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Abstract

In this paper, I study how the introduction of the nationwide minimum wage in Germany affects career outcomes of young workers who have just entered the labour market. The institutional setting, administrative micro data, and predicted minimum wage exposure allow estimating the causal effects of the policy by comparing cohorts initially affected by the minimum wage or not, while accounting for selection into educational track, endogenous timing of entry, changes in cohort composition, and macroeconomic conditions. Affected cohorts showed higher earnings, but no reduced employment. They worked somewhat more hours, were more likely to start careers at larger and higher-paying employers, less likely to perform occupations more exposed to the minimum wage, and less likely to carry out routine manual or menial tasks. According to these results, the minimum wage does not harm the education-to-work transition, but impacts the mix of both firms and occupations in the labour market.

Zusammenfassung

In dieser Arbeit untersuche ich, wie sich die Einführung des bundesweiten Mindestlohns in Deutschland auf die Arbeitsmarktergebnisse junger Berufseinsteiger auswirkt. Die institutionellen Rahmenbedingungen, administrative Mikrodaten und prognostizierte Mindestlohnbetroffenheit erlauben es, die kausalen Effekte der Maßnahme zu schätzen. Dazu werden Kohorten verglichen, die zu Beginn ihres Erwerbslebens vom Mindestlohn betroffen bzw. nicht betroffen waren, wobei Selektion in Ausbildung, Endogenität des Zeitpunkts des Berufseintritts, Veränderungen in der Kohortenzusammensetzung und makroökonomische Bedingungen kontrolliert werden. Die betroffenen Kohorten wiesen höhere Einkommen, aber keine geringere Beschäftigung auf. Sie arbeiteten etwas mehr Stunden, begannen ihre Karriere häufiger bei größeren und besser entlohnenden Arbeitgebern, übten seltener Berufe mit höherer Mindestlohnbetroffenheit aus und verrichteten seltener manuelle-routine Tätigkeiten oder Hilfsarbeiten. Den Ergebnissen zufolge behindert der Mindestlohn den Übergang von der Ausbildung in das Erwerbsleben nicht, beeinflusst aber die Zusammensetzung der Unternehmen und Berufe auf dem Arbeitsmarkt.

JEL classification

J23 - Labor Demand; J38 - Public Policy; J88 - Public Policy

Keywords

Minimum wage, young workers, labor market entry, vocational education, reallocation

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1 Introduction

The first years of a career show high job mobility and rapid wage growth, making them decisive for professional development. In their seminal paper, Topel/Ward (1992) show that two thirds of total career job changes take place during the first ten years in the labour market. Upward job mobility thereby accounts for at least a third of early-career wage growth. The early career, however, is also particularly prone to economic shocks. For example, von Wachter (2020) provides an overview of the recent literature studying the role of initial labour market conditions. According to this literature, adverse conditions can have long-lasting negative consequences for career development, particularly for ex-ante disadvantaged workers.

In this article, I exploit the introduction of Germany's nationwide minimum wage in 2015 as a natural experiment to analyse the effects of a large wage shock at the time of labour market entry on young workers' transition from education to work. Exploring these responses is important to gain a deeper understanding of both the effects of minimum wage policies and the process of career progression. Theoretically, the minimum wage could either have negative effects on initial career outcomes, e. g. by lowering the demand for inexperienced workers as predicted by neoclassical models, or may even have positive effects, for example by shielding entrants from starting careers in low-wage jobs at inefficient firms and instead reallocating them to more efficient firms that provide better career prospects (cf. Williamson 1968), as suggested by models with monopsonistic labour market competition, heterogenous firms, and workers valuing nonpecuniary job aspects (cf. Bhaskar et al. 2002, Manning 2003, Card et al. 2018, and Dustmann et al. 2022). Ultimately, an empirical analysis is needed to approach this question.

Against the backdrop of rising wage inequality (cf. Dustmann et al. 2009; Antonczyk et al. 2010; Card et al. 2013) and declining union coverage (cf. Kügler et al. 2018), Germany introduced a national minimum wage of 8.50 EUR/hour that came into force on January 1st 2015. The effects of the policy on the general workforce have been studied quite extensively; see literature reviews by Bruttel et al. (2018), Bruttel (2019), Caliendo et al. (2019), or Dütsch et al. (2025). There is literally no evidence on how it impacts young labour market entrants, however. This lack of evidence is striking because effects of the minimum wage may be concentrated on young workers, as already argued by Meyer/Wise (1983). I contribute to filling this gap by analysing the effects of the minimum wage introduction on initial career outcomes, including the likelihood to take up a first job, the level of entry wages, the working time as well as the quality of the first employer and occupation (conditional on education decisions already having been made).

The main data source used in this study are the Integrated Employment Biographies (IEB) of the Institute for Employment Research (IAB) located in Nuremberg, Germany. These administrative data originate from employers' reports to the social security system and allow following job-level employment periods at a daily basis. To be able to identify the event of labour market entry and to observe initial conditions, I follow von Wachter/Bender (2006) or, more recently, Mahajan et al. (2025) and restrict the data to individuals who entered by graduating from vocational education. This type of education usually takes three years and combines part-time schooling with practical training in a specific occupation at a so-called training firm. Training subjects range from occupations hardly exposed to the minimum wage, such as software development, to strongly

exposed occupations, such as gastronomy. Firms report episodes of vocational education, which is why they are recorded in detail in the IEB. According to own calculations based on data provided by the BIBB (Bundesinsitut für Berufsbildung / Federal Institute for Vocational Education and Training, 2013), about 50 percent to 60 percent of a birth cohort enter the labour market this way and, according to Harhoff/Kane (1997), this group is broadly comparable to high school graduates in the United States, which is another reason why they are an interesting case to study.

My estimation strategy is to compare outcomes in the first year after labour market entry between graduation cohorts for whom the minimum wage is binding in that first year (the treated cohorts, graduating 2014 or thereafter) or not (the control cohorts, graduating before 2014), while accounting for cohort composition and macro trends. I show that all outcomes evolved at a stable rate across control cohorts. I then test if outcomes of treated cohorts deviated significantly. Under the identifying assumption that outcomes of treated cohorts would have evolved at the same rate as outcomes of control cohorts had the minimum wage not been introduced, such deviations can be interpreted as caused by the minimum wage. Additionally, I use hourly entry wages and pre-entry characteristics of control cohorts to predict the individual risk of being exposed to the minimum wage (i. e. to initially start a job paying less than 8.50 EUR/hour). Differences between the effects by exposure risk underline the interpretation of the estimates as causal and help to shed light on the underlying mechanisms.

The data show significant increases in entry wages because of the minimum wage. Overall, the population mean of average daily earnings increased by about 2 percent to 3 percent, ceteris paribus, driven by graduates with an ex-ante high exposure risk. Given that about 10 percent of graduates can be expected to be actually treated, these numbers imply minimum-wage induced increases in earnings of actually affected workers of roughly 20 percent to 30 percent, on average.

Despite these quantitatively important earnings increases, the likelihood to start a job within one year since entry was not negatively affected by the minimum wage. If anything, the evidence suggests some positive yet weak effects on the employment probability of high-risk workers. Concerning effects at the intensive margin, estimates suggest that the minimum wage induced high-risk workers, but not low-risk workers to increasingly take up regular instead of marginal part-time jobs, implying an increase of working hours (from typically 8.3 to 23.9 hours per week in 2014; see vom Berge et al. 2023) and greater coverage by social security.

Another set of results concerns the quality of the first employer. While the minimum wage did not increase the likelihood to leave the training firm after graduation significantly, it led to the reallocation of training firm leavers to generally larger and higher-paying initial employers. This reallocation effect is not only statistically but also economically significant. It explains between 32 percent to 45 percent of the total minimum wage effect on entry wages.

Last but not least, I find that the minimum wage also led to the reallocation of workers to initial employers who utilized minimum-wage jobs less frequently already before the policy. At the same time, training firm leavers themselves increasingly started working in higher-paying, less exposed occupations and in jobs with a higher skill level. Taken together, these patterns suggest that the reallocation towards more efficient employers involved workers to increasingly perform more demanding tasks in higher-quality occupations, too.

My study contributes to at least three strings of the labour economics literature. First, it complements studies of Germany's national minimum wage introduction, including Ahlfeldt et al. (2018); Caliendo et al. (2018); Caliendo et al. (2019); Garloff (2019); Bossler/Gerner (2020); Bureaul et al (2020); Bossler/Schank (2023) and vom Berge/Umkehrer (2023), by analysing effects on the transition from education to work, which have hardly been studied so far. It particularly builds on Dustmann et al. (2022), who show for the general workforce that the introduction led low-wage workers to reallocate from smaller, lower paying to larger, higher paying firms. While Dustmann et al. (2022) focus on workers who are employed at baseline, here I focus on young adults who have not yet entered the labour market at baseline.

Second, it adds to international studies of minimum wage effects on young workers, including Meyer/Wise (1983), Wellington (1991), Katz and Krueger (1992), Neumark/Wascher (1992), Zavodny (2000), Neumark/Nizalova (2007), or Giuliano (2013) for the United States, Pereira (2003) for Portugal, Hyslop/Stillman (2007) for New Zealand, Böckerman/Uusitalo (2009) for Finland, Shannon (2011) for Canada, Dickens et al. (2014) for the United Kingdom, Galán/Puente (2015) for Spain, Kreiner et al. (2020) for Denmark, and van Bezooijen et al. (2024) for the Netherlands. This strand of literature, however, rarely goes beyond the analysis of wage and employment effects. Papers analysing further outcomes include Portugal/Cardoso (2006), Liu et al. (2016), or Kabátek (2021) studying turnover, Neumark/Wascher (2001) studying training, and Neumark/Shupe (2019), Dayioglu et al. (2022), Alessandrini/Milla (2024), or Schanzenbach et al. (2024) studying schooling decisions. To the best of my knowledge, no evidence on reallocation between employers and occupations at the time of labour market entry exists to date.

Third, it contributes to the literature investigating the role of labour market entry conditions, like adverse business cycle conditions (see the literature review by von Wachter 2020) or job loss (von Wachter/Bender 2006). A key finding of this literature is that unlucky cohorts suffer persistent career losses as they start working for smaller and lower paying employers, making it hard for them to catch up, especially for workers with low earning potential. Apparently, changing quality of initial employers is a quite general response to a larger variety of early career shocks. This is a crucial point because evidence suggests that starting the career at a larger, higher-paying firm has long-lasting beneficial effects on career development, as more attractive employers tend to provide more productive jobs, better job opportunities in the future, and enhanced skill-development through greater training (Arellano-Bover 2024). My study additionally suggests that such shocks can change the occupations and tasks performed by affected workers. The results by Kahn (2010) and Altonji et al. (2016), that young workers who graduated from college during a recession are more likely to start jobs in occupations with lower wages and less prestige, are perfectly in line with this conclusion.

This article proceeds as follows: In Section 2, I briefly describe the minimum wage policy, the vocational education system, the macroeconomic environment, and the composition as well as the minimum wage exposure of labour market entry cohorts. In Section 3, I outline the estimation strategy and present results, which I discuss in Section 4. I conclude in Section 5.

2 Background, Data, and Sample Description

2.1 Germany's National Minimum Wage Introduction

On January 1st, 2015, Germany introduced a minimum wage set at a gross hourly wage rate of 8.50 EUR (see, for instance, Dütsch et al. 2025 for a detailed description of the German statutory minimum wage legislation). The minimum was set uniformly across regions at the national level and only a few exemptions exist.[1] As a result, coverage of the policy was high and more than four million jobs were directly affected at the time of the introduction (see Section 2.5 for an analysis of minimum wage exposure in my estimation sample).

During the years surrounding the minimum wage introduction, the macroeconomic environment was quite favourable. Especially the labour market proved very robust, even with respect to the Global Financial Crisis. All findings concerning the effects of the minimum wage introduction have to be interpreted against this background.[2]

2.2 The Vocational Education System

Germany's system of vocational education and training combines transferring general skills with specific knowledge and practical training in a given occupation (cf. Hippach-Schneider et al. 2007). The education takes two to four years, depending on the occupation, and is regulated by the Vocational Training Act and Vocational Training Curricula. Training firms and school leavers meet on the training market and conclude contracts for conducting the education. About 50 to 60 percent of a birth cohort choose this career track, showing the high importance of the system for skill formation (BIBB 2013, own calculations).

2.3 Data and Sample Selection

The main data source used for this study is an excerpt of job-level employment biographies of workers with at least one day in vocational education from the IEB. In addition to socio-demographic characteristics, employers are obliged to report, at least once a year, the start and end dates of each employment relationship subject to social security contributions as well as marginal employment. During vocational education, workers receive a remuneration (not subject to the minimum wage during the period under study), which is why these periods are covered, too. Periods in other forms of employment, like self-employment, freelancing, or working abroad, are not included. Furthermore, unique establishment identifiers allow inferring employer

[1] Exempted from the national minimum wage are minors (below age 18) without completed vocational education, apprentices, trainees, interns, disabled workers, non-profit and voluntary workers, and the long-term unemployed. In some industries, covering less than 5% of the total workforce overall, like the meat processing industry, hairdressing, agriculture, temporary-work agencies, textile and clothing, and industrial laundry, somewhat lower sectoral minimum wages remained in place for a transition period ending 2017 the latest.

[2] Bossler et al. (2024) find positive wage effects with no significant employment effects for the increase of the minimum to 12 EUR/hour in 2022, too, when the macroeconomic environment was far less favourable. Their finding suggests some external validity of my results with respect to both the level of the minimum wage and business cycle conditions.

characteristics from the underlying person data and merging this information back to the job level.[3]

I start data preparation by identifying each individual's first period of vocational education in the IEB and define the end of this period to mark labour market entry. I focus on cases with successful graduation after at least two years, which assures, for the cohorts under study, that all decisions regarding the education have been made prior to the minimum wage introduction and are therefore exogenous with respect to the policy (cf. Section 3.1). To minimize misclassification, I further drop individuals if the education period is reported to last longer than five years or if they are younger than 18 or older than 26 when graduating. In the final estimation sample, the average graduation age is around 21 years.

Next, I draw on Stüber et al. (2023) for preparing the IEB data to form a yearly panel (states are either regular full- or part-time employment covered by social security, marginal employment, or non-employment) referenced to June 30. Besides some basic data cleansing and variable generation steps, this frequently used procedure involves cleaning, deflating, and imputing the earnings variable (similar to Gartner 2005, Dustmann et al. 2009, and Card et al. 2013) as well as merging information on employers, again referenced to June 30, from the Establishment History Panel (BHP 7521 v1; see Ganzer et al. 2022). The education variable is imputed using the procedure of Fitzenberger et al. (2006). Unfortunately, there is a severe structural break in the data between 2010 and 2011 that introduces time-inconsistencies. I therefore follow Dustmann et al. (2022) and restrict the analysis to workers entering the labour market after 2010.

2.4 Sample Composition

Prior to the minimum wage introduction, males and Germans were overrepresented among graduates from vocational education (Table 1, column (1)). The fraction of graduates in West Germany was also comparatively large and 19 percent of workers held a General University Entrance Qualification (Abitur) at the time of graduation.

Concerning training occupations, with a fraction of 39 percent the majority of workers graduated in production professions (like manufacturing or occupations in building and interior construction), followed by business-related services (31%) and person-related services (23%). The fractions of graduates in other economic service occupations (including safety and security, traffic and logistics, or cleaning services) and IT and scientific professions were comparatively small, with 4 percent and 3 percent, respectively.

Turning to changes between graduation cohorts initially affected by the minimum wage or not, cohort size declined, by about 5 percent between the 2011-2013 and the 2014-2016 graduation periods (Table 1, columns (2) vs (1)). The composition in terms of gender, nationality, and occupation remained largely stable. One striking difference, however, is that the fraction of graduates who have acquired an Abitur before the start of vocational education increased, by almost 8 percentage points (pp), from 19 percent to 27 percent. With the distribution of graduates

[3] Further information on employers, like size, workforce composition, wage level, and location, comes from the Establishment History Panel (BHP 7521 v1; see Ganzer et al. 2022). Employer information is actually included at the establishment level, not at the level of the firm/company. In the text, I use these terms interchangeably. However, German firms rarely have more than one establishment. According to Diegmann et al. (2024), for instance, 370,753 firms and 408,433 establishments existed in 2010 in the MUP-BHP (Mannheim Enterprise Panel linked to the Establishment History Panel of the IAB 2010-2020).

across occupations remaining stable, this development appears to reflect rather a more general shift towards higher school education in the system than changes in the sorting into occupational tracks. However, these changes still have to be taken into account when comparing graduates across cohorts.

Table 1: Sample composition and minimum-wage exposure

Fractions

	(1) Comparison of cohort composition	(2) Comparison of cohort composition	(3) Minimum wage exposure in 2014
Year of graduation:	**2011-2013**	**2014-2016**	**2013 | employment in 2014**
	Share	**Share**	**Fraction affected**
Female	0.436	0.429	0.121
Male	0.564	0.571	0.089
German	0.958	0.953	0.102
Foreign	0.042	0.047	0.125
East	0.123	0.097	0.209
West	0.877	0.903	0.090
By school education at graduation			
No Abitur	0.810	0.732	0.111
Abitur, but no univ. degree	0.189	0.268	0.072*
University degree	0.001	0.000	
By occupation trained			
Production professions	0.386	0.373	0.083
Person-related services	0.231	0.222	0.148
Business-related services	0.314	0.327	0.103
IT and scientific professions	0.030	0.037	0.039
Other economic services	0.038	0.043	0.075
N	800,589	761,315	191,288

Note: In columns (1) and (2) of the table, I show the fraction of graduates from vocational education with a certain characteristic by year of graduation. 'Abitur' means a General University Entrance Qualification. All characteristics are measured right before graduation. The minimum wage was introduced in 2015 and therefore workers graduating 2014 or later (column (2)) are subject to the minimum wage in their first year of potential labour market experience while workers graduating before 2014 are not. In column (3), I focus on workers who graduated in 2013 and were employed in 2014. I show the fraction of these workers with a given characteristic who earned an hourly wage below the forthcoming minimum wage level ('Fraction affected').

* Combined category "Abitur only or university degree". Source: Integrated Employment Biographies (IEB) – Version V17.00.00-202212, own calculations. © IAB

2.5 Minimum Wage Exposure

By default, the IEB include the working-time status of a job (full-time vs part-time vs marginal employment). In addition, for the years 2011 to 2014, it is possible to merge uncategorized working hours at the job level; cf. vom Berge et al. (2023). For workers in the estimation sample who were employed in 2014 after having entered the labour market in 2013, this information allows calculating the fraction of jobs paying less than 8.50 EUR/hour and therefore being directly exposed to the minimum wage.

According to results shown in column (3) of Table 1, women were more exposed to the minimum wage than men, non-Germans were more exposed than Germans, exposure was higher in East than in West Germany, and workers with higher school education were less exposed. With a fraction affected of roughly 4 percent, workers trained in IT and scientific professions were hardly exposed, followed by graduates in other economic services (7.5%), production professions (8.3%), and

business-related services (10%). Graduates in person related services were strongly exposed, with a fraction of almost 15 percent of jobs being directly affected by the minimum wage.

Overall, about 10 percent of young graduates earned an entry wage below 8.50 EUR/hour in 2014. The respective fraction of jobs affected by the minimum wage in the general German workforce was 15 percent (see Table 2, columns (1) vs (3); the SIAB's (Sample of Integrated Labour Market Biographies 1975-2021; cf. Schmucker et al. 2023) random sample is used to estimate statistics representative for the general workforce). At first glance, the graduates from vocational education therefore appear to be less exposed to the minimum wage than the average worker. However, graduates show a much higher probability to start working full time (87% vs 60%; see Table 2, columns (2) vs (4)) and full-time jobs are generally less exposed to the minimum wage. Within each of the three working time status categories, the fraction affected is actually significantly higher among the young graduates.

Table 2: Minimum wage exposure by working time status

Fractions

	(1)	(2)	(3)	(4)
	Estimation sample		Random sample	
	Fraction affected	Share	Fraction affected	Share
Full-time	0.071	0.870	0.053	0.601
Part-time	0.158	0.087	0.150	0.215
Marginal	0.628	0.043	0.465	0.184
All	0.103		0.150	
N_all	191,288		638,346	

Note: In columns (1) and (3), I show the fraction of workers employed in 2014 and earning an hourly wage of less than 8.50 EUR, which is the level at which the minimum wage was introduced in 2015. In columns (2) and (4), I show the relative size of the respective groups in the samples. In columns (1) and (2), I restrict the sample to graduates from vocational education in 2013. In columns (3) and (4), I calculate results for the general German workforce using the SIAB's random sample.

Source: Integrated Employment Biographies (IEB) – Version V17.00.00-202212, own calculations. Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2021, own calculations. © IAB

3 Effects of the minimum wage on initial labour market outcomes

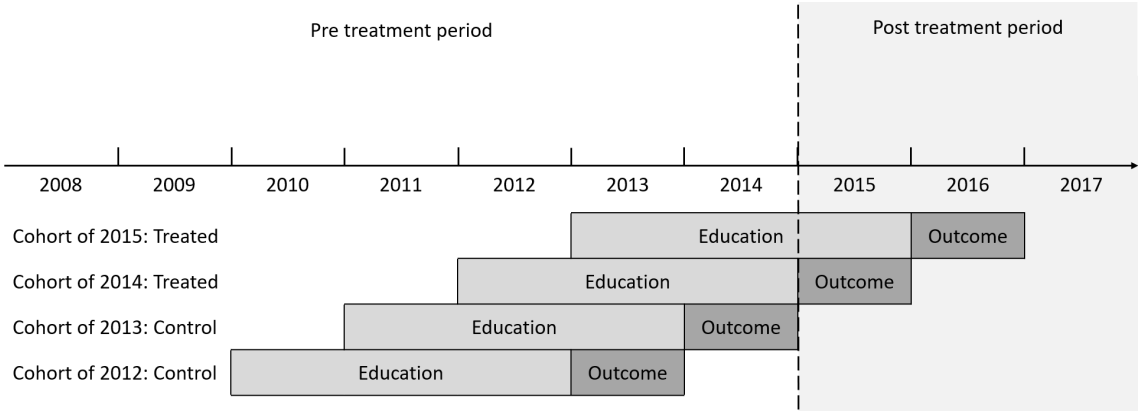
3.1 Method

Studies of labour market entry conditions face challenges related to endogeneity of timing of entry, cohort composition, selection of workers into educational tracks, firms, or regions, and macroeconomic conditions. Therefore, often strong identifying assumptions have to be imposed. In the current case, however, it is possible to observe detailed pre-entry conditions, like the occupation trained, the firm providing the training, and the date of graduation. The requirement of at least two years of vocational education (see Section 2.3) additionally assures that both timing and contents of the education are not confounded by the minimum wage introduction for cohorts before 2017, as decisions in this regard have been made before the policy. My estimation strategy hence is to compare outcomes one year after graduation between cohorts graduating 2011-2013 (control cohorts) and cohorts graduating 2014-2016 (treated cohorts), while controlling for

detailed socio-demographic and education-related characteristics; see Figure 1 for an illustration of the research design in the case of a three-year period of vocational education.

To account for continuous changes across cohorts, for instance due to the constantly improving macroeconomic environment, I additionally apply a trend-adjustment procedure similar to Dustmann et al. (2022).[4]

Figure 1: Illustration of the research design



Note: Fictitious example for individuals entering the labour market by graduating after three years of vocational education. Initial outcomes of cohorts graduating after 2013 are subject to the minimum wage, which was introduced on January 1st, 2015 (dashed vertical line); own illustration.

As benchmark, I run regressions of the form

$$y_{i,t+1} = \bar{y} + \sum_{c=2011\neq2013}^{2016}(\delta_c D_c) + \boldsymbol{\beta}\, \boldsymbol{x}_{i,t-2} + \boldsymbol{\pi}\, \boldsymbol{z}_{i,t-2} + u_{i,t+1}, \quad (1)$$

with outcome y of individual i measured in the first year of potential labor market experience ($t+1$). $D_c = I[c = t]$ denote dummy variables for the year of labor market entry (t=2011,…,2016), with the cohort of 2013 serving as reference, and $\boldsymbol{x}$ and $\boldsymbol{z}$ denote vectors of dummy variables for individual socio-demographic characteristics (gender, nationality (46 categories), age at graduation (9 categories), and school education at graduation (3 categories)) or for characteristics of the vocational education (occupation trained (140 categories), size of the training firm (6 categories), mean wage of the training firm (4 categories), and district of the training firm (401 categories)), respectively, all measured in $t-2$ and thus pre policy. u denotes an idiosyncratic error-term and δ, $\boldsymbol{\beta}$, and $\boldsymbol{\pi}$ the parameters. To allow error-terms to be arbitrarily correlated within regions across cohorts, standard errors are clustered at the level of training firms' districts.

Of primary interest are estimates of δ, which measure the difference in outcomes between cohorts of observationally equivalent graduates, trained by similar firms in similar occupations, relative to the respective cohort of 2013. After trend-adjustment, estimates for the control cohorts ($\delta_{t\leq2013}$) should be close to zero. If this placebo test holds, it would suggest outcomes of control cohorts to provide a valid counterfactual for treated cohorts. Estimates of $\delta_{t\geq2014}$ then capture the effect of the minimum wage under the identifying assumption that outcomes of treated cohorts would have evolved at the same rate as outcomes of control cohorts if the minimum wage would not have been introduced.

[4] This procedure involves estimating a linear trend using only pre-policy years, extrapolating this trend to post-policy years, and finally subtracting the estimates from the trend line. As can be seen from Figure 1 of Dustmann et al. (2022), both the nominal GDP growth, unemployment rate, and total employment have increased linearly between 2011 and 2016.

The “individual analysis” of Dustmann et al. (2022) focuses on workers who are employed at baseline, which allows additionally assigning workers to treatment and control groups by their actual exposure to the minimum wage and thus to control for macroeconomic shocks common to all workers. In the current setting, in contrast, this strategy is not feasible because the population under study has not yet entered the labour market at baseline. Although Dustmann et al. (2022) show that macroeconomic shocks have negligible impact on estimates of the effects of the minimum wage introduction, it is desirable to test how effects vary with predicted exposure. For this purpose, I run a probit regression of hourly wages on the first job actually being below the forthcoming minimum of 8.50 EUR/hour for cohorts entering before the policy:

$$P\left(hwage_{i,t+1} < MW \mid S_{i,t}\right)|_{c=2012,2013} \tag{2}$$

Predictors S are measured just before graduation in year t and comprise gender, German nationality, age, school degree at graduation, district and size of the training firm, and training occupation. I then use the model’s parameter estimates and pre-entry characteristics to predict the individual risk of being exposed to the minimum wage in the full estimation sample. Ultimately, I augment regression equation (1) with full interactions between the cohort dummies and the predicted exposure variable (denoted $PEXP$) to a difference-in-differences style specification:

$$y_{i,t+1} = \tilde{y} + \sum_{c=2011\neq2013}^{2016}\left(\tilde{\delta}_c D_c\right) + PEXP_i + \sum_{c=2011\neq2013}^{2016}(\theta_c D_c * PEXP_i) + \widetilde{\boldsymbol{\beta}}\,\boldsymbol{x}_{i,t-2} + \\ + \widetilde{\boldsymbol{\pi}}\,\boldsymbol{z}_{i,t-2} + \tilde{u}_{i,t+1} \tag{3}$$

In addition to comparing outcomes across cohorts, the parameters on the interaction terms θ also involve comparing outcomes between graduates with a high vs a low risk of being affected by the minimum wage within the same cohort. This additional difference eliminates any potential shocks common to a cohort.

However, estimates of θ capture minimum-wage effects only to the extent that they are linear in exposure risk. To allow for more flexibility, I alternatively define the 20 percent of graduates with the lowest predicted exposure (<3.6%) as the “low-risk” group, the 20 percent with the highest predicted exposure (>16.6%) as the “high-risk” group, and the remaining 60 percent as the “medium-risk” group and estimate regression equation (1) separately for these three groups in cases where results based on linearity would be misleading.

3.2 Effects on Earnings and Employment

In the left column of Figure 2, I plot OLS estimates of δ from regression equation (1) for average daily earnings (in Euro, deflated, imputed, in logs; first row) and the likelihood to start a job in the first year after labor market entry (second row) against the year of entry. In the second column, I plot estimates of the interaction terms θ from regression equation (3). The respective point estimates for the post-policy period are shown in Table 3, columns (1) to (4).

Across control cohorts, differences in entry wages are estimated close to zero and statistically insignificant, providing evidence that entry wages have evolved at a stable rate pre policy (panel (A) of Figure 2). Relative to control cohorts, the average entry wage of treated cohorts increased discontinuously, significantly and right after the minimum wage introduction, by 1.8 percent for the cohort of 2014, ceteris paribus. This difference increased further, to 2.7 percent for the cohort of 2015 and 3.2 percent for the cohort of 2016, consistent with some delay in the implementation of the policy for new entrants; see Dütsch et al. (2025). Recall that about 10 percent of graduates

within a cohort were directly affected by the minimum wage (Table 2, column (1)). An increase of the mean across all graduates by 3 percent due to the minimum wage therefore implies earnings increases for actually affected graduates by up to 30 percent, on average.

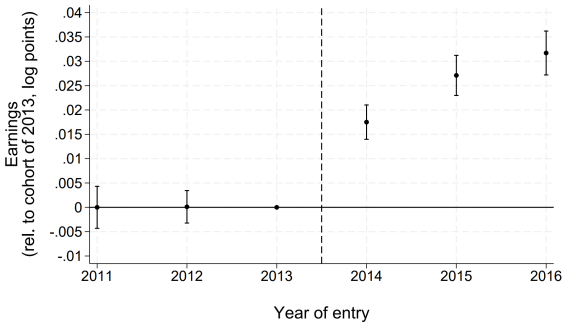
Turning to the interaction with predicted minimum-wage exposure, before the policy graduates with a risk of being affected by the minimum close to zero earned a 45 percent higher entry wage than graduates with a risk close to one, ceteris paribus (see the base effect shown in Table 3, column (2)). This gap remained stable across control cohorts, but narrowed by 11pp to 14pp (24% to 31%) for cohorts affected by the minimum wage (panel (B) of Figure 2). Note that these estimates are not subject to any cohort-specific macro shocks and are driven by minimum-wage workers. They therefore lend further support for interpreting the sudden increase in entry wages right after the policy intervention as a causal effect of the minimum wage.

Given these significant effects on entry wages, one might expect the minimum wage to adversely affect the inflow of young workers into the labour market, particularly for highly exposed individuals. However, estimates of regression equation (1) with a dummy for being employed within one year after entry as outcome do not detect any negative effects (panel (C) of Figure 2). There are also no significant changes in the employment gap by predicted minimum-wage exposure across cohorts (panel (D) of Figure 2). If anything, there are some increases in the employment rate for treated vs control cohorts. This estimated effect amounts to less than 1pp. Given a baseline employment probability of more than 84 percent, although statistically significant the employment effect appears not to be economically significant.

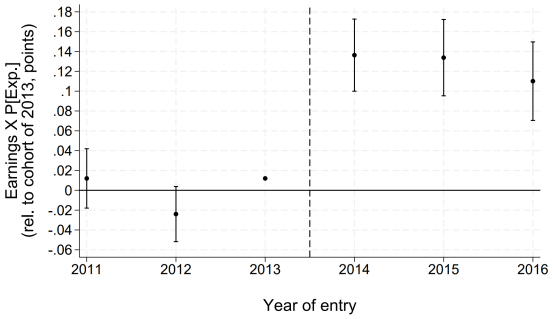
Figure 2: Effects of the minimum wage on earnings and employment in the first experience year

Differences relative to cohort of 2013 in points

Outcome: Initial average daily earnings

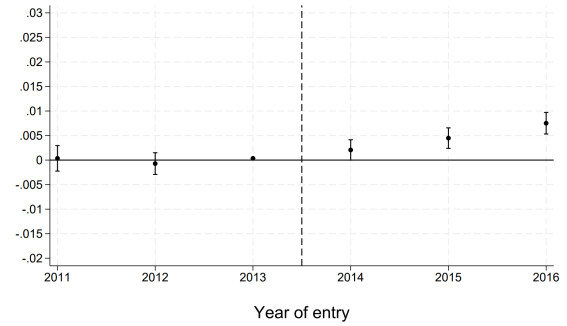


(A) Cohort dummies $[\hat{\delta}_c]$

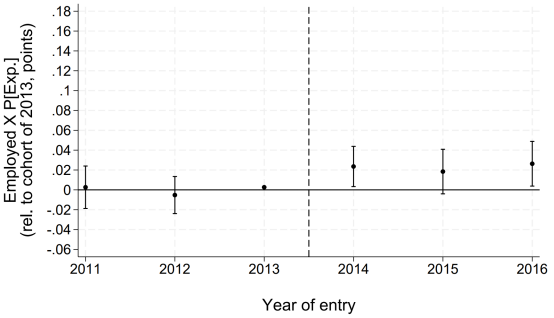


(B) Cohort dummies × exposure risk $[\hat{\theta}_c]$

Outcome: Initial employment probability



(C) Cohort dummies $[\hat{\delta}_c]$



(D) Cohort dummies × exposure risk $[\hat{\theta}_c]$

Notes: In the first column of the figure, I plot OLS estimates of coefficients δ from regression equation (1), measuring the difference in the means of a given outcome in $t+1$ between cohorts entering the labor market in t, relative to the respective cohort of 2013. In the second column, I plot estimates of coefficients θ from equation (3), measuring the difference in the outcome between graduates with a high vs a low risk of being affected by the minimum wage in a given cohort relative to this difference in the 2013 cohort. Outcomes of cohorts entering 2014 or later, as indicated by the dashed line, are subject to the minimum wage introduced in 2015. Outcomes are the log of average daily earnings (in Euro, deflated, imputed) in the first row and the likelihood of being employed in the second row. Control variables are measured two years before graduation and comprise socio-demographic characteristics (gender, nationality, age, school education) and characteristics of the vocational education (occupation, training firm size and wage level, district) and estimates are trend-adjusted (see Section 3.1 for details). 95% confidence intervals are based on standard errors clustered at the district of the training firm. See Table 3 for coefficient estimates.

Source: Integrated Employment Biographies (IEB) – Version V17.00.00-202212, own calculations. © IAB

Table 3: Effects of the minimum wage on earnings, employment, and working time status in the first experience year

Differences relative to cohort of 2013 in points

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Earnings		Employment		Marginal job		Part-time job	
	Cohort dummies interacted with minimum-wage exposure risk							
	no	yes	no	yes	no	yes	no	yes
2016	0.0317	0.1101	0.0075	0.0263	-0.0079	-0.0509	0.0047	0.0259
	(0.0023)	(0.0202)	(0.0011)	(0.0115)	(0.0007)	(0.0075)	(0.0009)	(0.0119)
2015	0.0271	0.1338	0.0045	0.0184	-0.007	-0.0501	0.0050	0.0432
	(0.0021)	(0.0196)	(0.0011)	(0.0115)	(0.0007)	(0.0082)	(0.0010)	(0.0125)
2014	0.0175	0.1363	0.0021	0.0236	-0.0033	-0.0353	0.0051	0.029
	(0.0018)	(0.0186)	(0.0011)	(0.0103)	(0.0007)	(0.0082)	(0.0009)	(0.0108)
Base mean	71.84	-0.4498	0.836	-0.1602	0.045	0.0325	0.086	0.0793
Observations	1,311,004	1,311,004	1,561,904	1,561,904	1,311,004	1,311,004	1,311,004	1,311,004
Controls								
Demogr.	Y	Y	Y	Y	Y	Y	Y	Y
Training	Y	Y	Y	Y	Y	Y	Y	Y
Trend	Y	Y	Y	Y	Y	Y	Y	Y
Pre cohorts	Y	Y	Y	Y	Y	Y	Y	Y

Notes: In the table, I plot OLS estimates of coefficients δ and θ from regression equation (1) and (3), respectively. The former measure the difference in the means of a given outcome in $t+1$ between cohorts entering the labor market in t, relative to the respective cohort of 2013. The latter measure the difference in the outcome between graduates with a high vs a low risk of being affected by the minimum wage in a given cohort relative to this difference in the 2013 cohort. The "Base mean" in the case of columns (1), (3), (5), (7) is the unconditional mean in levels of the outcome of the cohort of 2013. In the case of the other columns, it is the estimate of the base effect of the exposure risk variable (measuring the conditional difference in the outcome between graduates with a risk of zero vs a risk of one in the 2013 cohort). Outcomes of cohorts entering 2014 or later are subject to the minimum wage introduced in 2015. Cohorts of 2011, 2012, and 2013 (reference) are included, but estimates not displayed.

Outcomes are the log of average daily earnings (in Euro, deflated, imputed) in columns (1), (2); the likelihood of being employed in columns (3), (4); the likelihood of being employed in a marginal job, given employment, in columns (5), (6); and the likelihood of being employed in a regular part-time job, given employment, in columns (7), (8).

Control variables are measured two years before graduation and comprise socio-demographic characteristics (gender, nationality, age, school education) and characteristics of the vocational education (occupation, training firm size and wage level, district) and estimates are trend-adjusted (see Section 3.1 for details). Standard errors clustered at the district of the training firm are in parentheses.

Source: Integrated Employment Biographies (IEB) – Version V17.00.00-202212, own calculations. © IAB

3.3 Effects on Working Time

Although the evidence suggests no economically significant effect of the minimum wage introduction on finding employment, there might still be effects on working time. Unfortunately, the IEB do not provide information on the number of hours worked post policy, but they allow observing whether a job is full-time, part-time, or marginal employment.

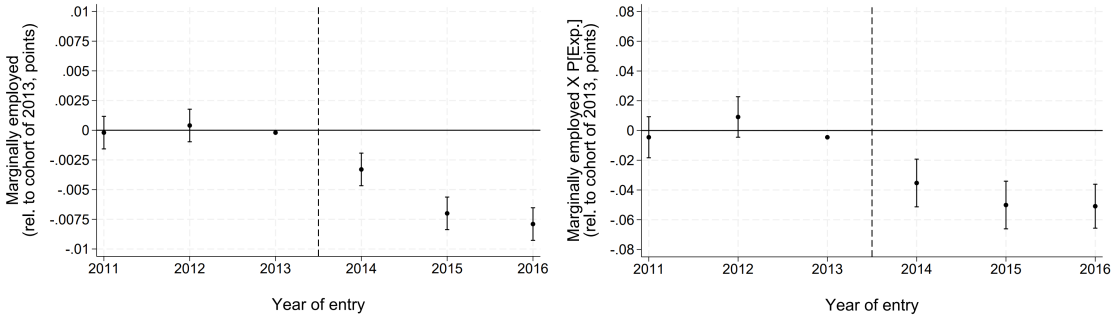
As documented in Table 2, the group of graduates from vocational education studied here is much more likely to work full-time than the average worker. With a fraction of merely 4 percent, starting in marginal employment is particularly rare. According to estimates presented in Figure 3 (first row) and Table 3 (columns (5) and (6)), the minimum wage introduction decreased the fraction of marginal jobs even further, by about (minus) 0.8pp for the cohort of 2016, on average; i.e. a decline by about 20 percent.

This decline of marginal jobs coincided with an increase of the fraction of regular part-time jobs (Figure 3, second row, and Table 3, columns (7) and (8)). With the employment probability remaining unchanged, these patterns suggest that workers who are more likely to be affected by

the minimum wage were induced to increasingly work in jobs with more working hours and social security coverage.

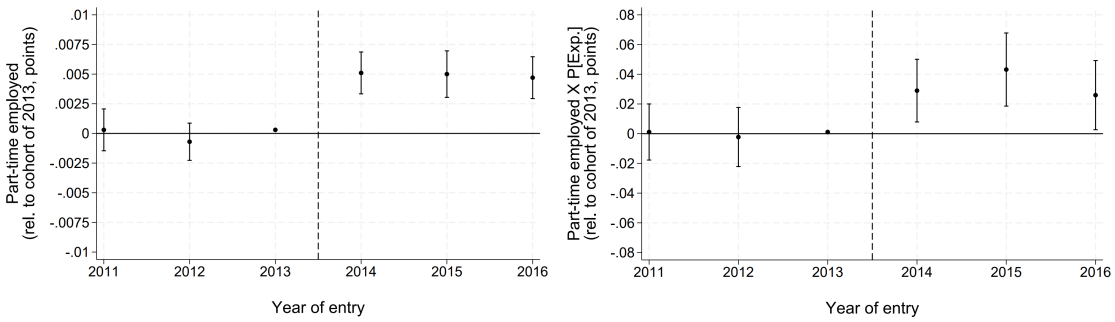
Figure 3: Effects of the minimum wage on working time status in the first experience year

Differences relative to cohort of 2013 in points
Outcome: Initial Marginal Employment Probability



(A) Cohort dummies [$\hat{\delta}_c$] (B) Cohort dummies × exposure risk [$\hat{\theta}_c$]

Outcome: Initial Part-Time Employment Probability



(C) Cohort dummies [$\hat{\delta}_c$] (D) Cohort dummies × exposure risk [$\hat{\theta}_c$]

Notes: In the first column of the figure, I plot estimates of changes in outcomes in $t + 1$ between cohorts entering in t, relative to the cohort of 2013. In the second column, I plot estimates of changes in the difference in the outcome between graduates with a high vs a low risk of being affected by the minimum wage. Outcomes of cohorts entering 2014 or later are subject to the minimum wage. Outcomes are the fractions of marginal part-time employees in the first row and of regular part-time employees in the second row, given employment. Control variables are measured two years before graduation (see Section 3.1 for details). 95% confidence intervals are based on standard errors clustered at the district of the training firm. See Table 3 for coefficient estimates.

Source: Integrated Employment Biographies (IEB) – Version V17.00.00-202212, own calculations. © IAB

3.4 Effects on employer and job quality

Wolter/Ryan (2011) document that some firms follow a production-oriented training strategy, aimed at utilizing the trainees' cheap labour. Particularly for these firms, the minimum wage hike may reduce the incentive to retain former trainees and to hire new ones instead. The data show that 52 percent of graduates started working for their training firms pre policy. There is no evidence, however, that the minimum wage reduced this fraction (Table 4, columns (1), and panel A of Table 7 of the Appendix). This pattern is consistent with the result of Dustmann et al. (2022), that the minimum wage did not increase the probability to switch employer per se, but changed the pool of firms hiring low-wage labour towards more efficient firms; by driving some small

businesses out of the market, for instance. As a result, workers affected by the minimum wage increasingly reallocated to more efficient firms.

I test if this reallocation effect is also present for initial labour market outcomes, by running regression equation (1) with outcomes of the form

$$y_{i,t+1}^{reall} = q_{f(i,t+1)}^{l=\mathrm{t}-2} - q_{f(i,\mathrm{t})}^{l=\mathrm{t}-2}. \quad (4)$$

These reallocation outcomes measure how a certain "quality" characteristic q differs between the employer or occupation in the first experience year $(t+1)$ and the training firm or occupation trained, respectively. In both cases, characteristics are evaluated two years before entry $(t-2)$, to rule out any direct effect of the minimum wage on these characteristics. By construction, a reallocation outcome takes on values of zero for stayers. Consequently, changes in these outcomes are driven by changes in individuals' mobility.[5] Ultimately, I estimate the difference between the reallocation outcomes for a given cohort relative to the cohort of 2013, for both the full estimation sample and separately by individuals' predicted minimum-wage exposure (see Section 3.1).

a) Starting careers at higher-paying and larger employers

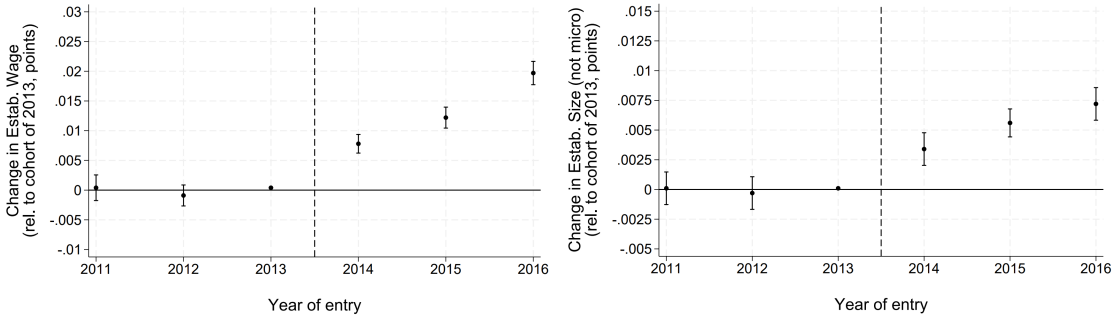
I start the analysis of reallocation effects by considering the wage level and the size of an establishment as quality characteristic q in equation (4). Estimates of the δ-coefficients from regression equation (1) with the respective reallocation measures as outcomes are shown in Figure 4 and Table 4, columns (2) and (3). The average of imputed daily earnings of all workers at the establishment (in logs) serves as measure of the wage level. As Dustmann et al. (2022) document effects of the minimum wage on the market exit of micro businesses, in the figure I focus on reallocation between generally smaller employers. For this purpose, I measure the size as the likelihood that the establishment is not a micro business; i.e. had at least five employees at baseline. Respective results for the size measured as the (logged) number of workers, both capped at the small business threshold of nine employees and without further modification, are robust; see columns (4) and (5) of Table 4.

Prior to the minimum wage introduction, new employers of training firm leavers tent to be both generally lower-paying and smaller (see the baselines means of the respective outcomes shown in Table 4 being negative). These gaps evolved constant across control cohorts, as shown by the δ-coefficients being estimated close to zero (Figure 4). For treated cohorts, in contrast, both gaps narrowed, as the quality of new employers increased suddenly and significantly right after the policy. For the cohort of 2016, for instance, relative to baseline the gap in the establishment wage level closed by almost 62 percent (=0.0197/0.032), on average, and the probability that the new employer is not a micro business increased, by on average 34 percent (=0.0072/0.021).

[5] As an example, for a worker who graduated in 2016, I take the difference between the wage level of the firm that employed the worker in her/his first experience year 2017 and the wage level of the firm that provided the vocational education, measuring both variables in 2014, so that any direct effect of the minimum wage on the wage level is ruled out.

Figure 4: Effects of the minimum wage on reallocation in the first experience year – establishment wage level and size

Differences relative to cohort of 2013 in points



(A) Establishment wage level (B) Establishment size

Notes: In the figure, I plot estimates of changes in outcomes in $t+1$ between cohorts entering in t, relative to the cohort of 2013. Outcomes of cohorts entering 2014 or later are subject to the minimum wage. In panel (A), the outcome is the difference between the wage levels (measured in $t-2$) of the establishment in $t+1$ and of the establishment in t (see equation (4)). In panel (B), the outcome is the differences in establishment size (measured as likelihood of the establishment not being a micro business; i. e. having at least five employees in $t-2$. Control variables are measured two years before graduation (see Section 3.1 for details). 95% confidence intervals are based on standard errors clustered at the district of the training firm. See Table 4 for coefficient estimates.

Source: Integrated Employment Biographies (IEB) – Version V17.00.00-202212, own calculations. © IAB

Table 4: Effects of the minimum wage on employer reallocation in the first experience year

Differences relative to cohort of 2013 in points

	(1)	(2)	(3)	(4)	(5)	(6)
	Stay at training firm	Change in establishment wage-level	Change in establishment size – not a micro business	Change in establishment size – small business cap	Change in establishment size	Change in establishment occupation-MW-exposure
2016	0.0138	0.0197	0.0072	0.0084	0.0429	-0.0236
	(0.0023)	(0.0010)	(0.0007)	(0.0009)	(0.0057)	(0.0021)
2015	0.0102	0.0122	0.0056	0.0067	0.0315	-0.0210
	(0.0022)	(0.0009)	(0.0006)	(0.0008)	(0.0046)	(0.0016)
2014	0.0044	0.0078	0.0034	0.0038	0.0164	-0.0214
	(0.0019)	(0.0008)	(0.0007)	(0.0008)	(0.0049)	(0.0015)
Base mean	0.518	-0.032	-0.021	-0.033	-0.146	0.038
Observations	1,311,004	1,215,628	1,233,243	1,233,243	1,233,243	1,034,709
Controls						
Demogr.	Y	Y	Y	Y	Y	Y
Training	Y	Y	Y	Y	Y	Y
Trend	Y	Y	Y	Y	Y	Y
Pre cohorts	Y	Y	Y	Y	Y	Y

Notes: In the table, I show estimates of changes in outcomes in $t+1$ between cohorts entering in t, relative to the cohort of 2013. Outcomes of cohorts entering 2014 or later are subject to the minimum wage. In column (1), the outcome is the fraction of graduates starting their first job at the firm that provided their vocational education. In column (2), the outcome is the difference between the wage levels (in logs and measured in $t-2$) of the establishment in $t+1$ and of the establishment in t (see equation (4)). In column (3), the outcome is the difference in establishment size (measured as likelihood of the establishment not being a micro business; i. e. having at least five employees in $t-2$. The outcomes in columns (4) and (5) use the log of the number of employees as measure of establishment size, either capped at nine employees or without further modification. In column (6), the outcome is the difference in the minimum-wage exposure of the occupations utilized by an establishment (in logs and measured in $t-2$) of the establishment in $t+1$ and of the establishment in t. Control variables are measured two years before graduation (see Section 3.1 for details). Cohorts of 2011, 2012, and 2013 (reference) are included, but estimates not displayed (see figures

and text). The 'Base mean' is the unconditional mean of the outcome of the cohort of 2013. Standard errors clustered at the district of the training firm are in parentheses.

Source: Integrated Employment Biographies (IEB) – Version V17.00.00-202212, own calculations. © IAB

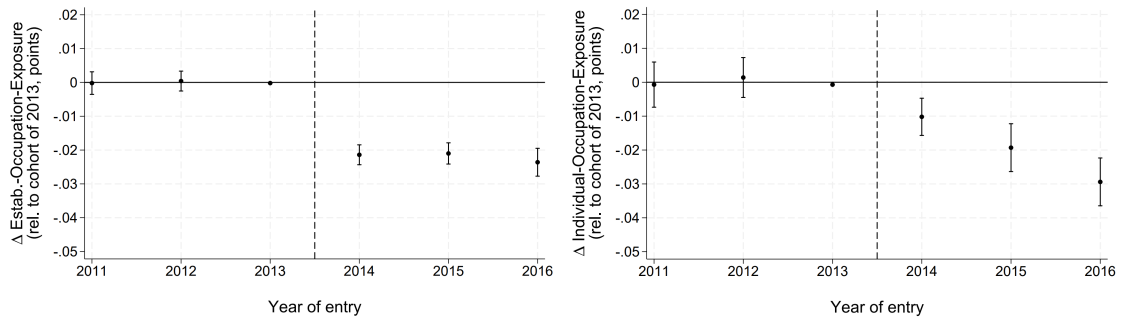
b) Starting careers in higher-paying occupations

Next, I investigate if reallocated workers still pursue similar jobs than in a counterfactual scenario without the minimum wage. If higher-paying employers tend to utilize higher-paying occupations, the reallocation effect of the minimum wage may involve reallocated workers to increasingly perform higher-paying, less-exposed occupations than without the policy. Alternatively, lower-paying occupations might have become more attractive to graduates because of the larger minimum-wage hike, potentially leading to more workers switching to more exposed occupations.

To approach this question, I start by measuring the minimum-wage exposure of an occupation by the fraction of entry wages of control cohorts being below the forthcoming minimum-wage level. Merged back to the estimation sample, I calculate two reallocation outcomes from this occupation-exposure measure (see equation (4)): The first outcome varies at the establishment level and uses the average of the occupation-exposure measure, weighted by the frequency of each occupation at the establishment, as quality characteristic, in logs (establishment-occupation-exposure). The second outcome varies at the person level and is constructed as the log-difference between the exposure of the occupation trained and the exposure of the occupation pursued at the first employer, conditional on leaving the training firm (individual-occupation-exposure). As with the establishment-level reallocation outcomes, if both occupations are identical, the observation enters the measure with a value of zero. I then estimate regression equation (1) to test changes in these reallocation outcomes across cohorts.

Figure 5: Effects of the minimum wage on reallocation in the first experience year – minimum-wage exposure of the occupations utilized by employers and the occupation pursued by the individual

Differences relative to cohort of 2013 in points



(A) Exposure of occupations at establishment (B) Exposure of individual occupation

Notes: In the figure, I plot estimates of changes in outcomes in $t+1$ between cohorts entering in t, relative to the cohort of 2013. Outcomes of cohorts entering 2014 or later are subject to the minimum wage. In panel (A), the outcome is the log-difference between the minimum-wage exposure of occupations (measured pre-policy) utilized at the establishment, between the establishment in $t+1$ and the establishment in t (see equation (4)). In panel (B), the outcome is the log-difference between the minimum-wage exposure of individual occupations (measured pre-policy), between the occupation trained and the occupation pursued in $t+1$ (see equation (4), but for individual characteristics instead of establishment characteristics), conditional on leaving the training firm. Control variables are measured two years before graduation (see Section 3.1 for details). 95% confidence intervals are based on standard errors clustered at the district of the training firm. See Table 4 for coefficient estimates.

Source: Integrated Employment Biographies (IEB) – Version V17.00.00-202212, own calculations. © IAB

The baseline mean of the establishment-occupation-exposure measure reveals that new employers of training firm leavers utilized more exposed occupations more frequently before the policy (Table 4, column (6)). This gap remained constant across control cohorts (Figure 5, panel (A)). Right after the introduction of the minimum wage, however, the gap closed significantly, as the occupations typically utilized by new employers are less exposed to the minimum wage, by around (minus) 62 percent (=0.0236/0.038) relative to baseline. Taken together, initial employers of training firm leavers from treated cohorts are not only generally higher-paying and larger, on average, they also utilize jobs that are less exposed to the minimum wage more often.

Next, I turn to individual-occupation-exposure. Among training firm leavers of the cohort of 2013, about 45 percent started working in an occupation that differed from the training occupation at the 3-digit level and this fraction did not change for treated cohorts (not shown in table). Pre policy, new occupations of switchers tent to be more exposed to the minimum wage than occupations trained (Table 5, column (1)), and this trend evolved stable across control cohorts (Figure 5, panel (B)). With the introduction of the minimum wage, however, training firm leavers from treated cohorts started to increasingly switch to occupations that are comparatively less exposed to the minimum wage. For the cohort of 2016, the gap between the exposure of the new occupation and the training occupation declined by almost 30 percent (=0.0294/0.096).

Table 5: Effects of the minimum wage on the quality of jobs in the first experience year
Differences relative to cohort of 2013 in points

	(1) Change in individual occupation-MW-exposure	(2) Mainly routine manual tasks	(3) Low level of skill requirement
2016	-0.0294	-0.0514	-0.0541
	(0.0036)	(0.0026)	(0.0029)
2015	-0.0193	-0.034	-0.0381
	(0.0036)	(0.0027)	(0.0027)
2014	-0.0102	-0.0139	-0.0186
	(0.0028)	(0.0027)	(0.0030)
Base mean	0.096	0.198	0.243
Observations	624,199	291,962	291,962
Controls			
Demogr.	Y	Y	Y
Training	Y	Y	Y
Trend	Y	Y	Y
Pre cohorts	Y	Y	Y

Notes: In the table, I show estimates of changes in outcomes in $t+1$ between cohorts entering in t, relative to the cohort of 2013. Outcomes of cohorts entering 2014 or later are subject to the minimum wage. In column (1), the outcome is the log-difference between the minimum-wage exposure of individual occupations (measured pre-policy), between the occupation trained and the occupation pursued in $t+1$ (see equation (4)), conditional on leaving the training firm. In column (2), the outcome is the fraction of jobs in $t+1$ with the main task being routine manual, according to the measure of Dengler et al. (2014), conditional on leaving the training firm and switching the training occupation. In column (3), the outcome is the fraction of jobs in $t+1$ requiring a low skill level according to the assessment of employers, conditional on leaving and switching. Control variables are measured two

years before graduation (see Section 3.1 for details). Cohorts of 2011, 2012, and 2013 (reference) are included, but estimates not displayed (see figures and text). Standard errors clustered at the district of the training firm are in parentheses.

Source: Integrated Employment Biographies (IEB) – Version V17.00.00-202212, own calculations. © IAB

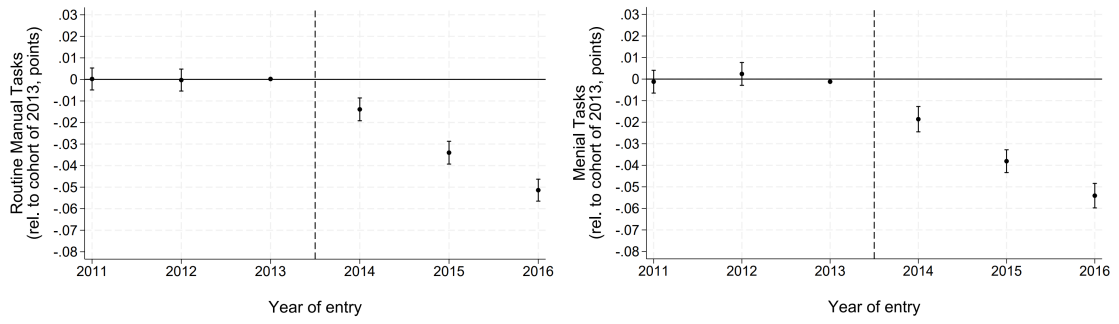
c) Switching to more demanding occupations

Finally, I take a closer look at changes in the task content of initial jobs pursued by workers who switched both training firm and training occupation upon labour market entry. As first measure, I rely on the method of Dengler et al. (2014) to identify the main task of an occupation to be routine manual. As second measure, I use employer-reported information on whether a job requires a low skill level. Estimates of regression equation (1) with the respective task measure as outcome are shown in Figure 6 and Table 5, columns (2) and (3).

Pre policy, the main task of almost 20 percent of initial jobs was routine-manual and around 24 percent were characterized by low skill requirements. These fractions have not changed across control cohorts, but started to decline significantly for treated cohorts, by (minus) 5.1pp (26%) and 5.4pp (22%) for the cohort of 2016, respectively. Taken together, the results suggest that the minimum wage not only led to reallocation of young workers to higher-quality employers, but also to reallocated workers increasingly start working in higher-quality jobs.

Figure 6: Effects of the minimum wage on the quality of tasks pursued in the first experience year

Differences relative to cohort of 2013 in points



(A) Mainly routine manual tasks

(B) Low level of skill requirement

Notes: In the figure, I plot estimates of changes in outcomes in $t+1$ between cohorts entering in t, relative to the cohort of 2013. Outcomes of cohorts entering 2014 or later are subject to the minimum wage. In panel (A), the outcome is the fraction of jobs in $t+1$ with the main task being routine manual, according to the measure of Dengler et al. (2014), conditional on leaving the training firm and switching the training occupation. In panel (B), the outcome is the fraction of jobs in $t+1$ requiring a low skill level according to the assessment of employers, conditional on leaving and switching. Control variables are measured two years before graduation (see Section 3.1 for details). Standard errors clustered at the district of the training firm are in parentheses. See Table 5 for coefficient estimates.

Source: Integrated Employment Biographies (IEB) – Version V17.00.00-202212, own calculations. © IAB

d) Reallocation by minimum-wage exposure risk

Other than the effects on earnings or working-time status, the reallocation effects I find do not always increase linearly with graduates' predicted minimum-wage exposure. This can be seen from results shown in Table 7 of the Appendix, reproducing estimates of regression equation (1) for all reallocation outcomes, but estimated separately for graduates with a low, medium, or high risk of being affected by the policy. Indeed, these estimates suggest reallocation effects to be as least as pronounced in the medium-risk group than in the high-risk group. Especially medium-risk

workers reallocated to even larger initial employers (panels (C) vs (D) vs (E)) and more demanding professions (panels (H) and (I)). I discuss potential mechanisms in the next section.

4 Discussion

My findings are in line with the now well-established result that the introduction of the German nationwide minimum wage did not harm individual employment, despite of sizeable increases in wages. This result even holds for particularly vulnerable groups on the labour market, such as young labour market entrants.[6]

One mechanism that explains the absence of negative employment effects on individuals is that higher-paying, larger employers absorbed minimum-wage workers who would have been employed by lower-paying, smaller employers otherwise; see Dustmann et al. (2022) for a formal analysis of this mechanism using a theoretical model with monopsonistic competition, heterogenous firms, and workers valuing nonpecuniary job aspects in addition to wages.

This reallocation effect is quantitatively important. Dustmann et al. (2022) find for the overall workforce that it explains up to 17 percent of the total wage effect of the minimum wage. To put my estimates into perspective, recall that I find a minimum wage effect on the population-average earnings of workers in the high-risk group of about 1.75 percent to 3.17 percent (Table 3, column (1)). Additionally, I use the result of Dustmann et al. (2022) that, prior to the minimum wage introduction, the individual wage of a low-wage worker increased by 7.3 percent if she/he switched to an employer with a 10 percent higher wage level, on average. The reallocation of young labour market entrants to higher-paying initial employers (Table 4, column (2)) therefore can explain between (0.0078 * 0.73 / 0.0175 ≈) 32 percent and (0.0197 * 0.73 / 0.0317 ≈) 45 percent of the total wage effect; i.e. an even larger fraction than in the case of the overall workforce.

Furthermore, I provide novel evidence that the minimum wage led young workers i) to reallocate to initial employers who generally utilize less-exposed occupations more frequently, ii) to reallocate to less-exposed occupations, and iii) to increasingly start working in occupations with a higher level of skill requirement. Taken together, these patterns suggest that employer upgrading involved switching to more demanding occupations, too.

Reallocation, however, appears mitigated for workers with a high risk of being affected by the minimum wage (Table 7). One explanation for reallocation effects not being strongest for high-risk workers is that employers who typically hire these workers are not only generally low-paying and small, but also quite homogenous in terms of wage-level and size. Pre policy, average firm wages in the low-risk group were 132.19 EUR/day, with a standard deviation of 39.79, while in the high-risk group they were merely 73.35 EUR/day, with a standard deviation of 26.01, for instance (Table 6, columns (2) vs (4)). The inter-quartile range of firm-size was 1,177 in the low- vs 78 in the high-risk group. These differences in the quality of potential employers suggest that the options for switching to larger and higher-paying employers are comparatively limited for graduates with

[6] Another vulnerable group are the long-term unemployed, which are exempted from the minimum wage. However, Umkehrer/vom Berge (2020) find that employers rarely used the exemption and that workers hired after a period of long-term unemployment received the minimum wage without facing reduced employment prospects.

a higher exposure risk. Additionally, these workers received their training in generally lower-paying, more strongly exposed occupations. If access to more demanding occupations requires a specific education, a lack of skills or legal barriers would hamper the upward mobility of high-risk workers.

Table 6: Pre-policy characteristics of employers in the first experience year

Means, standard deviations and quartiles in Euro or number of employees, respectively

Empty cell	(1)	(2)	(3)	(4)
	Empty cell	Individual minimum-wage exposure risk		
	Empty cell	low	medium	high
Wage-level	103.22	132.19	103.52	73.35
Empty cell	(39.34)	(39.79)	(35.18)	(26.01)
Size~	826	2,188	585	180
Empty cell	(3,922)	(6,528)	(3,168)	(1,279)
p25	[18]	[127]	[18]	[9]
p50	[76]	[458]	[64]	[26]
p75	[337]	[1,304]	[238]	[87]
Observations	213,498	43,656	126,246	43,596

Notes: In the table, I show average wage-level and size of employers in the first experience year of the cohort of 2013. In columns (2) to (4), I split the estimation sample by the workers' predicted minimum wage exposure: low [0,0.034), medium [0.034, 0.151], and high (0.151,1]. Variances in parentheses, quartiles in brackets.

Source: Integrated Employment Biographies (IEB) – Version V17.00.00-202212, own calculations. © IAB

Last but not least, to enable identification, my study excludes labour market entrants without any vocational education. The estimates by individual minimum-wage exposure risk suggest the lowest educated to face i) even stronger wage effects, ii) no negative employment effects, and iii) weaker reallocation effects to the extent that lacking skills restrict access to jobs that require performing more demanding tasks. Still, I want to stress that more research on the effects of the minimum wage on youths without completed education is needed.

5 Conclusion

In this study, I investigate the effects of the German minimum wage introduction on the education-to-work transition. I find that the minimum significantly increased the entry wages of young labour market entrants, without reducing their employment prospects. A substantial fraction of the wage effect can be explained by graduates increasingly starting careers at generally higher-paying and larger firms. Additionally, I provide novel evidence that reallocation also involved pursuing more demanding occupations at the new employers. I therefore conclude that policies aimed at increasing the wages for certain types of jobs have the potential to change the distribution of young workers across both employers and occupations, but not necessarily towards those occupations that face the strongest wage increases. Moreover, evidence from the broader literature on labour market entry conditions suggests that starting careers at more efficient firms can have persistent positive effects on individual career development. The analysis of longer-term career outcomes is left for future work.

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Appendix

This appendix contains tables with additional regression results. **Table 7: Effects of the minimum wage on employer reallocation – by predicted minimum-wage exposure**

Differences relative to cohort of 2013 in points

	(1)	(2)	(3)	(4)
		Exposure risk		
	All	Low	Medium	High
Panel A: Stay at training firm				
2016	0.0138	0.0186	0.0165	0.0077
	(0.0023)	(0.0058)	(0.0023)	(0.0041)
2015	0.0102	0.0101	0.0123	0.0088
	(0.0022)	(0.0053)	(0.0023)	(0.0040)
2014	0.0044	0.0005	0.0061	0.0054
	(0.0019)	(0.0042)	(0.0022)	(0.0036)
Base mean	0.518	0.575	0.530	0.428
Observations	1,311,004	262,213	786,591	262,200
Panel B: Change in establishment wage				
2016	0.0197	0.0096	0.0243	0.0151
	(0.0010)	(0.0021)	(0.0013)	(0.0023)
2015	0.0122	0.0070	0.0148	0.0090
	(0.0009)	(0.0021)	(0.0011)	(0.0019)
2014	0.0078	0.0034	0.0098	0.0054
	(0.0008)	(0.0016)	(0.0010)	(0.0019)
Base mean	-0.032	-0.045	-0.039	0.000
Observations	1,215,628	251,243	731,413	232,972
Panel C: Change in establishment size – not a micro business				
2016	0.0072	0.0037	0.0080	0.0090
	(0.0007)	(0.0010)	(0.0009)	(0.0020)
2015	0.0056	0.0022	0.0061	0.0083
	(0.0006)	(0.0009)	(0.0008)	(0.0018)
2014	0.0034	0.0012	0.0032	0.0070
	(0.0007)	(0.0009)	(0.0008)	(0.0019)
Base mean	-0.021	-0.013	-0.025	-0.020
Observations	1,233,243	252,908	741,506	238,829
Panel D: Change in establishment size – small business cap				
2016	0.0084	0.0053	0.0089	0.0107
	(0.0009)	(0.0013)	(0.0011)	(0.0025)
2015	0.0067	0.0033	0.0070	0.0101
	(0.0008)	(0.0012)	(0.0010)	(0.0023)
2014	0.0038	0.0017	0.0034	0.0074
	(0.0008)	(0.0012)	(0.0009)	(0.0023)
Base mean	-0.033	-0.021	-0.038	-0.029
Observations	1,233,243	252,908	741,506	238,829
Panel E: Change in establishment size				
2016	0.0429	0.0207	0.0689	-0.0043
	(0.0057)	(0.0129)	(0.0059)	(0.0130)
2015	0.0315	0.0185	0.0467	0.006

	(1)	(2)	(3)	(4)
		Exposure risk		
	All	Low	Medium	High
	(0.0046)	(0.0095)	(0.0054)	(0.0109)
2014	0.0164	-0.0031	0.0247	0.0154
	(0.0049)	(0.0102)	(0.0050)	(0.0104)
Base mean	-0.146	-0.355	-0.143	0.063
Observations	1,233,243	252,908	741,506	238,829
Panel F: Change in establishment-occupation-exposure				
2016	-0.0236	-0.0044	-0.0314	-0.0396
	(0.0021)	(0.0050)	(0.0021	(0.0036
2015	-0.0210	-0.0062	-0.0266	-0.0328
	(0.0016)	(0.0038)	(0.0020	(0.0036
2014	-0.0214	-0.0058	-0.027	-0.0299
	(0.0015)	(0.0036)	(0.0020	(0.0034
Base mean	0.038	0.035	0.046	0.012
Observations	1,034,709	240,266	623,243	171,200
Panel G: Change in individual-occupation-exposure				
2016	-0.0294	-0.008	-0.0377	-0.0368
	(0.0036)	(0.0070)	(0.0047)	(0.0055)
2015	-0.0193	-0.0114	-0.0244	-0.0173
	(0.0036)	(0.0064)	(0.0049)	(0.0055)
2014	-0.0102	-0.0033	-0.0171	-0.0014
	(0.0028)	(0.0067)	(0.0038)	(0.0052)
Base mean	0.096	0.199	0.138	-0.075
Observations	624,199	111,035	365,100	148,064
Panel H: Main task routine-manual				
2016	-0.0514	0.0078	-0.0656	-0.0396
	(0.0026)	(0.0063)	(0.0032)	(0.0052)
2015	-0.0340	0.0110	-0.0422	-0.0333
	(0.0027)	(0.006)	(0.0033)	(0.0057)
2014	-0.0139	0.0070	-0.0196	-0.0067
	(0.0027)	(0.0063)	(0.0031)	(0.0055)
Base mean	0.198	0.160	0.209	0.191
Observations	291,962	36,982	187,801	67,179
Panel I: Low level of skill requirements				
2016	-0.0541	-0.0386	-0.0601	-0.0487
	(0.0029)	(0.0074)	(0.0038)	(0.0063)
2015	-0.0381	-0.0277	-0.0434	-0.0287
	(0.0027)	(0.0069)	(0.0035)	(0.0064)
2014	-0.0186	-0.0163	-0.0220	-0.0090
	(0.0030)	(0.0075)	(0.0035)	(0.0061)
Base mean	0.243	0.184	0.238	0.286

	(1)	(2)	(3)	(4)
		Exposure risk		
	All	Low	Medium	High
Observations	291,962	36,982	187,801	67,179
Controls				
Demogr.	Y	Y	Y	Y
Training	Y	Y	Y	Y
Trend	Y	Y	Y	Y
Pre cohorts	Y	Y	Y	Y

Notes: In the table, I present OLS estimates of coefficients δ from regression equation (1), measuring the difference in the means of a given outcome in $t+1$ between cohorts entering the labour market in t, relative to the respective cohort of 2013. The sample is restricted to graduates with a low (<3.6%, column (2)), medium (column (3)), or high (>16.6%, column (4)) probability of being affected by the minimum wage. Outcomes of cohorts entering 2014 or later are subject to the minimum wage introduced in 2015.

In panel (A), the outcome is the fraction of graduates starting their first job at the firm that provided their vocational education.

In panel (B), the outcome is the difference between the wage levels (in logs and measured in $t-2$) of the establishment in $t+1$ and of the establishment in t (see equation (4)).

In panel (C), the outcome is the differences in establishment size (measured as likelihood of the establishment not being a micro business; i.e. having at least five employees in $t-2$. The outcomes in panels (D) and (E) use the log of the number of employees as measure of establishment size, either capped at nine employees or without further modification.

In panel (F), the outcome is the difference in the minimum-wage exposure of the occupations utilized by an establishment (in logs and measured in $t-2$) of the establishment in $t+1$ and of the establishment in t.

In panel (G), the outcome is the log-differences between the minimum-wage exposure of individual occupations (measured pre-policy), between the occupation trained and the occupation pursued in $t+1$ (see equation (4)), conditional on leaving the training firm.

In panel (H), the outcome is the fraction of jobs in $t+1$ with the main task being routine manual, according to the measure of Dengler et al. (2014), conditional on leaving the training firm and switching the training occupation.

In panel (I), the outcome is the fraction of jobs in $t+1$ requiring a low skill level according to the assessment of employers, conditional on leaving and switching.

The 'Base mean' is the average outcome of graduates from the cohort of 2013 in the respective estimation sample. Control variables are measured two years before graduation and comprise socio-demographic characteristics (gender, nationality, age, school education) and characteristics of the vocational education (occupation, firm size, wage-level, district) and estimates are trend-adjusted (see Section 3.1 for details). Cohorts of 2011, 2012, and 2013 (reference) are included, but estimates not displayed. Standard errors clustered at the district of the training firm are in parentheses.

Source: Integrated Employment Biographies (IEB) – Version V17.00.00-202212, own calculations. © IAB

Figures

Tables

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