel the market is cleared from the worst paying establishments.

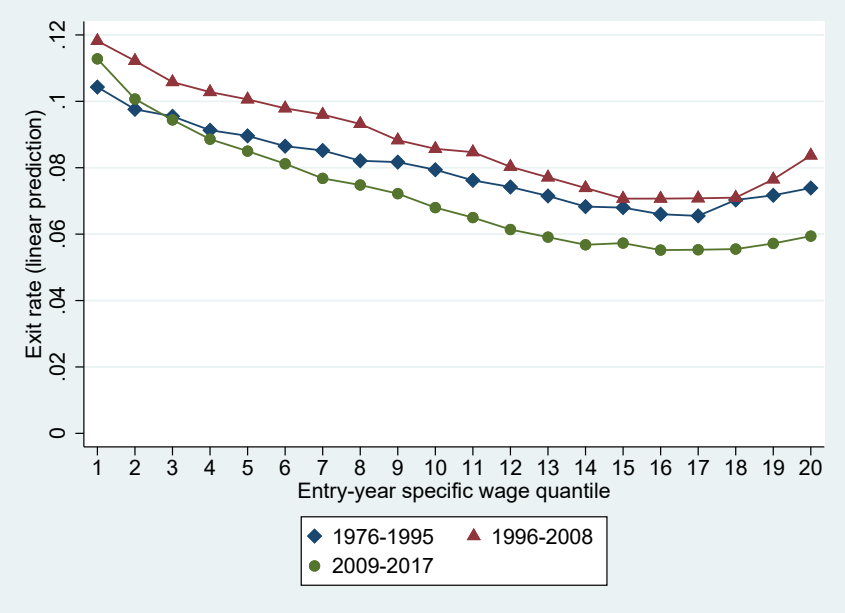


Figure 8: Exit rates in dependence of the wage level for different birth cohorts. *Note:* The underlying model includes every establishment that has been recognized as an entry and that can be assigned a specific entry year and age. Confidence intervals are omitted here as they are very small and therefore not of interest.

However, note that this general decrease is not linear, as the exit rates are found to increase for the best-paying establishments again. For all considered entry cohort clusters, we can observe a minimum at the 15th to 17th 5% quantile that is followed by an increase in the exit rates. This increase is low for the most recent cohorts (circle), mediocre for the oldest cohorts (diamond) and most pronounced for the middle cohorts (triangle). The analysis of the differences between these groups offers further insights. At first, it should be noted that the fundamental relationship between establishment exit and the wage level is fairly constant across different entry cohorts. However, studying the differences is nonetheless informative. As can be seen, the exit rates of establishments born between 1996 and 2008 are on a higher level for every depicted wage quantile than those of establishments born in earlier periods. Thus, exit patterns of entering establishments have indeed undergone a notable change as they became more dynamic in the period between 1996 and 2008. This exit dynamism has cooled off substantially in the period following the financial crisis which may be connected to the rise of zombie firms, for instance.

Of course, the choice of the applied classification into different groups of entering establishments is not carved in stone and therefore, objectionable. However, I think these are plausible cut-off years since, firstly, they roughly coincide with breaks in the overall

wage dispersion between establishments (steady, but stalled growth until the mid-90ies, more rapid growth until the late 00s and a slight decline afterwards) and secondly, they perfectly align with the work of Card et al. (2013). As a further robustness check, I changed the second cut-off year from 1996 to 1992 to study possible differences in the outcome. Figure A.8 in the appendix indicates that this alteration did not substantially change the results. In addition, the inclusion of the wage level as an explanatory variable into the exit regression raises concerns regarding multicollinearity since establishments' wages correlate with age and size of an establishment or firm (e.g. Brown & Medoff, 2003, 1989). However, I would argue that even if the coefficients of the wage quantile dummies are biased, there is no reason to believe that this bias systematically varies with birth cohort. Finally, it could be that the effect of the wage level on the exit probability is overestimated since knowledge about future exit in an establishment leads to selective labor turnover beforehand. As a consequence, the average wage in an establishment can be influenced by the knowledge of imminent closure. Schwerdt (2011), for instance, shows that predominantly high-earnings workers leave an establishment prior to an exit. This would reduce the wage level within the establishment and lead to an overestimation of the effect of the wage level. In contrast, Fackler, Schnabel, and Wagner (2014) document substantial employment adjustments concerning both size and composition prior to an exit, ultimately leading to a more skilled workforce. This would correspond to a positive effect on average wages within exiting establishments and therefore lead to an underestimation of the effect of the wage level on the exit probability.

4.5 The decline in collective bargaining agreements

In the case of Germany, the role of institutional factors, such as unionization and the coverage of collective bargaining agreements has been heavily emphasized in the literature on wage dispersion (Card et al., 2013; Hirsch & Mueller, 2020; Baumgarten et al., 2020). Card et al. (2013), for instance, associate the increasing dispersion between new establishments with the shrinking fraction of establishments covered by the traditional collective bargaining system in Germany, leading to a higher fraction of establishments that pay relatively low wages (Card et al., 2013, p.1009).

This, in turn, would contribute to "the rise in establishment-level heterogeneity" (Card et al., 2013, p.1010). To address this association, I depict the fraction of employees that are covered by a collective bargaining agreement jointly with the wage dispersion of entries, exits and incumbents since 1996, measured by the coefficient of variation. For that, I use aggregate yearly data from the IAB establishment panel which contains information on the fraction of employees that are covered by a sector-level collective

agreement. The data goes back to the year 1996 (IAB, 2021). Figure 9 shows that while the coverage rate dropped significantly, from close to 70% in 1996 to approximately 50% in 2017, the wage dispersion rose in every group of establishments considered.

Hence, there is a strong negative correlation between the fraction of employees that is covered by a sector-level collective agreement and the wage dispersion between establishments. The correlation coefficients range from -.66 for the dispersion of exiting establishments to -.81 for the dispersion of entering establishments. This highlights that two major developments simultaneously occurred in the respective observation period in West Germany. Firstly, the importance of traditional labor market institutions, such as collective bargaining agreements, declined substantially. Secondly, at the same time, the wage dispersion between establishments rose very quickly. This holds particularly true for newly entering establishments, which would be consistent with the decline in collective bargaining agreements being a major driver since it can be presumed that newly entering establishments decreasingly adopted collective bargaining regimes. While this is in line with the findings of Card et al. (2013), further and more explicit analyses are needed to better assess the underlying relationship.

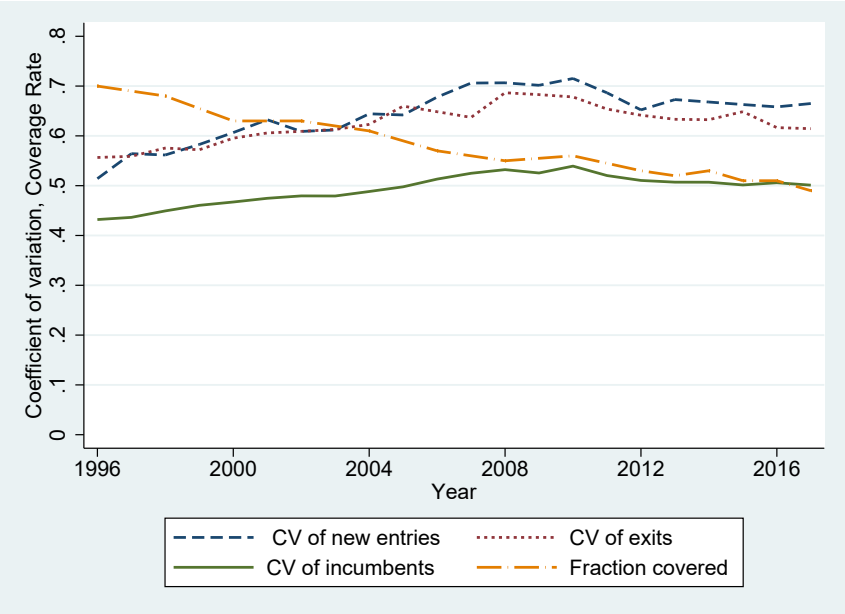


Figure 9: Coefficient of variation (CV) regarding average wages and fraction of employees covered by collective agreements, by year

5 Conclusion

Using a 50 % random sample of all establishments operating in West Germany over the period 1976-2017, this paper has examined the relationship between firm dynamics and the wage dispersion between establishments. More specifically, it has investigated how firm entry and exit dynamics relate to the evolution of the wage dispersion between establishments in West Germany. Even though this analysis is descriptive, I am able to unearth relevant patterns that have been neglected in the literature so far. These patterns are:

(1) The wage dispersion between establishments within the groups of entering, exiting and incumbent establishments is generally increasing over time.

(2) The divergence between the dispersion of the group of incumbents and the rest is also rising: entering and exiting establishments became increasingly heterogeneous in terms of their average wages.

(3) Hence, firm dynamics impact the wage structure since they bring groups of establishments into and out of the market that are characterized by high levels of dispersion.

(4) 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).

(5) This decline is predominantly driven by systematic establishment exit that mechanically reduces the wage dispersion of the residual cohort.

(6) 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, more crowded entry cohorts are associated with a lower average age at exit.

(7) 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) and (3) suggest that there is indeed a relationship between firm dynamics and the wage dispersion between establishments. Moreover, (2) and (4) 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)). However, these studies rely on regional or cross-country variation while this paper uses information on the establishment level.

Additionally, (2), (5) and (7) 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 the best of my knowledge, this paper is the first to address the question of how exits generally shape the wage distribution. Lastly, (6) reveals an interrelation between firm entry dynamics and subsequent exit patterns. Hence, more crowded entry cohorts exhibit faster exit patterns that are 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. In the literature review, I based my considerations on the neoclassical marginal productivity theory, on equilibrium search models and on learning models, proposed by Jovanovic (1982). While models that operate within the framework of perfect competition predict that firms that pay lower wages exhibit higher exit rates than those that pay higher wages, equilibrium search models imply that both low wage and high wage firms are less likely to exit than firms that pay wages from the middle of the wage distribution. In contrast, the prediction of Jovanovic (1982) is ambiguous: if high-wage firms are the most efficient, then these are the least likely to exit, however, if high-wage firms are also high-cost firms then this would, in turn, be associated with higher exit probabilities.

It turns out that my empirical results are consistent with predictions from perfect competition models and discard predictions from equilibrium search models since low-wage firms are found to exit the market with a higher probability than firms that pay higher wages. As a consequence, the channel of firm exit reduces the overall wage dispersion between establishments. 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 quantiles indicate that high-wage firms can also be high-cost firms which puts 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. (2021) and Sorenson et al. (2021) find strong and persistent drawbacks for startup employees, both in terms of wages and employment stability. This paper provides an additional and complementary 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 include these considerations into the assessment of policy instruments, such as subsidies for startups. My focus on wage dispersion supports the skeptical view of some authors towards a policy that devotes more and more resources to fostering new business formation (Santarelli & Vivarelli, 2007; Shane, 2009).

The costs and benefits of firm exit have mostly been discussed over the crucial role they play 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, an insight that is very intuitive but has not yet been documented in the literature. Analogously to firm entry, these distributional effects are not yet put forward in the discussion regarding the economic costs and benefits of firm exit. All in all, my findings supplement our knowledge of the consequences of firm dynamics and add a new layer to the discussion that is led over optimal policy instruments and targets with regards to both firm entry and exit.

Finally, it should be noted that this paper mainly 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 establishments has occurred. Future research may be able to tackle this question by bringing together the findings of this paper with patterns that describe prevailing trends in the labor market, such as digitalization, institutional changes, or market concentration.

A Appendix

A.1 Wage dispersion dynamics in establishments along the wage distribution

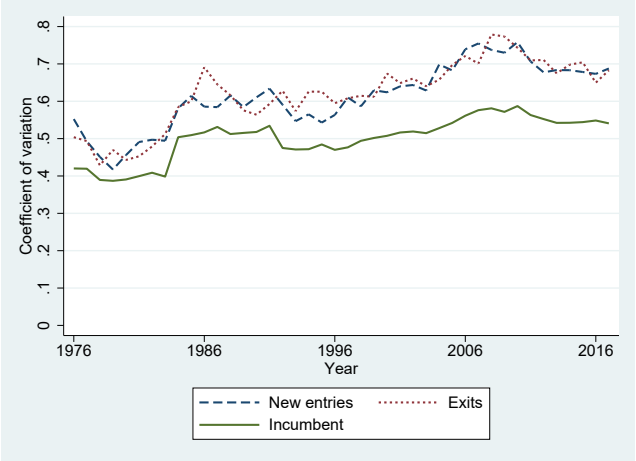


Figure A.1: Coefficient of variation for the wage level (average real wages) of high-skilled employees

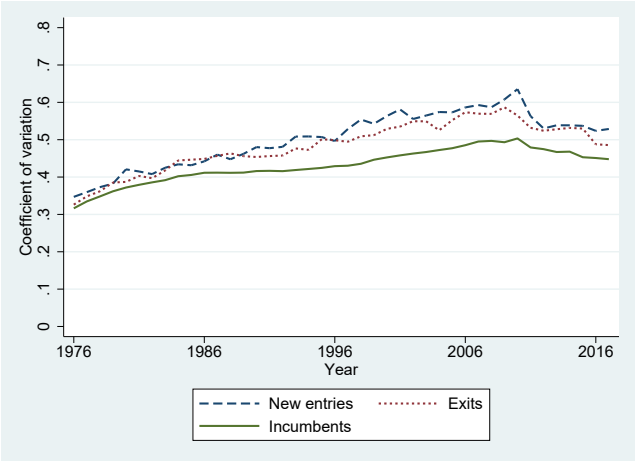
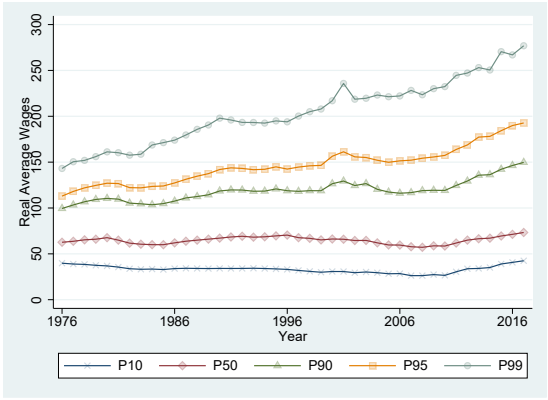
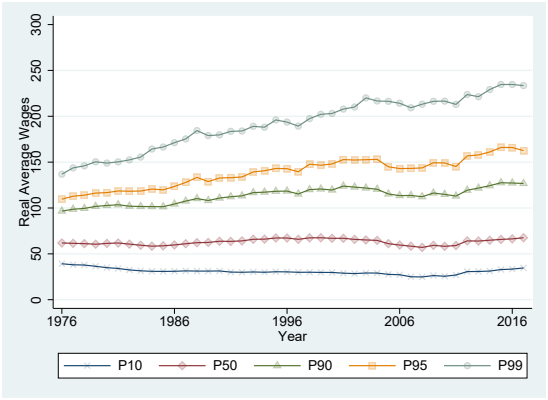


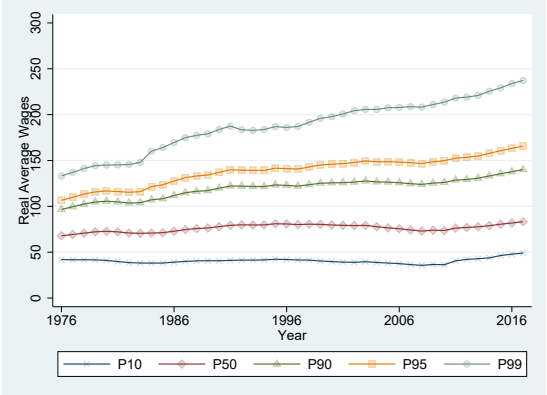
Figure A.2: Coefficient of variation for the wage level (average real wages) of low-skilled employees



(a) Entering Establishments



(b) Exiting Establishments



(c) Incumbent Establishments

Figure A.3: Distribution of average wages, by establishments status

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

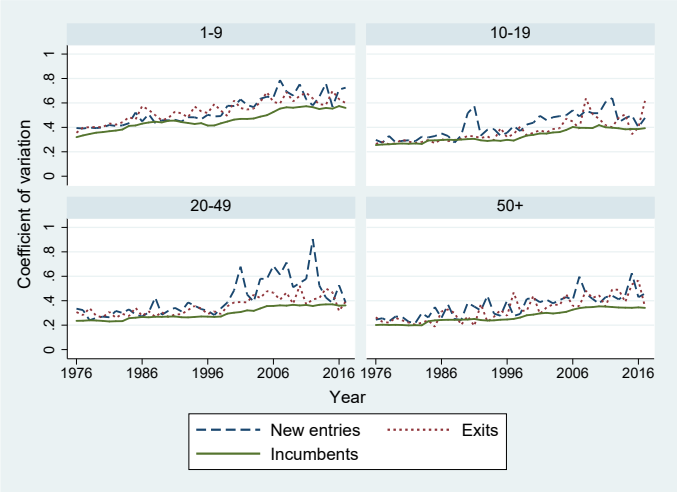


Figure A.4: Coefficient of variation within different establishment size classes for the manufacturing sector

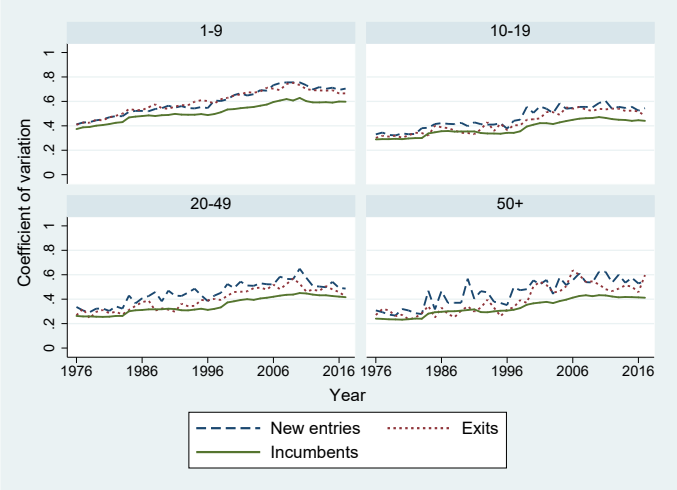
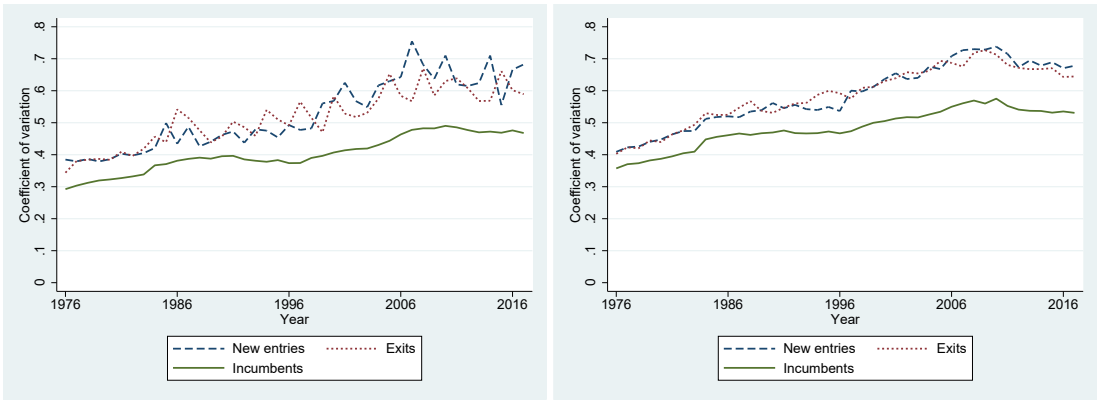


Figure A.5: Coefficient of variation within different establishment size classes for the service sector



(a) Manufacturing (b) Service

Figure A.6: Wage dispersion dynamics between entering, exiting and incumbent establishments in West Germany, by sector

Table A.1: Coefficient of variation as a function of sector, size, status and year, OLS estimations

Explanatory Variables		... Continued	
Manufacturing (reference)	-	1993 (dummy)	0.11*** (0.02)
Service (dummy)	0.06***	1994 (dummy)	0.09*** (0.02)
Establishment Size		1995 (dummy)	0.07*** (0.02)
1-9 employees (reference)	-	1996 (dummy)	0.07*** (0.02)
10-19 employees (dummy)	-0.15*** (0.00)	1997 (dummy)	0.10*** (0.03)
20-49 employees (dummy)	-0.16*** (0.00)	1998 (dummy)	0.10*** (0.02)
50+ employees (dummy)	-0.18*** (0.00)	1999 (dummy)	0.17*** (0.02)
Establishment Status		2000 (dummy)	0.18*** (0.02)
Entering (reference)	-	2001 (dummy)	0.23*** (0.03)
Exiting (dummy)	-0.03 (0.02)	2002 (dummy)	0.19*** (0.02)
Incumbent (dummy)	-0.06** (0.02)	2003 (dummy)	0.16*** (0.02)
Year		2004 (dummy)	0.23*** (0.02)
1976 (reference)	-	2005 (dummy)	0.22*** (0.02)
1977 (dummy)	-0.01 (0.02)	2006 (dummy)	0.25*** (0.03)
1978 (dummy)	-0.02 (0.02)	2007 (dummy)	0.29*** (0.03)
1979 (dummy)	-0.01 (0.02)	2008 (dummy)	0.27*** (0.03)
1980 (dummy)	0.00 (0.02)	2009 (dummy)	0.23*** (0.02)
1981 (dummy)	-0.01 (0.02)	2010 (dummy)	0.27*** (0.03)
1982 (dummy)	0.00 (0.02)	2011 (dummy)	0.27*** (0.02)
1983 (dummy)	0.02 (0.02)	2012 (dummy)	0.27*** (0.06)
1984 (dummy)	0.06* (0.02)	2013 (dummy)	0.22*** (0.02)
1985 (dummy)	0.06** (0.02)	2014 (dummy)	0.22*** (0.02)
1986 (dummy)	0.06* (0.02)	2015 (dummy)	0.23*** (0.03)
1987 (dummy)	0.07*** (0.02)	2016 (dummy)	0.21*** (0.02)
1988 (dummy)	0.06* (0.03)	2017 (dummy)	0.21*** (0.02)
1989 (dummy)	0.05** (0.02)	Year x Status	✓
1990 (dummy)	0.13*** (0.03)	Constant	0.43*** (0.02)
1991 (dummy)	0.11*** (0.03)		
1992 (dummy)	0.08*** (0.02)		
R^2	0.9		
N	1,008		

Notes: West Germany. Data has been aggregated on the year-sector-size-status level. Robust standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level.

A.3 Wage dispersion within and between entry cohorts

Table A.2: Within- and between-cohort wage dispersion, 1976-2008, OLS estimations with the coefficient of variation (sd/mean) as a dependent variable in all specifications, manufacturing sector

	(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** (0.02)	-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)	-0.01 (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)
Age > 10 (dummy)	-0.07*** (0.02)	-0.03 (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)	0.02 (0.02)
1979 (dummy)	-	-	0.00 (0.01)	0.00 (0.01)
1980 (dummy)	-	-	0.04** (0.02)	0.03* (0.01)
1981 (dummy)	-	-	0.05*** (0.01)	0.05*** (0.01)
1982 (dummy)	-	-	0.03* (0.01)	0.02 (0.01)
1983 (dummy)	-	-	0.03** (0.01)	0.03* (0.01)
1984 (dummy)	-	-	0.02 (0.01)	0.01 (0.01)
1985 (dummy)	-	-	0.03 (0.02)	0.02 (0.02)
1986 (dummy)	-	-	0.02* (0.01)	0.02 (0.01)
1987 (dummy)	-	-	0.05*** (0.01)	0.05** (0.02)
1988 (dummy)	-	-	-0.00 (0.01)	-0.02 (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)	0.03** (0.01)
1992 (dummy)	-	-	0.02 (0.01)	0.00 (0.01)

	(1)	(2)	(3)	(4)
	All	Survivors	All	Survivors
	1996-2008	1996-2008	1976-1995	1976-1995
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 (0.02)	-0.04** (0.01)	-	-
1998 (dummy)	-0.00 (0.02)	-0.02 (0.01)	-	-
1999 (dummy)	0.04* (0.02)	0.02 (0.01)	-	-
2000 (dummy)	0.09*** (0.02)	0.09*** (0.01)	-	-
2001 (dummy)	0.09*** (0.02)	0.08*** (0.02)	-	-
2002 (dummy)	0.10*** (0.02)	0.10*** (0.02)	-	-
2003 (dummy)	0.05*** (0.01)	0.02* (0.01)	-	-
2004 (dummy)	0.15*** (0.02)	0.09*** (0.02)	-	-
2005 (dummy)	0.08*** (0.02)	0.08*** (0.01)	-	-
2006 (dummy)	0.11*** (0.02)	0.11*** (0.02)	-	-
2007 (dummy)	0.08** (0.03)	0.05** (0.02)	-	-
2008 (dummy)	0.13*** (0.02)	0.09*** (0.02)	-	-
Intercept	0.52*** (0.02)	0.50*** (0.01)	0.40*** (0.01)	0.40*** (0.01)
R^2	0.69	0.67	0.47	0.45
N	142	142	220	220

Notes: West Germany, manufacturing sector. Robust standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level.

Table A.3: Within- and between-cohort wage dispersion, 1976-2008, OLS estimations with the coefficient of variation (sd/mean) as a dependent variable in all specifications, service sector

	(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)
Age > 10 (dummy)	-0.10*** (0.01)	-0.03** (0.01)	-0.01 (0.01)	0.02*** (0.01)
1976 (reference)	-	-	-	-
1977 (dummy)	-	-	0.02 (0.01)	0.01 (0.01)
1978 (dummy)	-	-	0.03** (0.01)	0.02** (0.01)
1979 (dummy)	-	-	0.04*** (0.01)	0.03*** (0.01)
1980 (dummy)	-	-	0.05*** (0.01)	0.05*** (0.01)
1981 (dummy)	-	-	0.08*** (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)	0.08*** (0.01)
1985 (dummy)	-	-	0.08*** (0.01)	0.08*** (0.01)
1986 (dummy)	-	-	0.07*** (0.01)	0.07*** (0.01)
1987 (dummy)	-	-	0.08*** (0.01)	0.08*** (0.01)
1988 (dummy)	-	-	0.09*** (0.01)	0.09*** (0.01)
1989 (dummy)	-	-	0.09*** (0.01)	0.08*** (0.01)
1990 (dummy)	-	-	0.11*** (0.01)	0.09*** (0.01)
1991 (dummy)	-	-	0.10*** (0.01)	0.08*** (0.01)
1992 (dummy)	-	-	0.12*** (0.01)	0.11*** (0.01)
1993 (dummy)	-	-	0.11*** (0.01)	0.09*** (0.01)
1994 (dummy)	-	-	0.12*** (0.01)	0.10*** (0.01)
1995 (dummy)	-	-	0.13*** (0.01)	0.12*** (0.01)

	(1)	(2)	(3)	(4)
	All	Survivors	All	Survivors
	1996-2008	1996-2008	1976-1995	1976-1995
1996 (reference)	-	-	-	-
1997 (dummy)	0.04** (0.01)	0.03** (0.01)	-	-
1998 (dummy)	0.04*** (0.01)	0.03* (0.01)	-	-
1999 (dummy)	0.05*** (0.01)	0.05*** (0.01)	-	-
2000 (dummy)	0.07*** (0.01)	0.06*** (0.01)	-	-
2001 (dummy)	0.08*** (0.01)	0.07*** (0.01)	-	-
2002 (dummy)	0.06*** (0.01)	0.04*** (0.01)	-	-
2003 (dummy)	0.08*** (0.01)	0.07*** (0.01)	-	-
2004 (dummy)	0.10*** (0.01)	0.08*** (0.01)	-	-
2005 (dummy)	0.08*** (0.01)	0.07*** (0.01)	-	-
2006 (dummy)	0.09*** (0.02)	0.08*** (0.01)	-	-
2007 (dummy)	0.10*** (0.01)	0.09*** (0.01)	-	-
2008 (dummy)	0.08*** (0.02)	0.07*** (0.01)	-	-
Intercept	0.59*** (0.01)	0.53*** (0.01)	0.43*** (0.01)	0.40*** (0.01)
R^2	0.74	0.62	0.84	0.82
N	142	142	220	220

Notes: West Germany, service sector. Robust standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level.

Table A.4: Within- and between-cohort wage dispersion, 1976-2008, OLS estimations with the ratio of P90 and P10 as a dependent variable in all specifications

	(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)	-0.24*** (0.05)	-0.11** (0.04)	-0.13*** (0.02)
Age 3 (dummy)	-0.23** (0.08)	-0.29*** (0.05)	-0.13*** (0.03)	-0.15*** (0.02)
Age 4 (dummy)	-0.34*** (0.08)	-0.33*** (0.04)	-0.15*** (0.03)	-0.16*** (0.02)
Age 5 (dummy)	-0.49*** (0.08)	-0.35*** (0.04)	-0.17*** (0.03)	-0.15*** (0.02)
Age 6 (dummy)	-0.59*** (0.08)	-0.36*** (0.04)	-0.20*** (0.03)	-0.14*** (0.02)
Age 7 (dummy)	-0.68*** (0.08)	-0.36*** (0.04)	-0.21*** (0.03)	-0.12*** (0.02)
Age 8 (dummy)	-0.76*** (0.08)	-0.35*** (0.04)	-0.22*** (0.03)	-0.09*** (0.02)
Age 9 (dummy)	-0.84*** (0.09)	-0.34*** (0.05)	-0.24*** (0.03)	-0.06** (0.02)
Age 10 (dummy)	-0.92*** (0.09)	-0.32*** (0.06)	-0.25*** (0.03)	-0.01 (0.02)
Age > 10 (dummy)	-1.18*** (0.08)	-0.59*** (0.05)	-0.29*** (0.04)	-0.05* (0.02)
Entry year				
1976 (reference)	-	-	-	-
1977 (dummy)	-	-	0.07 (0.06)	0.06 (0.04)
1978 (dummy)	-	-	0.12* (0.06)	0.09** (0.03)
1979 (dummy)	-	-	0.17** (0.05)	0.13*** (0.03)
1980 (dummy)	-	-	0.28*** (0.05)	0.22*** (0.03)
1981 (dummy)	-	-	0.36*** (0.05)	0.31*** (0.03)
1982 (dummy)	-	-	0.38*** (0.05)	0.32*** (0.03)
1983 (dummy)	-	-	0.35*** (0.05)	0.30*** (0.03)
1984 (dummy)	-	-	0.34*** (0.05)	0.28*** (0.03)
1985 (dummy)	-	-	0.35*** (0.05)	0.28*** (0.04)
1986 (dummy)	-	-	0.36*** (0.05)	0.28*** (0.04)
1987 (dummy)	-	-	0.40*** (0.05)	0.33*** (0.03)
1988 (dummy)	-	-	0.44*** (0.05)	0.35*** (0.03)
1989 (dummy)	-	-	0.49*** (0.05)	0.36*** (0.03)
1990 (dummy)	-	-	0.59*** (0.06)	0.41*** (0.03)
1991 (dummy)	-	-	0.61*** (0.06)	0.43*** (0.03)
1992 (dummy)	-	-	0.64*** (0.06)	0.46*** (0.04)
1993 (dummy)	-	-	0.63*** (0.06)	0.44*** (0.04)
1994 (dummy)	-	-	0.64*** (0.06)	0.42*** (0.03)
1995 (dummy)	-	-	0.72*** (0.06)	0.51*** (0.03)

	(1) All 1996-2008	(2) Survivors 1996-2008	(3) All 1976-1995	(4) Survivors 1976-1995
1996 (reference)	-	-	-	-
1997 (dummy)	0.22** (0.08)	0.17** (0.06)	-	-
1998 (dummy)	0.21** (0.07)	0.15** (0.05)	-	-
1999 (dummy)	0.34*** (0.08)	0.30*** (0.05)	-	-
2000 (dummy)	0.48*** (0.07)	0.42*** (0.05)	-	-
2001 (dummy)	0.50*** (0.07)	0.39*** (0.05)	-	-
2002 (dummy)	0.43*** (0.07)	0.27*** (0.05)	-	-
2003 (dummy)	0.40*** (0.07)	0.24*** (0.05)	-	-
2004 (dummy)	0.27*** (0.07)	0.18*** (0.05)	-	-
2005 (dummy)	0.27*** (0.07)	0.18*** (0.05)	-	-
2006 (dummy)	0.17* (0.07)	0.11 (0.06)	-	-
2007 (dummy)	0.23* (0.10)	0.10 (0.06)	-	-
2008 (dummy)	0.23* (0.12)	0.12 (0.07)	-	-
Intercept	3.88*** (0.10)	3.37*** (0.06)	2.82*** (0.07)	2.68*** (0.04)
R^2	0.85	0.76	0.90	0.90
N	142	142	220	220

Notes: West Germany, all sectors. Robust standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level.

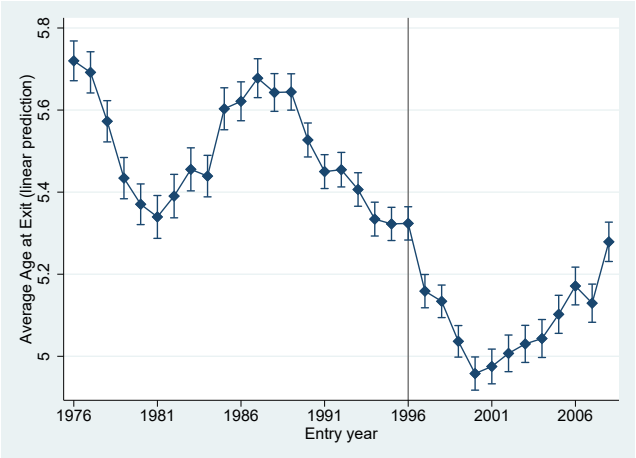


Figure A.7: Average age at exit, linear predictions from a more basic regression model, only including entry year dummies

Table A.5: Age at exit (1-10) as a function of the entry year, 1976-2008, OLS estimations

	(1)	(2)
Explanatory Variables	Basic Model	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*** (0.04)
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)
Size	-	0.49*** (0.00)
Further Controls	X	✓
Industry (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

Notes: West Germany, all sectors. Clustered standard errors in parentheses. */**/*** indicates statistical significance at the 10/5/1 percent level.

A.4 Establishment exits and the wage level

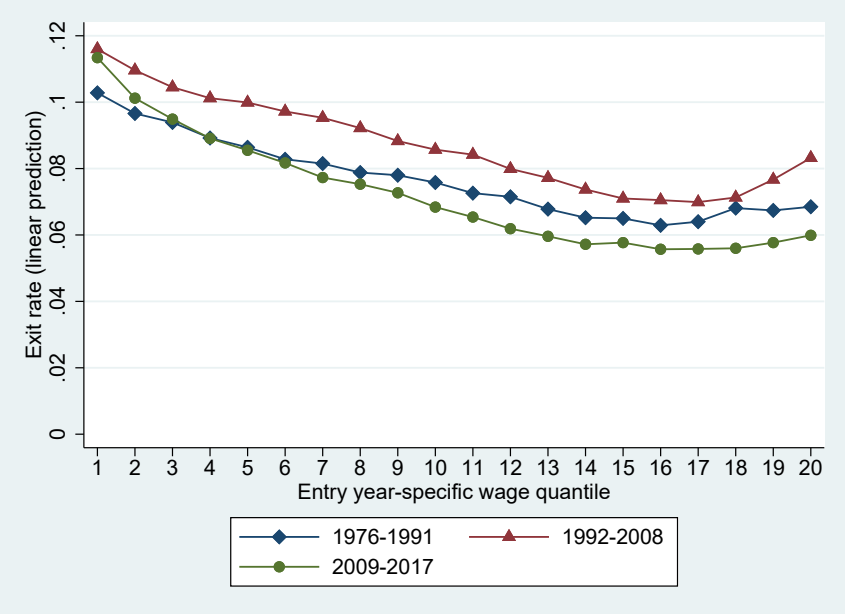


Figure A.8: Exit rates in dependence of the wage level for different birth cohorts: 1976-1991, 1992-2008, 2009-2017 *Note:* The underlying model includes every establishment that has been recognized as an entry and that can be assigned a specific entry year and age. Confidence intervals are omitted here as they are very small and therefore not of interest.

Table A.6: Establishment exits (1=yes) 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)	-0.03*** (0.00)
56-60 (Dummy)	-0.03*** (0.00)
61-65 (Dummy)	-0.03*** (0.00)
66-70 (Dummy)	-0.04*** (0.00)
71-75 (Dummy)	-0.04*** (0.00)
76-80 (Dummy)	-0.04*** (0.00)
81-85 (Dummy)	-0.04*** (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)	0.01*** (0.00)
Entry: 2009-2017 (Dummy)	0.01*** (0.00)
Interaction Wage Percentile x Entry Year Cluster	✓
Age Dummies	✓
Firm Size Dummies	✓
Controls	✓
Industry (1-digit)	✓
Entry Year	✓
Constant	0.01*** (0.00)
R^2	0.06
N	14,725,558

Notes: West Germany, all sectors. Clustered standard errors in parentheses.
*/**/*** indicates statistical significance at the 10/5/1 percent level.

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