The Minimum Wage in Germany:
Facing the Wage and Employment Inequality between Migrants and Natives?

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Abstract

This paper investigates the effects of the introduction of a statutory minimum wage in Germany on the wages and employment of migrants. Migrants are an overrepresented group in the low-wage sector and can be expected to particularly benefit from a minimum wage. We combine a differential trend adjusted difference-in-differences estimator (DTADD) and descriptive evidence to evaluate the impact of the minimum wage introduction in 2015 on hourly and monthly wages, working hours and changes in employment and wage distribution. Contrary to expectations, our results show that the introduction of the minimum wage has worsened the position of migrants in the low-wage sector compared to their native counterparts. Among migrants, we notice an increase in part-time employment and a comparatively less favourable unemployment trend. The minus in monthly salaries for migrants is even greater than in hourly wages. We observe a wage compression just above the minimum wage threshold together with a temporary wage convergence between employees with and without a migration background at the lower end of the wage distribution, which afterwards returns to a wage divergence.

Keywords: Minimum wage, migrants, differential trend adjusted difference-in-differences, SOEP
JEL Classification: J31, J63, J38, J21

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1 Introduction

In 2015, the German Government introduced a nationwide statutory minimum wage with two objectives: (1) to protect employees in the low-wage sector from wage dumping and (2) for precipitating an improvement in social security for lower income groups (The Federal Government 2014). This introduction was justified by the reduction in the number of employees covered by collective agreements. Falling wages at the lower end of the wage distribution (Bossler & Schank 2020) has led to increasing wage inequality (Biewen et al. 2017). A few years later, however, approximately one quarter of the German labour force is still employed in the low-wage sector (Grabka & Schröder 2019).

Despite a growing number of studies providing evidence on the effects of the minimum wage introduction in 2015 (see Ahlfeldt et al. 2018, Bossler & Gerner 2020, Bossler & Schank 2020, Caliendo et al. 2018, Caliendo et al. 2019, Dustmann et al. 2022, Garloff 2019, Holtemöller & Pohle 2020), none of the studies consider the effects on migrants. Although one in four persons in the German labour force has a migration background (Federal Statistical Office 2020) and was much more likely to earn less than the new minimum wage threshold in 2014 than native-born employees (Amlinger et al. 2016), research about the effects of the minimum wage on migrants has been almost exclusively limited to the U.S. (Zavodny 2014). Thus, this paper makes a contribution to the unnoticed effects of the minimum wage introduction in 2015 on the labour market situation of migrants in Germany. We use a causal effects analysis to estimate the effects of the minimum wage reform on the hourly wages (resp. monthly wages, working hours) of migrants and natives. We are the first to apply the differential trend adjusted difference-in-differences (DTADD) analysis (suggested by Burauel et al. 2020) to migrants in the labour market. We complement the causal estimations with further descriptive analyses to discuss distributional shifts, such as potential squeeze and spillover effects.

Migrants are often a particularly disadvantaged labour market group due to lower language proficiency, job qualifications, and usability of their human capital (Aldashev et al. 2009, Kogan 2011). In addition, they are more likely to be victims of statistical discrimination (Kaas & Manger 2012). These circumstances are not necessarily the result of intentional decisions but partly arise from misaligned incentives. Consequently, migrants more often work in the low-wage sector, typically characterized as marginal employment (so-called mini-jobs)[1] or part-time employment.[2] This creates structural wage inequalities compared to native workers (Aldashev et al. 2012, Ingwersen & Thomsen 2021). Due to their comparatively lower labour market position, migrants were expected to have benefited more from the introduction of minimum wages.

However, our empirical results show a different picture: there was only a smaller positive minimum wage effect for migrants than for natives. This caused a temporary increasing wage divergence around the minimum wage introduction between migrants and natives at the cost of the latter. A disadvantageous

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[1] "*Mini-jobs are marginal employment with a maximum monthly salary of €450 or a work assignment of a maximum of 70 days per calendar year. Due to the lack of contributions to social insurance, mini-jobs do not provide social security*" (Federal Employment Agency 2022).

[2] In 2014, the share of employed migrants with a monthly income below €500 was 19.9 % (compared to 11.5 % of natives) and the proportion earning below €900 was 41.9 % (vs. 28.3 %). The share of migrants in part-time employment was 31.1 % (vs. 28.1 %) and the proportion working less than 20 hours per week was 16.7 % (vs. 21.1 %) (Federal Statistical Office 2020).

development in employment status can also be observed. Based on these findings, we draw initial conjectures regarding the impact of the large minimum wage increase in October 2022 on migrants.

The remainder of the paper proceeds as follows: Section 2 gives a brief insight into the reasons for and the extent of the introduction of minimum wages in Germany. This is accompanied by a literature review of the evidence to date on the effects of the minimum wage. Section 3 includes the data and sample description. Section 4 is devoted to the methodology and comprises the econometric specifications. This is followed by comprehensive analyses of the wage and employment changes for migrants and natives in the wake of the introduction of the minimum wage in Section 5 and the impact on the wage distribution in Section 6. A discussion of the results is provided in Section 7 before the study closes with a conclusion.

2   Minimum Wages: Introduction in Germany and Related Evidence

2.1   Introduction in Germany

The introduction of the minimum wage in 2015 was one of the most profound social policy reforms in recent years that directly affected approximately 4 million workers (Bossler & Gerner 2020). Before this reform, Germany was one of the few European countries and economically strong industrial nations worldwide without a statutory minimum wage (Bruttel et al. 2018, Schulten 2021).[3] Since the end of the 1990s, however, collective bargaining coverage in Germany fell from over 70 % to below 50 % by 2014 (Garloff 2019). Deunionization, outsourcing of service personnel, a change in working hours, and low-skilled workers being employed in low-paying firms caused an increasing lower wage tail inequality (Antonczyk et al. 2010, Bossler & Gerner 2020, Bossler & Schank 2020).

The main objective of the minimum wage implementation was to secure the subsistence level for the working population. A statutory minimum wage should protect workers in the low-wage sector from wage dumping (BMAS 2021). However, the implementation of a minimum wage levers out marginal productivity. It was set at €8.50 per hour for 2015/16 and increased to €8.84 in 2017/18.[4] Based on the 2013 wage level, the initial minimum wage was approximately 50 % of the median income or roughly the 15th wage percentile, which had declined significantly before resulting in a growing wage spread below the median (Bossler & Schank 2020). This is a moderate minimum wage compared to other EU countries (Eurostat 2021). Based on a 39-hour week, an employee working full-time received a gross monthly wage of at least €1,440 (2015/16) and €1,500 (2017/18).[5]

The 2015 introduction of the minimum wage affected employees to different degrees (see Figure 1). The direct impact on employees with a migration background (19 %) was considerably larger compared to the impact on natives (12 %). Furthermore, the differences were particularly noticeable by employment status and qualification: In more than half of all jobs with marginal employment (54 %), employees received an hourly wage of below €8.50, while the proportion was much lower for part-time (19 %) and

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[3] There is no statutory minimum wage in Denmark, Norway, Sweden, Finland, Italy, Austria and Switzerland (Schulten 2021).

[4] Further annual increases resulted in a minimum wage of €9.82 in the first half of 2022.

[5] The *Minimum Wage Act* only applies where the provisions in the existing industry or company collective agreement were previously lower. In selected sectors with a particularly large impact due to the minimum wage, wages were still allowed to be below the general minimum wage during the transitional period until the end of 2017 (The Federal Government 2014). This applies to 2.1 % of the workforce in 2015, for example, in agriculture and forestry, in horticulture and in the textile and clothing industry. The share of migrants in industries with and without transitional arrangements is the same (own calculations).

full-time jobs (7 %). Low-skilled workers benefited more than average from the introduction of the minimum wage (22 %), while highly skilled workers were hardly affected (5 %). Due to the lower average wage in eastern Germany, the *wage bite* – the ratio of the minimum wage and the median hourly wage – was larger in this region. In addition, women (19 %) were affected twice as often as men (8 %), and young employees were comparatively more likely than other age groups to earn less than €8.50 an hour (Figure 1).

< Figure 1 >

2.2 Related Evidence

Due to the worse labour market situation of migrants compared to natives, a minimum wage may contribute to closing the migrant-native wage gap in Germany. There is a strong overrepresentation of people with a migration background at the bottom of the wage distribution, and their wages would rise more sharply if there was a minimum wage introduction than those of native Germans. Reasons for the lower average wages of migrants (compared to natives) are manifold, but their lower human capital endowment is the key for productivity disadvantages. This lower level of human capital results from a lower level of education and generally poorer language skills (Ingwersen & Thomsen 2021). For migrants with own migration experience (first-generation migrants), the imperfect transferability of human capital (due to the limited compatibility of the home and host labour markets) leads to significantly lower returns compared to human capital acquired in Germany (Basilio et al. 2017). For migrants of successive generations, lower levels of human capital result partly from migrant-specific challenges in the German education system (Christl et al. 2018). However, wage differentials between migrants and natives cannot be attributed to productivity differences alone. They also point to statistical discrimination, which (partly) arises from cultural differences (Ingwersen & Thomsen 2021). Thus, an employer's reservation about hiring, retention, and promotion can lead to a preference for native-born workers (Kaas & Manger 2012). Nevertheless, irrespective of the actual causes or their importance, there is a clear selection of migrants into low-income occupations and sectors (Humpert 2013).

Both employers and employees respond to higher hourly wages: To keep labour costs stable, employers may reduce the contractual weekly working hours of their low-wage workers, demanding that they work harder or face termination (Bruttel et al. 2018, Bruttel 2019, Holtemöller & Pohle 2019). Furthermore, "*minimum wage gives employers a profit incentive to substitute away from the least-skilled towards more-skilled workers*" (Zavodny 2014, p.3), which can lead to reduced hiring of low-skilled workers (Zavodny 2014). If low-wage earners become unemployed because of the minimum wage, this could both raise the average wage of the lower income groups and promote inequality in the country. Employers could also pass along the additional labour costs to their customers by raising prices for goods and services (Bruttel et al. 2018, Bruttel 2019). A reduction in investments and adjusted work requirements are equally conceivable (Caliendo et al. 2019). Eventually, additional costs may force predominantly small employers to exit the market (Dustmann et al. 2022). However, the employees themselves could also initiate a reduction in working hours, for example, if they wish to work less while keeping the same monthly salary (Bruttel 2019). Caliendo et al. (2019) therefore recommend also considering monthly wages when evaluating the effects of the minimum wage reform. Several studies found that the average contractual working hours in regular employment fell significantly following the minimum wage implementation in Germany (Bonin et al.

2020), which prevented higher hourly wages from translating into higher monthly wages (Caliendo et al. 2019).

A statutory minimum wage may also represent a labour market screening device by which primarily better-qualified workers in the low-wage sector may transition into regular employment. Since migrants often have lower levels of qualification than natives, their employment opportunities may even deteriorate due to the minimum wage introduction (Zavodny 2014). This leads to two opposing effects for migrants: On the one hand, they may find it more difficult to enter the labour market. On the other hand, however, they will benefit from higher wage levels if they successfully obtain employment.

Currently, there are very few studies analysing the effects of the minimum wage on migrants or on different ethnic groups, and the research has been limited exclusively to English-speaking countries with labour markets that are less institutionalized than Germany's. Wursten & Reich (2021) and Derenoncourt & Montialoux (2021) reveal that minimum wage policies in the US have narrowed the wage gap between whites and African Americans and improved employment opportunities for black workers. The minimum wage even further reduces the racial wage gap among less-educated workers. Similar developments can be observed in the UK, where the introduction of the minimum wage has led to a wage gap reduction between ethnic minorities and white workers in the lower wage groups (Clark & Nolan 2021). In addition, both the minimum wage in the UK (when it was introduced) and the national minimum wage in the U.S. were set comparatively low in relation to median income. However, Edo & Rapoport (2019) observe that, in the US, high federal minimum wages preserve native-born workers from competition with migrants with similar qualification. Consequently, the relative level of the minimum wage could affect the labour force participation of ethnic minorities and could thus influence wage inequality between migrants and natives.

According to competitive market theory, the minimum wage introduction affects labour market opportunities in the form of wage increases and employment losses (Bruttel 2019, Zavodny 2014), i.e., the interplay of income and substitution effects. The predicted decline of approximately half a million jobs led to wide concerns among the German population (Arni et al. 2014, Knabe et al. 2014). With regard to its primary objectives, the introduction of the minimum wage has significantly increased the hourly wages at the bottom of the distribution at an above-average rate from 2014 to 2016 (e.g., Bruttel 2019, Caliendo et al. 2019, Dustmann et al. 2022). Therefore, it may play a key role in the reduction of wage inequality in Germany (Grabka & Schröder 2019). In particular, low-skilled employees as well as marginally employed persons experienced an over-proportional wage increase (Caliendo et al. 2019, Amlinger et al. 2016, Burauel et al., 2020). However, the estimated reduction in wage inequality may also arise from job losses in the low-wage sector, although these effects seem to be small (Bossler & Gerner 2020, Bossler & Schank 2020, Caliendo et al. 2018, Garloff 2019). Regardless, the new wage floor has led to a notable wage compression slightly above the minimum wage (Bruttel 2019) and to spillover effects on higher wages.[6]

In contrast to the expected effects on the wage distribution, the employment effects of a minimum wage were less clear in advance. The decline appears to have been far less extensive than some previous studies have predicted. Unlike almost all studies finding a significant negative effect on total employment (e.g., Bonin et al. 2018, Bossler et al. 2018, Bossler & Gerner 2020, Caliendo et al. 2018, Garloff 2019,

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[6] Bossler & Schank (2020) observe that the minimum wage introduction had an impact on monthly wages up to the 50th percentile, although the extent of wage spillover towards higher wage groups is ambiguous (Bruttel et al. 2018, Bruttel 2019).

Holtemöller & Pohle 2019), a few studies report slightly positive effects (e.g., Ahlfeldt et al. 2018, Bruttel et al. 2018). However, the type of employment relationship determines the extent to which employees have been afflicted by the minimum wage (Caliendo et al. 2018). Holtemöller & Pohle (2019, p.189) "*find a robust negative effect of the minimum wage on marginal and a robust positive effect on regular employment*." Other studies also observe a sharp decline in the number of mini-jobs (e.g., Amlinger et al. 2016, Bruttel et al. 2018), whereas full-time and part-time employment remained almost unaffected (Caliendo et al. 2018). This decline in marginal employment has therefore largely determined the decline in overall employment. Moreover, the empirical literature is quite consistent in reporting that approximately half of marginal employment was converted into regular employment (Amlinger et al. 2016, Bonin et al. 2018, Bruttel 2019, Caliendo et al. 2018, Caliendo et al. 2019). The other half of all marginally employed persons, however, left the labour market or became unemployed (Bruttel 2019).

Despite the observed reduction in wage inequality, Bruttel (2019) concludes that – as frequently observed in other states – "*the minimum wage has not helped to reduce welfare dependency and the risk of poverty*" in Germany (Bruttel 2019, p.11). This conclusion is derived from at least four reasons. First, the share of low-wage employees has not declined due to the minimum wage introduction (Grabka & Schröder 2019). Second, "*many employees in the low-wage sector still do not generate adequate earned income and depend on wage-replacement benefits*" (Grabka & Schröder 2018, p.120). This is explained by the fact that workers' previous incomes in the low-wage sector plus potential social benefits roughly correspond to the monthly income after minimum wage implementation. Third, the minimum wage is sufficient only for single full-time employees, which comprise only 3 % of all top-up payment recipients in Germany. For households with additional household members without income (e.g., partner, children), a monthly salary on a minimum wage basis is (still) not sufficient to cover basic costs (Bruttel 2019). Thus, the vast majority of minimum wage earners continue to rely on social benefits. Fourth, unemployment effects are concentrated among low-wage families (Neumark & Wascher 2002), which increases labour market segmentation.

Although the literature does not explicitly address migrants in Germany, some insights can be derived based on how migrants have fared after the introduction of the minimum wage. Caliendo et al. (2019) emphasize that low-skilled and marginal workers in particular have benefited substantially from the introduction of the minimum wage, explicitly mentioning – but not analysing – people with a migration background. Nevertheless, low-wage earners face adverse consequences from the introduction of a minimum wage: Although they benefit from the wage raise, they are exposed to an increased risk of job loss and a reduction in working hours (Neumark et al. 2004). Therefore, we conjecture that migrants are more strongly affected than natives by the introduction of the minimum wage in Germany, both positively and negatively. Migrants may tend to benefit more from the minimum wage due to their overrepresentation in the low-wage sector, and the average wage of migrants in the low-wage sector is slightly lower than that of natives, which should generate higher wage growth due to the minimum wage. On the other hand, imposed wage increases lead to budget adjustments by employers, which may result in job cuts. Migrants may be at a disadvantage in the increased competition for jobs if they are competing with native-born Germans with equal job qualifications. Hence, only workers who remain employed can truly benefit from the introduction of the minimum wage.

3 Data Description

3.1 Data and sample restrictions

For the empirical analysis, we use 2007 to 2017 survey data from the German Socio-Economic Panel (SOEP).[7] This timeframe includes an appropriate period to account for previous wage developments prior to the minimum wage introduction. This reduces possible bias due to anticipation effects. Simultaneously, (wage) changes in the first, second and third years of the minimum wage introduction can be included. The SOEP is a wide-ranging and representative longitudinal panel study of approximately 30,000 persons interviewed annually on issues related to income, employment, education, living conditions and health (Goebel et al. 2019). A particular asset of these data is the identification of migration status beyond the concept of citizenship. In the analysis, we consider (1) persons with a migration background who were born in Germany but have at least one parent who immigrated to Germany (indirect migration background) or who immigrated themselves (direct migration background) as "migrants" and (2) persons who have no known migration history[8] as "natives" (DIW-SOEP n.d.). In this regard, the group of migrants is characterized by large heterogeneity (origin, time of residence, language proficiency, place of educational acquisition, reason for migration, etc.). Labour market barriers and lower upwards mobility apply equally to individuals from both direct and indirect migration backgrounds (Speckesser 2013).

Our main variable of interest, 'gross hourly wage,' is obtained by dividing the individual gross wages for each month by the contractual working hours of the last week in the main job extrapolated to monthly hours.[9] Wages from side jobs are not considered. We assume that there are 4.35 weeks in each month for the calculation. We further apply symmetric trimming to the wage growth rates by dropping the upper and lower one percent from the analysis to correct for outliers. Information on the individual's employment status is taken directly from the dataset. We use the provided survey weights at the individual level to mitigate a potential bias due to an overrepresentation of high-income households and immigrants in SOEP data. With these restrictions in place, the estimation sample includes 124,138 observations (or an average of 11,285 observations per year), subdivided into 19.6 % migrants and 80.4 % natives.[10]

3.2 Sample Description

Migrants and natives differ significantly in most labour market characteristics: Table 1 shows the mean characteristics of these two groups in the period of 2012-2014 (pre-minimum wage) and their absolute and relative changes towards the period 2015-2017 (post-minimum wage introduction). We look at these two periods to capture the average differences between the two groups in terms of labour market characteristics directly before as well as the change immediately after minimum wage introduction. The share of low-skilled workers with a migration background is considerably higher than that of native workers, while the

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[7] Migration samples from after 2013 are not included to minimize bias from refugee samples and immigrants immediately before the minimum wage introduction in 2015.

[8] The group "no migration background" also includes persons with German citizenship who were born in Germany and about whose parents no information is available. Since some of them could also be descendants of migrants, the number of persons with a migration background group may be slightly underestimated (DIW-SOEP n.d.).

[9] We disregard all workers who have no eligibility for the minimum wage: (1) workers in jobs that are not bound by the statutory minimum wage (self-employed, apprentices, intern, and handicapped workers in sheltered workshops), (2) workers in industries with higher minimum wages than the statutory minimum wage, and (3) workers in an industry with a transitional period of minimum wage introduction.

[10] The share of the population with a migration background ("migrants") was 20.3 % in 2014 (Federal Statistical Office 2020).

opposite is true for medium-skilled persons. The share of high-skilled workers is therefore almost identical. Migrants often have higher levels of educational attainment than natives. They are also more often employed in marginal employment (13 %), although this proportion decreased towards 2015-2017 compared to native workers (8 %). Both groups had significant gains in part-time employment, where the share of native employees (21 %) is slightly higher than among migrants (19 %). Similarly, migrants (68 %) were slightly less likely to work full-time in 2012-2014 than natives (70 %). However, there was no appreciable change in either group in 2015-2017, confirming the results of previous studies for migrants. However, unemployment levels show a notable difference. Whereas the share of unemployed native workers decreased substantially by 12 % by the 2015-17 period, there was no significant change for migrants. The fact that migrants often have a lower employment status, which tends to be associated with a lower wage level (see Figure 1), highlights the extent to which migrants are affected by the minimum wage.

< Table 1 >

A first look at wage developments reveals that both groups experienced a significant and comparable increase in median gross hourly wage of nearly 10 % during the 2015-2017 period. The relative increase was even greater at the 10th wage percentile for migrants (+14 %) than for natives (+11 %). Due to these considerable level differences, there was only a slight convergence at the lower end of the wage distribution. Meanwhile, natives made slightly larger gains in the higher wage groups. Thus, from the 20th decile onwards, there is a discernible wage spread. In both groups, we observe a strong significant increase in wage dispersion. The differences between migrants and natives in the development of the average gross monthly wage are particularly noticeable: While migrants show a considerable increase of 12 %, this is only half as high for natives (6 %). In addition to the increase in wages, changes in employment relationships could also explain this shift. In summary, these descriptive results indicate that the introduction of the minimum wage affected migrants and natives to different degrees.

4   Econometric Methodology

In order to quantify how migrants and natives were affected by the introduction of the minimum wage, we use a causal effects analysis. This methodological framework refers to the approach used by Burauel et al. (2020) and Dustmann et al. (2022) and enables us to determine the effects of the minimum wage reform on hourly wages (resp. monthly wages and working hours). This identification strategy is based on the underlying assumption that wages below the minimum wage threshold (treatment group) would have developed identically to those just above the minimum wage threshold (control group) if the minimum wage were not introduced. The effect of the minimum wage is estimated by using a "*differential trend adjusted difference-in-differences*" (DTADD) approach, in which the observed wage change in the treatment group is contrasted with the (counterfactual) wage change in the control group. Therefore, the treatment effect is represented by the difference between wage changes in the treatment group and the wage changes perceived in the control group. This identification builds on the assumption that the existing differences between the treatment and the control group would have remained unchanged over time. To

empirically support the plausibility of this assumption, we consider previous wage trends in the model. The analysis particularly focuses on the minimum wage effects on migrants compared to natives. To complement the causal evaluation, we conduct comprehensive descriptive analyses in addition to uncovering and discussing distributional shifts, such as squeeze and spillover effects.

< Table 2 >

Following Burauel et al. (2020) and Dustmann et al. (2022), we divide the employees into three groups based on their location in the wage distribution prior to the minimum wage introduction (t_0). In our application, the wage thresholds correspond to the rounded single (€10.32) and double standard deviations (€12.14) of the group under treatment. The first group includes workers who earned an hourly wage below the minimum wage threshold of €8.50 in 2013 and 2014.[11] These workers were directly affected by the introduction of the minimum wage in 2015 and therefore constitute the "treated group". Due to their close proximity to the minimum wage threshold, workers with hourly wages just above the minimum wage (€8.50 to €10.00/hour) form our "control group". However, this group may experience indirect effects of the minimum wage introduction. For subsequent robustness checks, we therefore implement a third group: The "peer group" comprises all workers *"higher up in the initial wage distribution"* (€10.00-12.00/hour) and should be (almost) unaffected by the introduction of the minimum wage. Table 2 shows an outline of the treated group and both control groups.

We use a regression analysis to control for different individual and job-specific characteristics of the "treated group", the "control group" and the "peer group" influencing hourly wage changes. We adopt the basic regression equation from Burauel et al. (2020):

$$\Delta w_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 Y_{it} + \beta_3 T_{it} \times Y_{it} + \beta_4 X_{it} + \beta_5 change_{it} + \varepsilon_{i.t} . \qquad (1)$$

Δw_{it} represents the logarithmic change in individual hourly wage between t_0 and t_1 (alternatively between t_0 and t_2 resp. t_3), which allows us to model non-linear relationships. The treatment group indicator T_{it} takes the value of one if a worker earned an hourly wage below €8.50 in period t_0 (and t_{-1}) and zero otherwise. Thus, β_1 depicts the average hourly wage growth of individuals in the treated group. $\beta_2 Y_{it}$ is the individuals' average overall hourly wage growth over time. The interaction term between the treatment group indicator T_{it} and the time vector Y_{it} indicates deviations from the average hourly wage growth of the treated group within a particular year. For 2015, this reveals hourly wage changes caused by the minimum wage introduction (minimum wage effect). The vector $\beta_4 X_{it}$ captures individual and job-specific characteristics: age, gender, living in a partnership, migration background, place of residence, educational level, labour market experience, firm size, job tenure, time-limited contract, employment status (marginal employment vs. employment subject to social security contributions), and economic sector. We further control for changes in sector affiliation, changes in firm size and changes from temporary to permanent contracts and vice versa ($\beta_5 change_{it}$).

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[11] We choose a two-year baseline to reduce potential anticipation effects in the year prior to the minimum wage introduction.

We analyse the change in the hourly wages of the "treated group" (hourly wages below €8.50) compared to the "control group" (hourly wages €8.50-€10.00). The groups show no significant differences with regard to age, gender, educational level, and migration background. We prefer the two-year analysis as it reduces the impact of short-term wage fluctuations, a lagged minimum wage implementation and an adjustment of the hiring behaviour. To enhance the robustness of the findings, we estimate additional model variants with different time horizons to reflect immediate (one-year analysis) and medium-term effects (three-year analysis). For example, the full effect of the minimum wage can only be considered in the longer timeframe when the transition periods in certain industries have expired. Perceptible anticipation effects of the minimum wage implementation, e.g., higher hourly wage growth rates in the lower wage segment between 2013 and 2014 compared to previous years, suggest that a one-year analysis from 2014 to 2015 may have limited validity. Supplementary model variants were conducted to reveal deviating effects of the introduction of the minimum wage on migrants and natives separately. For this purpose, two separate treatment groups are formed. These groups are further contrasted with the full control group to compare the effect between migrants and natives rather than to show a within-group effect.

5 Empirical Results

5.1 Effects on Hourly Wages

Table 3 summarizes the main causal estimation results for changes in contractual hourly wages for all workers eligible for the minimum wage. We present the results of the one-year analysis (columns 1-3), the two-year analysis (columns 4-6) and the three-year analysis (columns 7-9) and show the change in the hourly wage of the "treated group" (hourly wage below €8.50) compared to the "control group" (hourly wages €8.50-€10.00). The dependent variable is defined in logarithmic form so that the coefficients approximately reflect percentage changes. Columns (1), (4) and (7) display the results of the baseline specifications with the treatment indicators and the year fixed effects as control variables. In columns (2), (5) and (8), sociodemographic information has been provided. In columns (3), (6) and (9), we further control for occupational characteristics and changes in employment. Due to industry-specific transition periods for the implementation of the minimum wage until the end of 2017, the two-year analysis and the three-year analysis additionally include employees from industries that had completed their transition periods.[12]

The treatment group indicator illustrates the differential wage developments between the "treated group" and the "control group". We only consider people who are covered by the minimum wage introduction. Referring to the final specification of the two-year analysis, the wages of workers in the treated group grew on average 3.4 % faster than those of the "control group" between 2014 and 2016. Moreover, the interaction term (DTADD) describes an additional wage increase of 13.1 percentage points (ppts) for workers the treated group, which is attributable to the introduction of the minimum wage in 2015. The treatment effect is significant at the 1 % confidence level and remains highly significant even with the inclusion of additional control variables (Table 3). The placebo interaction term controls for our key

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[12] The results excluding the industries in the transition period can be found in Table A.1 in the appendix. As expected, the general wage increase as well as the minimum wage effects are higher, since the minimum wage had to be implemented immediately in the remaining industries.

assumption, i.e., whether the wages of the "treated group" and the "control group" have evolved identically in the pre-minimum wage period. Since the placebo coefficient is insignificant, we can assume that this is the case. The wages of both groups increased at relatively the same rate before the introduction of the minimum wage, which supports our main identifying assumption. The estimated wage increases can thus be interpreted as a causal result of the minimum wage introduction.

Immediately after the introduction of the minimum wage (one-year analysis), the estimated minimum wage effect for the treated group was initially only 10.6 %. We assume that this can be explained by a delay in the implementation of the minimum wage. The effect of the minimum wage introduction on the wage growth of the "treated group" decreases over time. The results for the three-year analysis show that wage growth in the "treated group" grew on average 7.4 % faster than in the "control group" between 2008 and 2017. Another 7.2 ppts are added by the introduction of the minimum wage. The three-year analysis even includes the increase in the minimum wage to €8.84 in 2017.

< Table 3 >

The wage growth of migrants in the "treated group" is lower, although the difference is not significant. In the two- and three-year analyses, the wage increase of migrant workers is approximately 1 to 2 ppts lower than that of native workers. To emphasize the different effects of the minimum wage introduction on individuals with and without a migration background, we perform a modification of the original model. Table 4 shows the results of the modified model, where the treated groups are defined according to the workers' migration background. In columns (1), (3) and (5), the "treated group" contains only natives with an hourly wage below €8.50. In columns (2), (4), and (6), these specifications are applied to migrants. The "control group" remains unchanged from the original model and includes all workers regardless of their migration background. Therefore, this model specification reveals the wage change of the "treated group" as well as the effect of the minimum wage introduction depending on the migration background compared to the control group.[13]

In all three annual analyses, the average wage growth of the "treated group" is almost similar for workers with and without a migration background. From 2014 to 2015 (one-year analysis), the average wage increase for migrants was 3.2 %, and therefore only slightly larger than that for natives (2.1 %). However, the introduction of the minimum wage resulted in an additional 12.7 ppts wage increase for native workers compared to the control group, while workers with a migration background only experienced an insignificant increase of 6.0 ppts (Table 4). Thus, the introduction of the minimum wage led, at least temporarily, to a slight divergence between workers with and without a migration background. In the period from 2014 to 2016 (two-year analysis), the minimum wage effect on migrants' wage growth now substantially exceeds that of natives. The minimum wage increases the wages of migrants by an additional 15.8 % compared to the "control group", while the additional rise for natives was 11.6 %. The wage increase caused by the minimum wage is now also significant for workers with a migration background. After three years, however (three-year analysis), the average hourly wage growth of native workers is again higher than that of migrants.

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[13] Table A.2 shows a model variant by migration background separately, e.g., treated-migrants versus untreated-migrants.

< Table 4 >

5.2 Effects on Working Hours and Monthly Wages

Rising hourly wages do not necessarily lead to higher monthly income. A possible response of employers to the additional costs caused by higher hourly wages is to reduce the weekly working hours of their employees. Since only full-time employment results in the minimum wage and provides an adequate monthly income, adjusting work hours could keep workers below this necessary monthly income threshold. Using our causal effects analysis, we estimate the changes in contractual weekly working hours for the "treated group" due to the introduction of the minimum wage. The results show a 4 to 8 % increase in weekly work hours for the treated group in the first and second years (see Table A.3 in the appendix). The introduction of the minimum wage, however, has slowed down growth considerably in working hours, as it can be attributed to a significant reduction of -6.6 % and -12.4 % in weekly working hours during the first and second years, respectively. Without the introduction of minimum wages, the increases would probably have been considerably larger. Although not significant, the weekly hours worked by migrants decreased on average slightly more than that of natives. These patterns are well reflected by the separate consideration of the migration-specified treated groups. The hours worked by native workers follow the previous trend, while those of migrants in the treated group, which had previously risen sharply, suddenly dropped with the introduction of the minimum wage (Figure 2).

< Figure 2 >

A detailed consideration of different employment statuses shows that there is a clear decrease in the number of hours worked in marginal employment, and the decline is more pronounced among migrants than among natives. Based on the same number of hours worked per week in marginal employment in 2014, a decrease of -16 % was recorded for migrants by 2016, while this was only -10 % for natives. This contrasts with slight increases in hours worked by migrants on a part-time basis (see Figure A.1 in the appendix). The decrease in weekly working hours in marginal employment from 2015 may be linked to the mini-job wage threshold of €450, which is achieved earlier by higher hourly wages. Thus, migrants in marginal employment experienced a comparatively larger reduction in hours worked with the introduction of the minimum wage, while they also face a comparatively larger increase in hours worked in part-time employment.

The evaluation of monthly salary confirms this indication of increased working hours among the "treated group" (Table 5). The monthly salary of this group grew by approximately 4 to 5 % after one to two years and by 7 % after three years. In addition, the introduction of minimum wages caused a further increase of 5 to 8 ppts. Within the "treated group", the increase in monthly salary for natives was only marginally higher than that of migrants. Therefore, it can be assumed that there are no significant differences between the two groups in terms of their monthly salary growth.

< Table 5 >

5.3 Employment Effects

While employment losses were observed primarily in marginal employment, employment in full-time and part-time remained almost unaffected (e.g., Bonin et al. 2018, Caliendo et al. 2018, Holtemöller & Pohle 2019). Figure 3 illustrates the shifts in the proportions of employment status as indices presented separately for migrants and natives.[14] The patterns shown are descriptive evaluations that cannot necessarily be causally attributed to the introduction of the minimum wage, although a direct influence is obvious. As in the existing literature, we find no appreciable deviations from the previous trend with respect to the share of full-time employed persons among migrants or natives (Figure 3, tile a). Nevertheless, there is a small dip in the share of full-time employment prior to the minimum wage introduction, which is subsequently compensated only by natives, but not by migrants. As a result, the gap between these two groups widens again.

< Figure 3 >

The average share of part-time employment has increased steadily since the economic crisis of 2008/09. In the years immediately preceding the minimum wage introduction in 2015, however, part-time employment among migrants experienced a brief drop, only to subsequently grow again at a much faster rate than among natives (Figure A.2). During the implementation of the minimum wage, however, there was a noticeably higher growth rate for migrants than for natives. While the curve for natives continues to rise unabated, the rate of increase for migrants following the introduction of the minimum wage is substantial (Figure 3, tile b). Related evidence shows the largest employment effects from the minimum wage in the case of marginal employment. In contrast, we find a flattening trend in the share of marginal employment prior to the minimum wage changing into only slight falling shares after the minimum wage was introduced (Figure 3, tile c). This trend is particularly pronounced for migrants (Figure A.2). Thus, the introduction of the minimum wage has not induced a significant shift away from precarious employment, but it has slowed it down. As the shares of migrants and natives shifted differently before the introduction of the minimum wage, it is difficult to determine to what extent migrants were more affected by the decline in mini-jobs. Based on the previous trend, it can be assumed that the favourable development would not have taken place without the introduction of minimum wages. Finally, the share of unemployed persons has been steadily decreasing overall (Figure 3, tile d). However, the drop in the unemployment share after the introduction of the minimum wage introduction has not been as pronounced for migrants as it has been for natives. While the unemployment rate among natives has fallen sharply, it has declined only slightly among migrants (Figure A.2). Natives may have been less affected than migrants by job losses after the introduction of the minimum wage. Overall, we interpret this evidence as indicating that the introduction of the minimum wage worsened the labour market position of migrants compared to that of natives. Although part-time employment among migrants has increased at an above-average rate, full-time employment has declined more sharply, while the rates of mini-jobs and unemployment have fallen less substantially.

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[14] On overview of yearly relative changes in the proportions of employment status can be found in Figure A.2 in the appendix. Absolute changes in employment cannot be measured with the SOEP.

5.4 Spillover Effects

The results of the final model specification show growth rates of the hourly wage attributable to the minimum wage introduction, namely 10.6 % in the first year, 13.1 % in the second year, and 7.4 % in the third year for the "treated group" (<€8.50/hour) compared to the "control group" (€8.50-€10.00/hour) (see Table 3). To check the robustness of our estimated minimum wage effect in the "treated group's" wage development with regard to its causality, we check whether our "control group" is unaffected by the introduction of the minimum wage. A comparison of the "treated group" with the "peer group" (€10.00-€12.00/hour) will show us whether there are differences in the minimum wage effect compared to the "control group". Assuming that the wage development of the "control group" is mostly unaffected by the introduction of the minimum wage, positive differences in the effect size can be associated with a wage spillover from the "treated group" to the "control group".

The results reveal that the introduction of the minimum wage increased the hourly wages of the "treated group" by 13.2 % in the first year, 19.1 % in the second year and 14.1 % in the third year compared to the "peer group" (see Table A.4 in the appendix, columns 1-3). The observed wage effect is thus substantially higher than the "control group". This implies that the difference in effects represents a possible wage spillover from the minimum wage introduction. If no spillover effects had occurred as a result of the minimum wage introduction, the wages of the "treated group" should have increased by only 7.2 % in the first year (10.2 %, 3.0 ppts), 7.3 % in the second year (13.2 %, 5.9 ppts), and 4.3 % in the third year (9.2 %, 4.9 ppts) relative to the "control group". Moreover, a comparison between the "control group" and the "peer group" shows insignificant differences in the general wage development as well as small and largely insignificant effect sizes of the wage development due to the introduction of the minimum wage (see Table A.4, columns 4-6). These results strengthen the conclusion that wage spillover into the "control group" has occurred.

6 Changes in the Wage Distribution

The introduction of the minimum wage has led to above-average wage increases at the lower end of the wage distribution and further wage spillover effects into higher wage groups (see Section 5.4). Among low-wage earners, the share of migrants is disproportionately large, so this group of workers should have received strong wage increases due to the minimum wage. Figure 4 displays the ratios between the 10th, 20th and 50th wage percentiles of employees with a migration background versus native employees (reference=1) from 2007 to 2017. The smaller the gap to the reference, the closer the wage percentiles of migrants and natives. In the period from 2009 to 2014, the wage differences of the 10th, 20th and 50th percentiles between workers with and without a migration background increased significantly. A particularly high increase in wage divergence can be observed in 2013 and 2014. In the year before the introduction of the minimum wage, the differences in the wage percentiles between migrants and natives were approximately 12 to 14 % (0.863-0.873). Directly after the minimum wage introduction, there is a visible wage convergence across the lower wage distribution between both groups. The strongest wage convergence is observed at the 10th wage percentile, with an interim divergence in 2017 of only 8 % (0.917). The 20th and 50th wage percentiles also show a reduction in differences, which, however, started to widen

again two years after the introduction of the minimum wage. The wage divergence in 2017 between migrants and natives was 11 % (0.889) at the 20th wage percentile and 13 % (0.868) at the 50th wage percentile. Thus, wage inequality in 2007 was greater than in the period from 2009 to 2012 (Figure 4).

< Figure 4 >

The changes at the lower end of the wage distribution during the introduction of the minimum wage also had an impact on the overall wage distribution. The wage distribution of migrants has partly converged towards the wage distribution of natives. Figure 5 shows the deviation of the proportion of employees with migration backgrounds within the wage deciles of employees without migration backgrounds for the periods 2012-2014 and 2015-2017. For example, a deviation within a wage decile of 0.05 means that the share of migrants is 5 ppts higher than the share of natives. The sum of all ten deviations is zero by definition. In the period 2012-2014, migrants over-proportionally fell into the first to third wage deciles of natives (+5.9 to +3.6 ppts). While they nearly corresponded to each other in the fourth to sixth wage decile (+1.0 to -1.4 ppts), migrants were strongly underrepresented in the seventh and tenth wage deciles (-2.3 to -4.6 ppts). The underlying numbers for the figure can be found in Table A.5 in the appendix.

< Figure 5 >

Since migrants are disproportionately overrepresented in the low-wage sector, they should have experienced more comprehensive wage increases than natives. In the period 2015-2017, however, we observe an increase in inequality in the first wage decile between employees with and without a migration background towards the period 2012-2014 (Figure 5). In the second and third wage deciles, however, the deviation between migrants and natives is mitigated but at the expense of the fourth wage decile. This finding confirms the wage compression slightly above minimum wage. Thus, a clear overrepresentation of migrants remains in the lower wage deciles. The substantial underrepresentation of migrants in the higher wage deciles persisted (sixth to tenth), albeit with a slight decrease compared to 2012-2014 in the ninth and tenth wage decile. However, this is not linked to the minimum wage introduction at all. A further illustration of various wage ratios confirms that the introduction of the minimum wage has been accompanied by a slight wage convergence, which is mainly due to wage increases in the lowest deciles (see Figure A.3 in the appendix).

The introduction of the minimum wage has led to shifts in the wage structure, thus changing the likelihood of working in the low-wage sector. Although insignificant, we observe different effects for migrants and natives: For natives, the introduction of the minimum wage has led to a reversal of the trend, so that with a time lag, the probability made an upwards turn. Among migrants, on the other hand, a steady increase in the probability of working in the low-wage sector can initially be observed. In 2015 and 2016, there was a significant short-term decline before the probability rose rapidly thereafter (see Figure A.4 in the appendix). One possible explanation for the negative turns for both groups could be the fact that the median wage increased more than the subsequent minimum wage raises, elevating the low-wage threshold.

7 Discussion

Our analyses demonstrate that the introduction of the statutory minimum wage in Germany in 2015 led to excessive wage development in the lower income levels as well as to shifts in employment status. Our results show a large significant effect of 10 to 13 % on the hourly wages after one to two years that can be attributed to the introduction of the minimum wage. The effects we observe are larger than those of Burauel et al. (2020) and Dustmann et al. (2021) by approximately 7 %. Our findings further reveal that not all workers in the "treated group" benefited equally from wage increases. The minimum wage effect for migrants (6 %) is less substantial than that for natives (13 %). An explanation for the increase in the effect size for migrants in the second year (16 %) might be due to progressing workplace effects. Job cuts for lower-skilled workers may have promoted this wage effect. In addition, the completion of the transition periods and the associated consideration of industries with comparatively low wages may have increased the effect. We obtain comparatively weaker wage performance for migrants relative to natives in the longitudinal comparison, contrary to the pooled descriptive cross-sectional comparison in the lower deciles (Table 1). The probability of remaining employed prior to the minimum wage introduction is – according to our own calculations – lower for migrants relative to natives, leaving potentially low-wage migrants out of the sample and thus excluding their potential high wage growth in the longitudinal comparison.

Separate model specifications with migration-related treatment groups confirm the weaker wage growth of migrants in response to the minimum wage (Table 3). We therefore conclude that the introduction of the minimum wage only temporarily turned the previously perceptible wage divergence into a wage convergence between these two groups. A before-after comparison of the relative wage distribution of migrants compared with the wage distribution of native workers confirms a widening in the gap at the lower end of the wage distribution between these two groups. The growth in inequality is shown by an increased wage divergence around the introduction of the minimum wage as well as a slight reduction afterwards. Absent effects on full- and part-time employment have thus far only been found for the total workforce (Caliendo et al. 2018). Our results show that this holds only for natives, while migrants experienced a comparatively high increase in part-time employment and, at the same time, an increase in moving from employment to unemployment.

The minus in monthly salaries for migrants in comparison to natives is even larger than for hourly wages. The differences in monthly wages between these two groups have substantially widened after the introduction of the minimum wage, most likely caused by a deterioration in employment status. These developments could reinforce the labour market segmentation. Butschek (2022) provides a possible explanation for why monthly wages have fallen and unemployment rates have declined less among migrants. According to his findings, hiring standards have increased following the introduction of the minimum wage, as the "demand for a higher quality workforce" has increased. Migrants have comparatively less competitive labour market characteristics on average, putting them in a worse position than natives when seeking employment. This explanatory approach builds on the findings of Edo & Rapoport (2019), in which (too) high minimum wages – as in Germany – protect native workers from competition with migrants with similar qualifications. This may negatively affect wage inequality between

those groups. This also explains why the sharp decline in the number of hours worked per week is evident among migrants in the "treated group" but not for natives.[15]

Overall, the introduction of the minimum wage has helped to improve the wage level of workers in the low-wage sector but partly at the cost of employment relationships. Nevertheless, the overrepresented groups of migrants benefited less from the minimum wage, as their hourly wages increased less than those of natives did. At the same time, their share of full-time employment has declined slightly, while their share of part-time employment and unemployment has comparatively increased. Based on our findings, we expect that the rise in the statutory minimum wage in October 2022 could lead to further inequality for disadvantaged groups in the German labour market. Due to its substantially high increase from €9.82/hour (until June 2022) to €12.00/hour in October 2022 (+22 %), the minimum wage will thus be approximately 60 % of the median income in 2022. As Edo & Rapoport (2019) state, this high wage level may lead to a further reduction in the competitiveness of migrants relative to natives. Combining the evidence provided in our paper with this finding, we expect that negative effects for migrants will be exacerbated by the minimum wage increase: This includes the wage divergence caused by the introduction of the minimum wage, together with a more adverse employment trend for migrants. Our analysis shows that the minimum wage −, although intended as a holistic social protection measure −, does not consider vulnerable groups, such as (ethnic) minorities or migrants. The intensified competitive situation can therefore lead to an increase in statistical discrimination, which would further exacerbate increased labour market segregation. We therefore question whether the introduction of the "poverty-proof minimum wage" (BMAS 2022) will also help migrants and other minorities.

8 Conclusion

In this paper, we analyse the development in wages and the employment of German workers in following the statutory minimum wage introduction in 2015. The objective of the paper is to examine potentially different minimum wage effects on natives and migrants. To the best of our knowledge, this is the first study that explicitly addresses the impact of the minimum wage introduction on disadvantaged groups in Germany. Using a causal effects analysis, we compare the impact of the minimum wage on hourly and monthly wages between workers with migration background ("migrants") and those without migration background ("natives"). This approach enables us to determine whether workers below the minimum wage threshold have benefited more than those above the threshold. The effect of the minimum wage is estimated using a "differential trend adjusted difference-in-differences" (DTADD) approach, in which the observed wage change in the treated group is contrasted with the (counterfactual) wage change in the control group. We further use comprehensive descriptive evidence to evaluate changes in employment status and wage distribution to obtain a holistic picture of the impacts of the minimum wage.

The results of the causal effect analysis show that the introduction of the minimum wage caused a different impact on the hourly wages of natives than on the wages of migrants. In the first year, hourly wage growth rates attributable to the introduction of the minimum wage were 12.7 % for natives and only 6.0 % for migrants in the wage group below €8.50/hour. Only in the second year after the introduction of the

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[15] Identified for the workforce also by Bonin et al. (2020).

minimum were larger positive wage effects discernible for migrants, which had already disappeared by the third year. We further observe a less positive development of monthly wages for migrants, which can be attributed largely to a deterioration in their employment status. Subsequent descriptive analyses support the comparatively worse effects on migrants shown by our causal evaluation. The share of part-time employment rises sharply after the introduction of the minimum wage, while the share of unemployed persons does not fall as it does among native workers. Trends in full-time and marginal employment also show a worse outcome for migrants. The introduction of the minimum wage in Germany therefore increased the risk of labour market segmentation.

These stated shifts also affected the distribution of wages. In the course of the introduction of the minimum wage, we observe a temporary wage divergence between workers with and without a migration background in the lower deciles. This is particularly pronounced in the 10th wage percentile and to smaller extents up to the 50th wage decile. A before-after comparison of the relative wage distribution of migrants compared to the wage distribution of native workers confirms that the gap between the two groups in the first and second wage deciles has been widening as a result. There has been a wage compression just above the minimum wage threshold and slight wage spillover in adjacent wage deciles.

We emphasize that one of the main objectives, the reduction of inequality, was not achieved. The introduction of the minimum wage is associated with significant wage increases in the lowest wage brackets; however, migrants experienced this only to a limited extent. In addition to a wage divergence at the lower end of the wage distribution between the two groups, the share of part-time employment and unemployment grew adversely among migrants, which may have cushioned wage developments. In view of the weaker wage development due to the minimum wage and a comparatively disadvantageous change in the employment status of migrants, it is even reasonable to suggest a decline in their labour market position. Based on our evidence on the introduction of the minimum wage, we expect the minimum wage increase in October 2022 to negatively affect disadvantaged groups. This large minimum wage increase will intensify competition between migrants and natives in Germany. When we extrapolate our evidence to the current setting, wages and employment between migrants and natives at the lower end of the wage distribution will further diverge – at the cost of migrants.

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Tables

Table 1: Workers' characteristics by migration background 2012-2014 and changes towards 2015-2017

Characteristics of workers	Migrants mean, 2012-2014	Migrants change towards 2015-2017 absolute	Migrants change towards 2015-2017 %	Natives mean, 2012-2014	Natives change towards 2015-2017 absolute	Natives change towards 2015-2017 %
Labour force participation	0.73	0.02	3***	0.75	0.01	1***
… employed	0.88	0.00	0	0.93	0.01	1
… registered unemployed	0.13	0.00	1	0.07	-0.01	-12***
Salary						
gross hourly wage	15.54	1.61	10***	17.83	1.52	9***
Std. Dev.	8.82	1.12	13***	10.65	2.17	20***
p10	7.07	0.98	14***	8.05	0.92	11***
p15	7.66	0.96	13***	8.96	0.89	10***
p20	8.62	0.71	8***	9.96	0.93	9***
p50	13.79	1.15	8***	15.80	1.44	9***
gross monthly wage	2,277.32	2,548.31	12***	2,712.54	2,886.46	6***
Employment						
working hours (contractual)	33.24	33.23	0	34.43	34.04	-1***
full-time employment	0.68	0.00	0	0.70	-0.01	-2***
part-time employment	0.19	0.01	8**	0.21	0.02	10***
marginal employment	0.13	-0.01	-9**	0.08	0.00	-2
Qualification						
low-skilled	0.41	-0.03	-6***	0.24	-0.02	-7***
medium-skilled	0.34	0.01	2	0.49	0.00	0
high-skilled	0.25	0.02	9***	0.27	0.02	6***
labour market experience	14.40	0.44	3**	18.89	0.35	2***
job tenure	7.48	0.30	4**	12.05	0.11	1
Company						
firm size: <20 empl.	0.24	0.02	7**	0.20	-0.01	-3*
firm size: 20-199 empl.	0.26	-0.02	-8***	0.26	-0.02	-6***
firm size: 199-1999 empl.	0.21	0.00	-1	0.22	0.00	1
firm size: >2000 empl.	0.28	0.01	5*	0.29	0.03	10***
Personal information						
age	39.70	0.94	2***	44.17	0.79	2***
gender (male=1)	0.55	-0.02	-4***	0.51	-0.01	-1
No. of observations	**8,890**	**7,327**		**30,065**	**23,613**	

Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36 2012-2017, own calculations incl. survey weights.

Table 2: Treated group and control groups

group	wages in 2013/14	wage changes towards 2015/16
treated group	< €8.50	▪ (subordinate) overall wage trend ▪ wage increase above the threshold of €8.50
control group	€8.50-€10.00	▪ overall wage trend ▪ small additional wage increase due to indirect effects of the minimum wage introduction
peer group	€10.00-€12.00	▪ overall wage trend ▪ (almost) unaffected by the minimum wage introduction

Source: Own illustration.

Table 3: Minimum wage effect on hourly wage growth

	One-Year Analysis			Two-Year Analysis			Three-Year Analysis		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
One-Year Analysis									
Hourly wage < €8.50	0.030**	0.035***	0.030**						
✕ DTADD 2014-2015	0.110***	0.110***	0.106***						
✕ Placebo 2012-2013	-0.063**	-0.063**	-0.049*						
✕ migration background		-0.018	-0.018						
Two-Year Analysis									
Hourly wage < €8.50				0.050***	0.049***	0.034*			
✕ DTADD 2014-2016				0.138***	0.135***	0.131***			
✕ Placebo 2010-2012				-0.062	-0.059	-0.042			
✕ migration background					-0.004	-0.010			
Three-Year Analysis									
Hourly wage < €8.50							0.078***	0.079***	0.074***
✕ DTADD 2014-2017							0.094***	0.092***	0.072***
✕ Placebo 2008-2011							-0.095*	-0.087*	-0.035
✕ migration background								-0.009	-0.021
Control Variables									
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Socio-demographic info.		yes	yes		yes	yes		yes	yes
Job characteristics			yes			yes			yes
Changes in employment			yes			yes			yes
Constant	0.019	0.082***	0.023	0.033	0.095*	0.090	0.039*	0.144***	0.182**
Observations	2,188	2,181	1,959	2,536	2,527	2,231	2,625	2,616	2,263
Adj. R^2	0.060	0.063	0.064	0.081	0.084	0.094	0.085	0.092	0.103

Dependent variable: Logarithmic change in gross hourly wage. Control group: €8.50 to <€10.00. Robust standard errors, clustered at the individual level. Significance levels: * $p<0.1$, ** $p<0.05$, *** $p<0.01$.
Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36 2008-2017, own calculations.

Table 4: Minimum wage effect on hourly wage growth by migration background

	One-Year Analysis		Two-Year Analysis		Three-Year Analysis	
	Natives	**Migrants**	**Natives**	**Migrants**	**Natives**	**Migrants**
	(1)	(2)	(3)	(4)	(5)	(6)
Two-Year Analysis						
Hourly wage < €8.50[1]	0.021	0.032				
× DTADD 2014-2015[2]	0.127***	0.060				
× Placebo 2012-2013[2]	-0.045	-0.030				
Two-Year Analysis						
Hourly wage < €8.50[1]			0.037**	0.035		
× DTADD 2014-2016[2]			0.116***	0.158***		
× Placebo 2010-2012[2]			-0.034	-0.147		
Three-Year Analysis						
Hourly wage < €8.50[1]					0.072***	0.085**
× DTADD 2014-2017[2]					0.081**	0.022**
× Placebo 2008-2011[2]					-0.035	0.049
Control Variables						
Year fixed effects	yes	yes	yes	yes	yes	yes
Socio-demographic info.	yes	yes	yes	yes	yes	yes
Job characteristics	yes	yes	yes	yes	yes	yes
Changes in employment	yes	yes	yes	yes	yes	yes
Constant	0.008	0.084	0.079	0.123	0.180**	0.138
Observations	1,597	1,006	1,922	1,083	2,006	1,058
Adj. R^2	0.084	0.023	0.103	0.062	0.110	0.079

Dependent variable: Logarithmic change in gross hourly wage. Robust standard errors, clustered at the individual level. Significance levels: * $p<0.1$, ** $p<0.05$, *** $p<0.01$.
1) Treated group: (1),(3),(5) no migration background, (2),(4),(6) migration background. Control group (1)-(6): all workers.
2) DTADD and placebo are the respective different interaction terms, depending on the treated group.
Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36 2008-2017, own calculations.

	One-Year Analysis		Two-Year Analysis		Three-Year Analysis	
	Natives	**Migrants**	**Natives**	**Migrants**	**Natives**	**Migrants**
	(1)	(2)	(3)	(4)	(5)	(6)

Table 5: Minimum wage effect on relative monthly salary growth

	One-Year Analysis			Two-Year Analysis			Three-Year Analysis		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
One-Year Analysis									
Hourly wage < €8.50	0.070***	0.071***	0.040**						
× DTADD 2014-2015	0.071**	0.073**	0.055*						
× Placebo 2012-2013	-0.075**	-0.073**	-0.080**						
× Migration background		-0.004	-0.014						
Two-Year Analysis									
Hourly wage < €8.50				0.098***	0.100***	0.047**			
× DTADD 2014-2016				0.094**	0.092**	0.081**			
× Placebo 2010-2012				-0.154***	-0.148***	-0.128**			
× Migration background					-0.004	-0.004			
Three-Year Analysis									
Hourly wage < €8.50							0.115***	0.130***	0.073***
× DTADD 2014-2017							0.063	0.065	0.047
× Placebo 2008-2011							-0.151**	-0.148**	-0.036
× Migration background								-0.091	-0.056
Control Variables									
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Socio-demographic info.		yes	yes		yes	yes		yes	yes
Job characteristics			yes			yes			yes
Changes in employment			yes			yes			yes
Constant	0.056***	0.256***	0.137**	0.121**	0.396***	0.271**	0.053	0.463***	0.348***
Observations	2,259	2,252	2,006	2,709	2,700	2,335	2,866	2,857	2,408
Adj. R^2	0.019	0.038	0.081	0.025	0.048	0.131	0.034	0.074	0.153

Dependent variable: Logarithmic change in gross monthly wage. Control group: €8.50 to < €10.00. Robust standard errors, clustered at the individual level. Significance levels: * $p<0.1$, ** $p<0.05$, *** $p<0.01$.
Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36 2008-2017, own calculations.

Figures
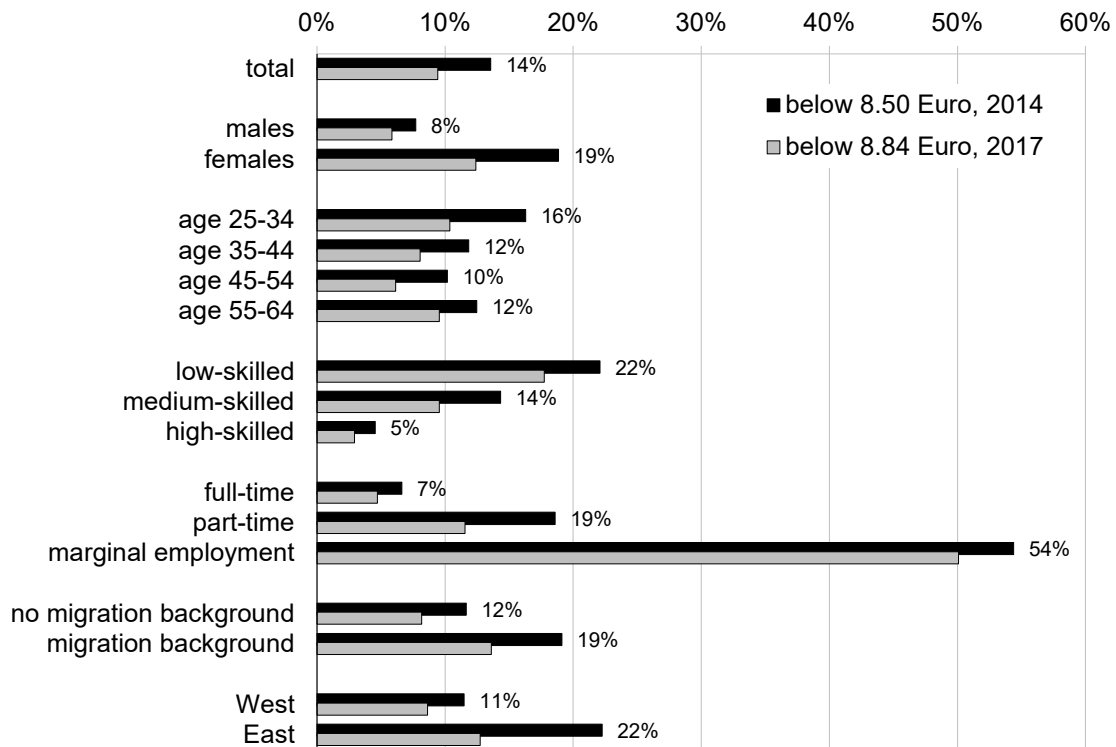
Figure 1: Employees with gross wages below minimum wage by categories

Gross hourly wage calculated on the basis of contractual hours worked. Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36. Own calculations. Illustration based on Amlinger et al. (2016).
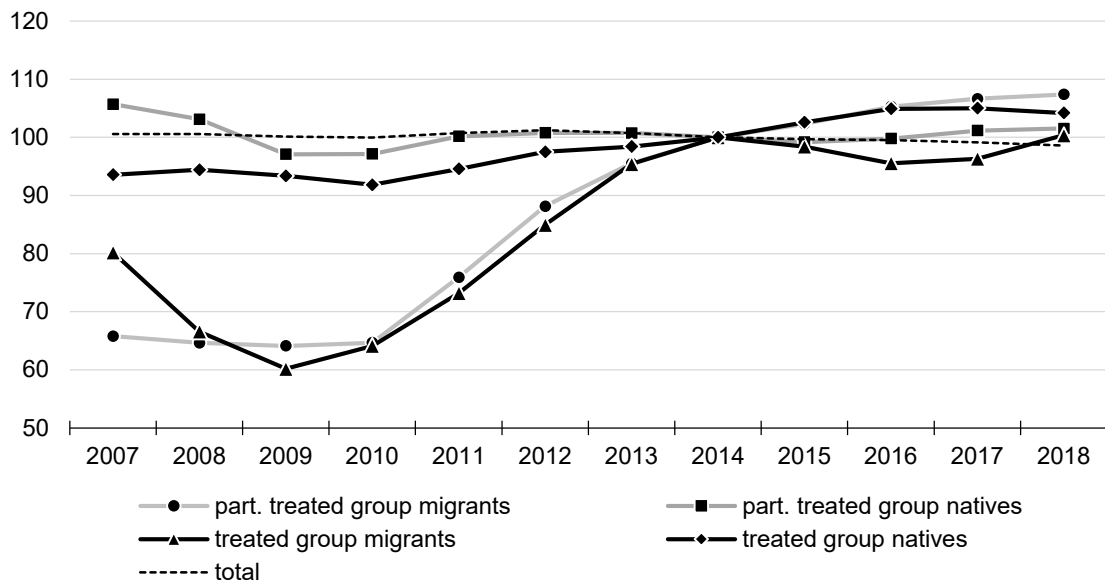
Figure 2: Development of contractual weekly working hours by migration background

Index 2014=100. Index is smoothed with adjacent years. Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Hourly wage of the "treated group" (<€8.50) and the "control group" (€8.50-10.00) in 2013/14. Source: SOEP v36, 2007-2017. Own calculations incl. survey weights.

(a) Full-time employment

(b) Part-time employment

(c) Marginal employment

(d) Unemployment

Figure 3: Developments in employment status

Index 2014=100. Index is smoothed with adjacent years. Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36, 2007-2017. Own calculations incl. survey weights.
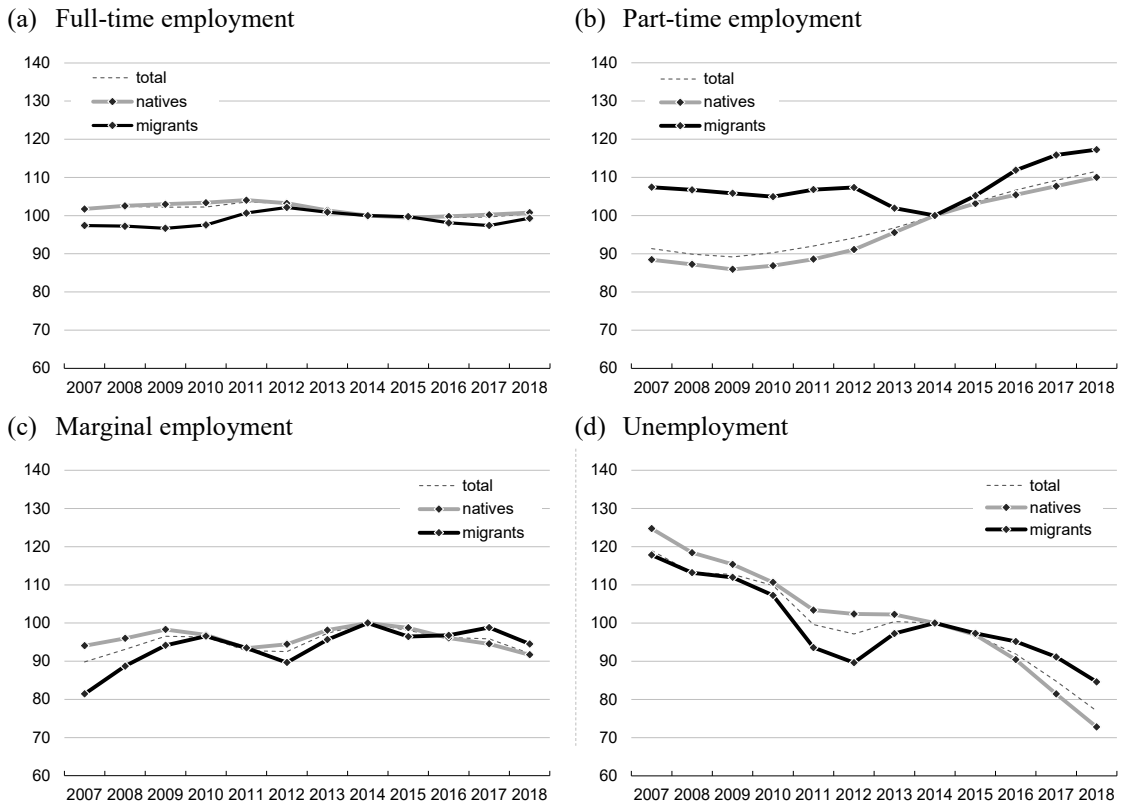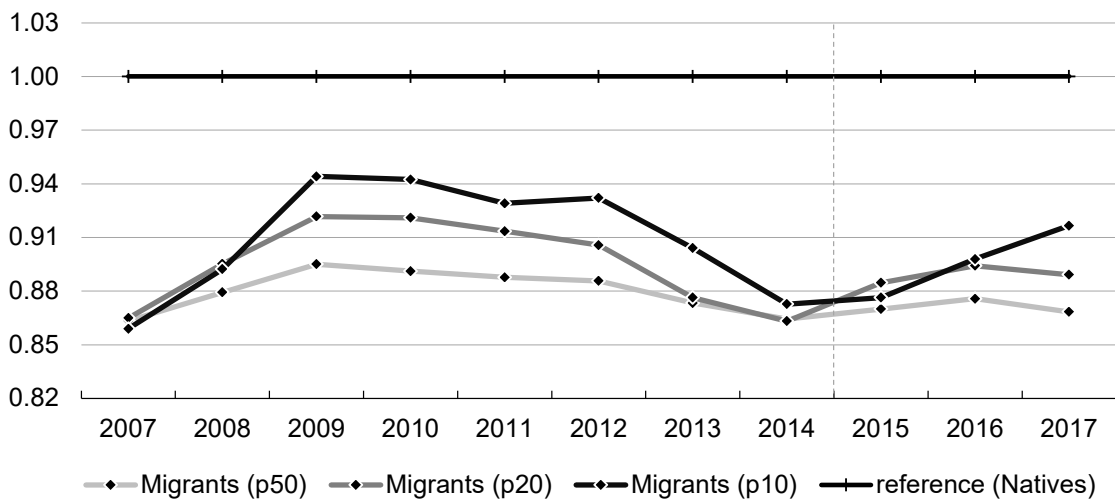
Figure 4: Wage convergence by selected wage percentiles

Ratio between the 10th, 20th and 50th wage percentiles of employees with a migration background to employees without a migration background (reference=1), 2017-2017. Wage ratios are smoothed with adjacent years. Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36. Own calculations incl. survey weights.
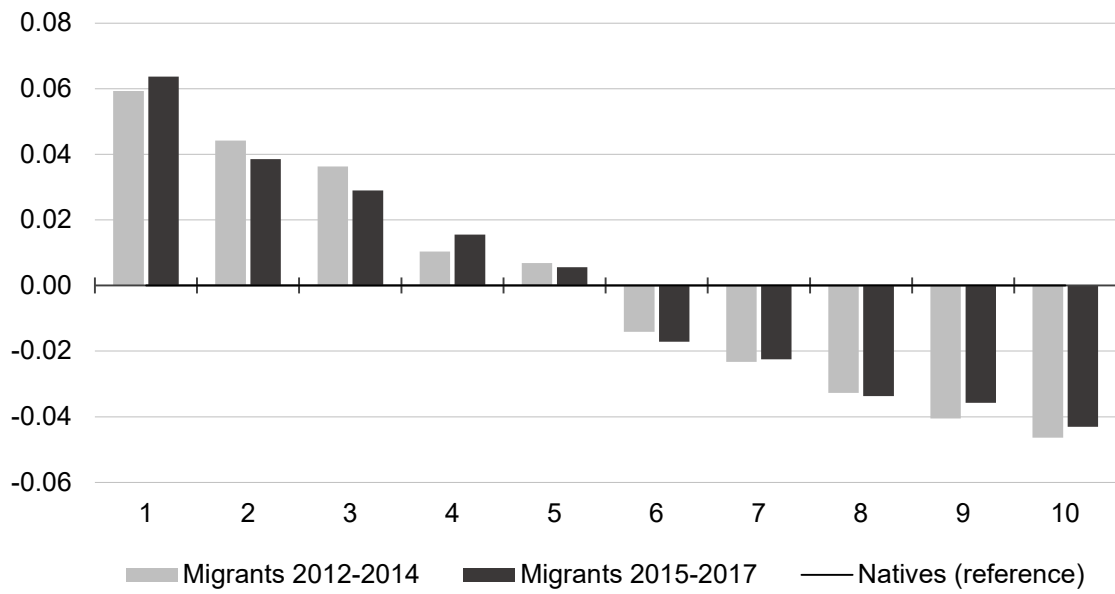
Figure 5: Deviation of migrants' wage by the wage deciles of natives

Deviation of the proportion of employees with migration background within the wage deciles of employees without migration background, 2012-2014 and 2015-2017. Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36. Own calculations incl. survey weights. Illustration based on Clark & Nolan (2021).

Appendix

Tables

Table A.1: Minimum wage effect on hourly wage growth without branches in transition period

	One-Year Analysis			Two-Year Analysis			Three-Year Analysis		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
One-Year Analysis									
Hourly wage < €8.50	0.030**	0.035***	0.031**						
✕ DTADD 2014-2015	0.109***	0.108***	0.106***						
✕ Placebo 2012-2013	-0.063**	-0.063**	-0.049*						
✕ migration background		-0.018	-0.020						
Two-Year Analysis									
Hourly wage < €8.50				0.050***	0.04950***	0.035**			
✕ DTADD 2014-2016				0.146***	0.143***	0.136***			
✕ Placebo 2010-2012				-0.062	-0.060	-0.043			
✕ migration background					-0.007	-0.013			
Three-Year Analysis									
Hourly wage < €8.50							0.077***	0.079***	0.075***
✕ DTADD 2014-2017							0.095***	0.094***	0.075***
✕ Placebo 2008-2011							-0.094*	-0.087*	-0.035
✕ migration background								-0.008	-0.024
Control Variables									
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Socio-demographic info.		yes	yes		yes	yes		yes	yes
Job characteristics			yes			yes			yes
Changes in employment			yes			yes			yes
Constant	0.019	0.080**	0.020	0.033	0.091*	0.084	0.039*	0.144***	0.182**
Observations	2,147	2,140	1,921	2,507	2,498	2,208	2,599	2,590	2,245
Adj. R^2	0.057	0.061	0.060	0.082	0.085	0.095	0.087	0.094	0.105

Dependent variable: Logarithmic change in gross hourly wage. Control group: €8.50 to < €10.00. Robust standard errors, clustered at the individual level. Significance levels: * $p<0.1$, ** $p<0.05$, *** $p<0.01$.
Note: Self-employed, apprentices, intern, and handicapped workers in sheltered workshops, branches with industrial wage floors, and branches in transition period are excluded. Source: SOEP v36 2008-2017, own calculations.

Table A.2: Minimum wage effect on hourly wage growth separately by migration background

	One-Year Analysis		Two-Year Analysis		Three-Year Analysis	
	Natives	**Migrants**	**Natives**	**Migrants**	**Natives**	**Migrants**
	(1)	(2)	(3)	(4)	(5)	(6)
One-Year Analysis						
Hourly wage < €8.50	0.018	0.057**				
✕ DTADD 2014-2015	0.128***	0.050				
✕ Placebo 2012-2013	-0.030	-0.109				
Two-Year Analysis						
Hourly wage < €8.50			0.029*	0.036		
✕ DTADD 2014-2016			0.130***	0.171**		
✕ Placebo 2010-2012			-0.052	-0.013		
Three-Year Analysis						
Hourly wage < €8.50					0.064***	0.081
✕ DTADD 2014-2017					0.090***	0.044
✕ Placebo 2008-2011					-0.023	-0.039
Control Variables						
Year fixed effects	yes	yes	yes	yes	yes	yes
Socio-demographic info.	yes	yes	yes	yes	yes	yes
Job characteristics	yes	yes	yes	yes	yes	yes
Changes in employment	yes	yes	yes	yes	yes	yes
Constant	-0.013	0.229**	0.111	0.042	0.209***	0.267
Observations	1,424	535	1,754	477	1,852	411
Adj. R^2	0.085	0.021	0.112	0.078	0.112	0.092

Dependent variable: Logarithmic change in gross hourly wage. Control group: €8.50 to < €10.00. Robust standard errors, clustered at the individual level. Significance levels: * $p<0.1$, ** $p<0.05$, *** $p<0.01$.
Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36 2008-2017, own calculations.

Table A.3: Minimum wage effect on contractual weekly working hours

	One-Year Analysis		Two-Year Analysis		Three-Year Analysis	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
One-Year Analysis						
Working hours < €8.50	0.125***	0.041*				
✕ DTADD 2014-2015	-0.078**	-0.066*				
✕ Placebo 2012-2013	-0.039	-0.035				
✕ Migration background	-0.003	-0.006				
Two-Year Analysis						
Working hours < €8.50			0.127***	0.080***		
✕ DTADD 2014-2016			-0.072	-0.124***		
✕ Placebo 2010-2012			-0.095	-0.193**		
✕ Migration background			-0.010	0.007		
Three-Year Analysis						
Working hours < €8.50					0.131***	0.023
✕ DTADD 2014-2017					-0.035	-0.048
✕ Placebo 2008-2011					-0.081	0.012
✕ Migration background					-0.121	-0.049
Control Variables						
Year fixed effects	yes	yes	yes	yes	yes	yes
Socio-demographic info.	yes	yes	yes	yes	yes	yes
Job characteristics		yes		yes		yes
Changes in employment		yes		yes		yes
Constant	0.277***	0.087	0.490***	0300**	0.521***	0.510***
Observations	2,187	1,964	2,537	2,240	2,623	2,270
Adj. R^2	0.019	0.094	0.019	0.109	0.033	0.121

Dependent variable: Relative change in contractual working hours of workers with hourly wage below €8.50 in 2013/14. Control group: €8.50 to €10.00. Robust standard errors, clustered at the individual level.
Significance levels: * $p<0.1$, ** $p<0.05$, *** $p<0.01$.
Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36, 2008-2017. Own calculations.

Table A.4: Minimum wage effect on hourly wage growth with different comparison groups

	≤€8.50 (T) vs. €10.00-€12.00 (C)			€8.50-€10.00 (T) vs. €10.00-€12.00 (C)		
	1 year	**2 year**	**3 year**	**1 year**	**2 year**	**3 year**
	(1)	(2)	(3)	(4)	(5)	(6)
One-Year Analysis						
Hourly wage < €8.50	0.023*			-0.008		
× DTADD 2014-2015	0.132***			0.025		
× Placebo 2012-2013	-0.053*			-0.015		
Two-Year Analysis						
Hourly wage < €8.50		0.020			-0.016	
× DTADD 2014-2016		0.191			0.058**	
× Placebo 2010-2012		-0.039			0.015	
Three-Year Analysis						
Hourly wage < €8.50			0.051***			-0.016
× DTADD 2014-2017			0.141***			0.044
× Placebo 2008-2011			-0.008			0.021
Control Variables						
Year fixed effects	yes	yes	yes	yes	yes	yes
Socio-demographic info.	yes	yes	yes	yes	yes	yes
Job characteristics	yes	yes	yes	yes	yes	yes
Changes in employment	yes	yes	yes	yes	yes	yes
Constant	0.008	-0.002	0.111	0.005	-0.026	0.089
Observations	2,148	2,560	2,712	1,524	1,916	2,071
Adj. R^2	0.068	0.081	0.082	0.012	0.009	0.020

Dependent variable: Logarithmic change in contractual working hours. Robust standard errors, clustered at the individual level. Significance levels: * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36, 2008-2017. Own calculations.

Table A.5: Number, share and deviation of migrants' wage by the wage deciles of natives

						2012-2014
decile	wage decile cap, in Euro	number of natives	number of migrants	share of natives	share of migrants	deviation migrants to natives
1	8.05	3,089	1,407	0.114	0.174	0.059
2	10.23	2,565	1,128	0.095	0.139	0.044
3	12.26	2,772	1,126	0.103	0.139	0.036
4	14.08	2,639	876	0.098	0.108	0.010
5	15.80	2,423	783	0.090	0.097	0.007
6	17.82	2,507	638	0.093	0.079	-0.014
7	20.31	2,490	559	0.092	0.069	-0.023
8	23.65	2,649	530	0.098	0.065	-0.033
9	30.06	2,879	536	0.107	0.066	-0.041
10	max.	2,970	516	0.110	0.064	-0.046
sum		**26,983**	**8,099**	**1.000**	**1.000**	**0.000**

						2015-2017
decile	wage decile cap, in Euro	number of natives	number of migrants	share of natives	share of migrants	deviation migrants to natives
1	8.97	2,184	1,069	0.102	0.162	0.060
2	11.03	2,169	912	0.101	0.138	0.037
3	13.24	2,205	868	0.103	0.131	0.028
4	15.09	2,059	740	0.096	0.112	0.016
5	17.24	2,321	759	0.108	0.115	0.007
6	19.36	1,730	425	0.081	0.064	-0.016
7	21.98	2,060	495	0.096	0.075	-0.021
8	25.54	2,055	415	0.096	0.063	-0.033
9	32.02	2,232	459	0.104	0.069	-0.035
10	max.	2,418	467	0.113	0.071	-0.042
sum		**21,433**	**6,609**	**1.000**	**1.000**	**0.000**

Number, share and deviation of the proportion of employees with migration background within the wage deciles of employees without migration background, 2012-2014 and 2015-2017. Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36. Own calculations incl. survey weights.
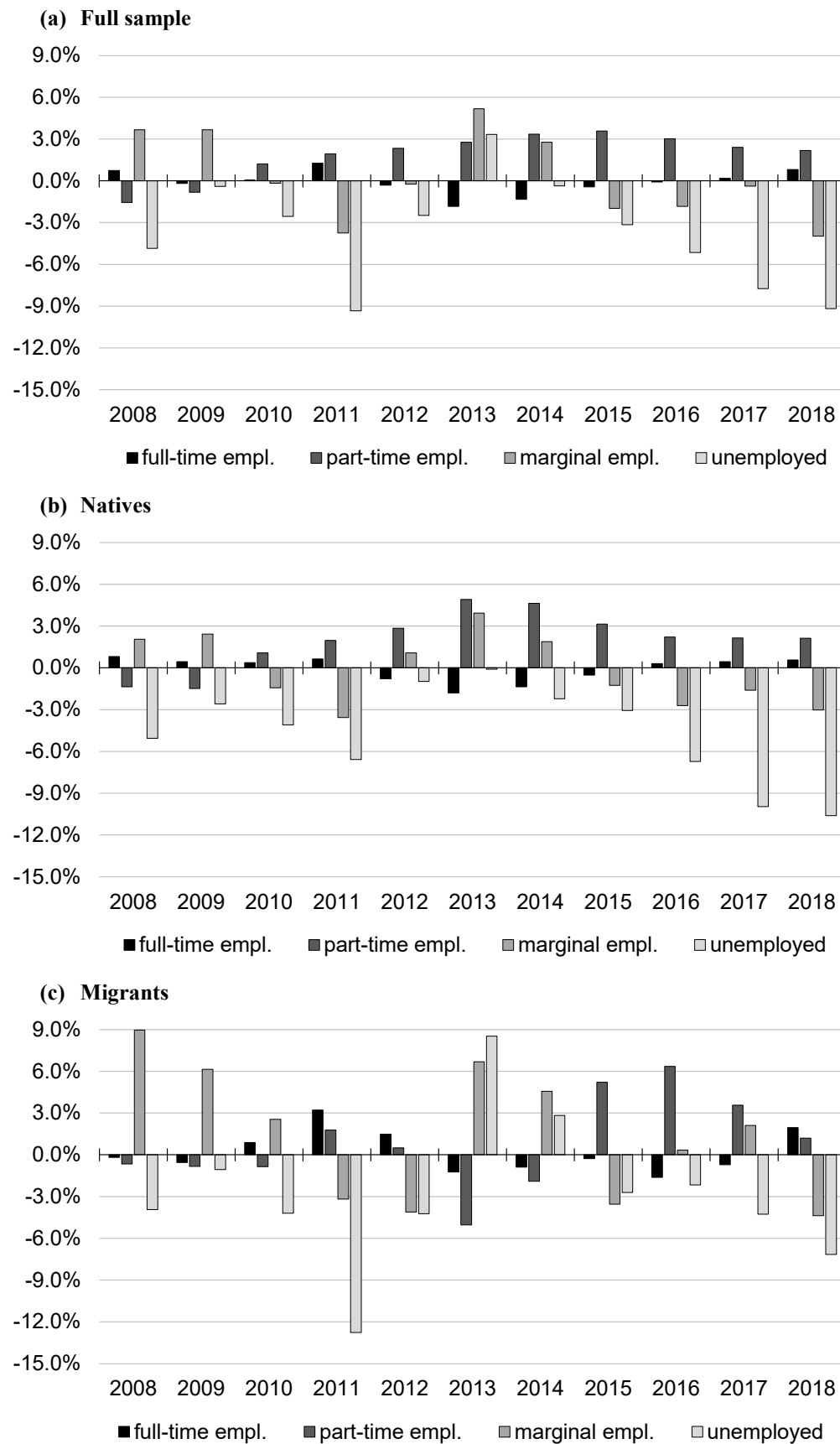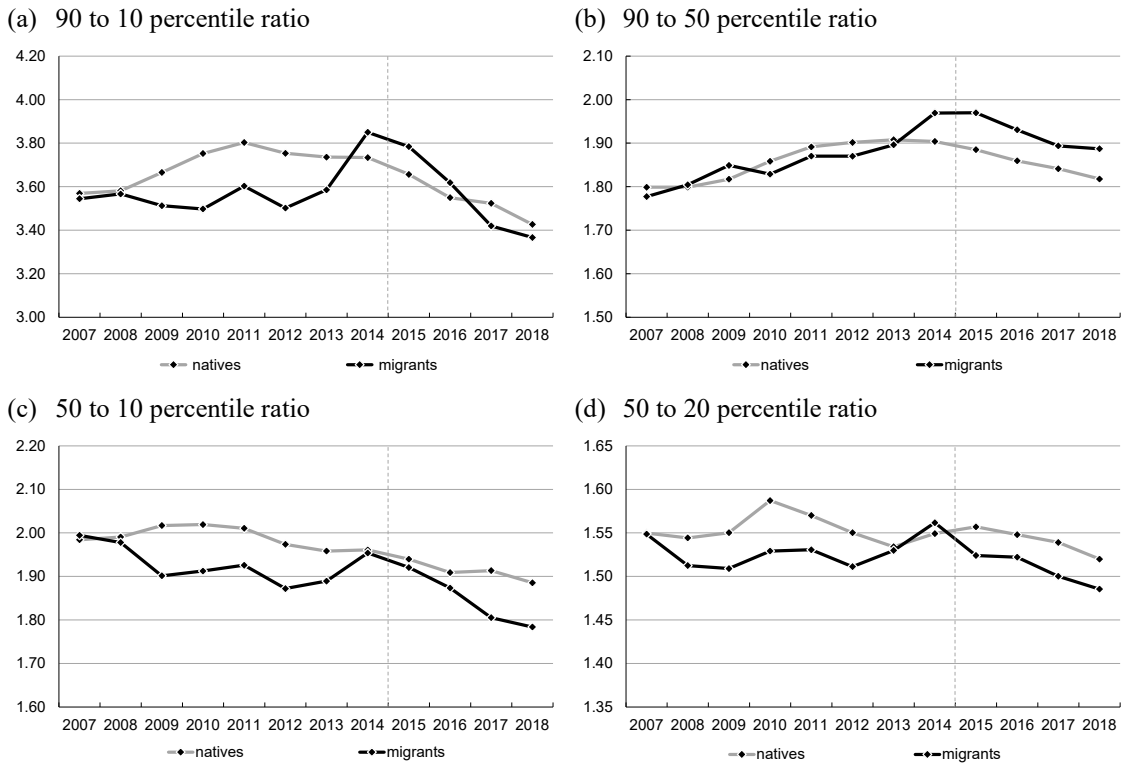
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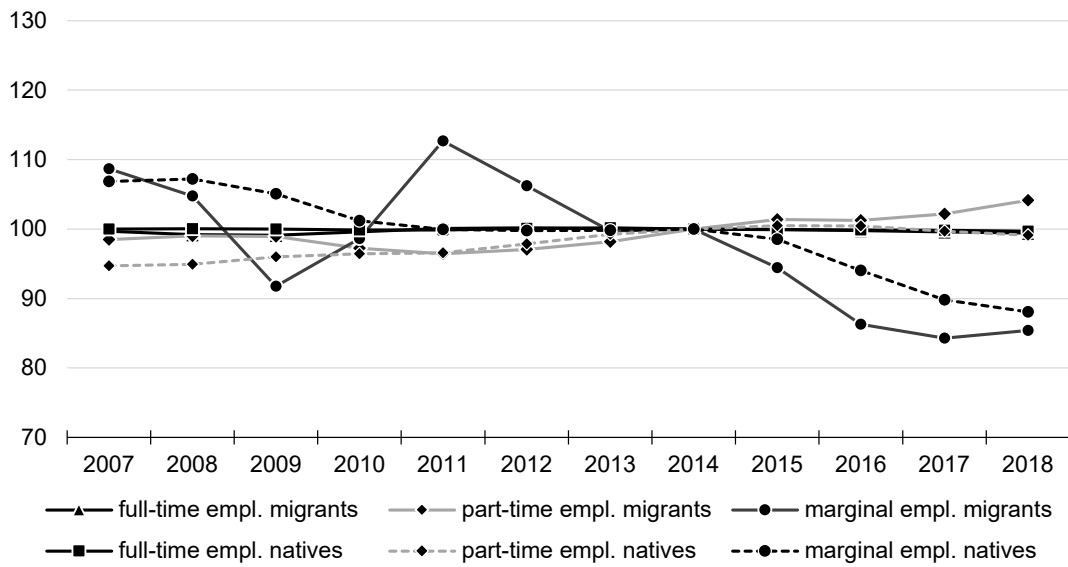
Figure A.1: Development of contractual weekly working hours by employment status and migration background

Index 2014=100. Index is smoothed with adjacent years. Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36, 2007-2017. Own calculations incl. survey weights.

(a) Full sample

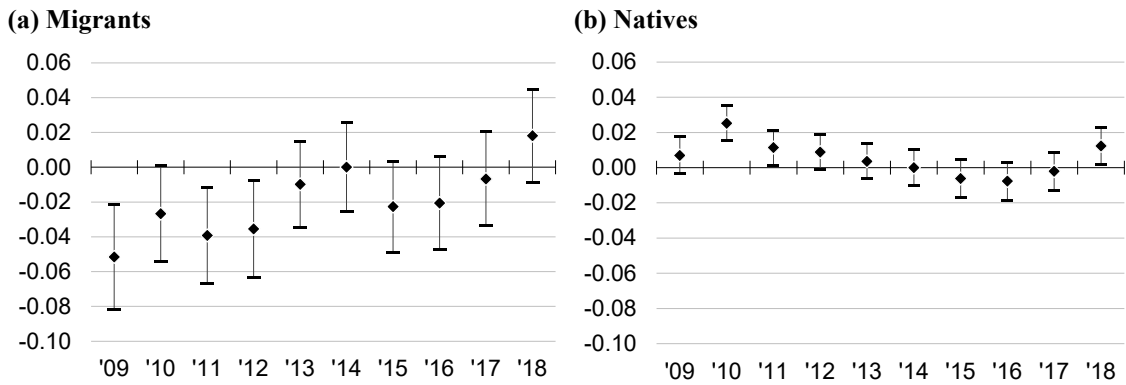

(b) Natives

(c) Migrants

Figure A.2: Changes in the proportions of employment statuses by migration background

Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36, 2007-2017. Own calculations incl. survey weights.

(a) 90 to 10 percentile ratio

(b) 90 to 50 percentile ratio

(c) 50 to 10 percentile ratio

(d) 50 to 20 percentile ratio

Figure A.3: Wage ratios by migration background

Ratios between selected wage percentiles for employees with migration background and without migration background. Wage ratios are smoothed with adjacent years. Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36 2007-2017. Own calculations incl. survey weights.

(a) Migrants

(b) Natives

Figure A.4: Probability of working in the low-wage sector by migration background

Linear Probability Model (LPM), 2014 = 0
Note: Self-employed, apprentices, intern, handicapped workers in sheltered workshops and branches with industrial wage floors are excluded. Source: SOEP v36, 2008-2017. Own calculations.