

Cumulative risks in a segmented labour market: Working-time patterns of low-wage workers

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baua: Focus

Based on a unique, representative study comprising about 20,000 individuals, we provide insights into the specific working-time arrangements of low-wage earners regarding the duration of work, atypical work hours and working-time autonomy. Our findings indicate that low-paid workers have significantly longer average actual working hours. They report higher average weekly overtime and a greater number of unpaid hours. Low-wage workers are more exposed to working hours outside normal working hours. They work more often on weekends and do more rotating day-shift work. Additionally, low-wage workers have less influence on the beginning or end of their working day and on breaks. Finally, they work on demand more often and their working hours change more frequently due to operational reasons.

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1 Introduction

In recent decades, there has been a polarization of work in many developed countries. Jobs are increasingly segmented into 'lousy and lovely jobs' as Goos and Manning (2007) put it, or into 'good jobs' and 'bad jobs', in Kalleberg's (2011) words. The polarization concerns not only wages and fringe benefits, but also other aspects of job quality. Kalleberg (2011) takes a multidimensional view of job quality that includes more quantifiable aspects such as pay, career opportunities and degree of perceived job insecurity and satisfaction as well as intangible parameters such as autonomy, control, flexibility, and work-family balance in relation to working time.

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The views expressed in this paper are those of the authors, and do not necessarily represent those of the Minimum Wage Commission.

A number of studies have analysed the trends toward a growing polarization of wages and a concomitantly rising incidence of low-wage jobs (see, for instance, Autor & Dorn, 2013; Card, Heining, & Kline, 2013; Kim & Sakamoto, 2008). In many – though not all – developed countries, the low-wage sector has grown over the past few decades (McKnight, Stewart, Himmelweit, & Palillo, 2016; OECD, 2018). Germany has experienced particularly marked growth since 1995, reaching a level that is above average among developed countries (Bosch & Kalina, 2008). For full-time employees, the proportion of low-wage employment amounted to 18.9 percent in Germany, compared to 15.8 percent across the average of all OECD countries (OECD, 2018). For workers in all sectors – though only those in companies with ten and more employees – Eurostat (2016) reports a share of 22.5 percent for 2014 which was the highest share of low-wage employment among West European countries and above the EU average of 17.2 percent.

The composition of the low-wage workforce has been described in detail (for Germany, e.g.: Bosch & Kalina, 2008; Kalina & Weinkopf, 2018; see for an international comparison, e.g.: Mason & Salverda, 2010; McKnight, Stewart, Himmelweit, & Palillo, 2016). Research has also highlighted the fact that low pay, and jobs in low-pay industries, are often associated with less favourable working conditions (see, for instance, Gautié & Schmitt, 2010; Kalleberg, 2011; McCrate, Lambert, & Henly, 2019; Poggio, 2007). Only a few of these studies have addressed the link between low pay and working time as a specific element of working conditions and job quality. However, as the ILO has recently emphasized, ‘working time, perhaps second only to wages, is the working condition that has the most direct impact on the day-to-day lives of workers’ (ILO, 2018, S. 2). It is especially relevant to employees’ health.

Long work hours, including overtime, have been negatively correlated with physical as well as psychological health (Bannai & Tamakoshi, 2014; Kivimäki et al., 2015; Sparks and Cooper, 1997), and also with the risk of workplace accidents (Dembe, Erickson, & Banks, 2005; Fischer, Lombardi, Folkard, Willetts, & Christiani, 2017). Regarding atypical work hours, studies have found negative health impacts related to working during socially valuable times – Sundays, for example (Wirtz et al., 2011), and night shifts, in particular (Costa, 2003; Frost, Kolstad, & Bonde, 2009; Harrington, 2001). Finally, research also provides evidence of the effects of flexible work hours on workers’ health and well-being (Costa, Sartori, & Åkerstedt, 2006; Joyce, Pabayo, Critchley, & Bamba, 2010). These effects can go in two opposite directions. On the one hand, self-determined flexibility, such as autonomy regarding the beginning and end of the workday, is a resource for workers and therefore has positive effects on health and well-being. On the other hand, operational requirements regarding flexible work hours that limit workers’ individual autonomy, such as frequent operational changes in work hours and on-call work, which primarily make demands on employees, constitute stressors that negatively affect health (Slany, Schütte, Chastang, Parent-Thirion, Vermeylen, & Niedhammer, 2014; Väänänen, 2008). Beyond individual health effects, working time arrangements can curtail leisure time and accelerate work-life and, in particular, work-family conflict, through long work hours, atypical working times and/or unpredictable schedules (Henly and Lambert, 2014; Jansen, Kant, Nijhuis, Swaen, & Kristensen, 2004; La Valle, Arthur, Millward, Scott, & Clayden, 2002).

Given the importance of working time as a parameter not only for job quality but also for its potential consequences for workers’ health status, it is surprising that so few studies have addressed the link between low pay and working time as a specific element of working conditions and job quality. Researchers have done this by classifying occupations as being located in the low-wage sector (Golden, 2001; Mason & Salverda, 2010) or in case studies for specific industries (Carré, Tilly, Van Klaveren, & Voss-Dahm 2010; Halpin & Smith, 2017; Henly & Lambert, 2014). However, none of these studies have been based on the analysis of microdata that include individual hourly earnings and working-time patterns. Few quantitative studies

have investigated the relationship between unstable work schedules and underemployment or zero hour employment (McCrate, 2018; McCrate, Lambert, & Henly, 2019; O'Sullivan, Lavelle, McMahon, Ryan, Murphy, Turner, & Gunnigle, 2019). Several data constraints may explain this gap. First, surveys need to include workers' hours and their associated gross earnings to be able to calculate an hourly wage as an indicator to identify low-wage employees. Second, surveys must also cover the details of working-time arrangements. Finally, surveys need to have a sufficient number of cases to allow sophisticated econometric methods to be applied even to subgroups. In this article, we draw on a unique dataset that fulfils these requirements. The German BAuA Working Time Survey is a nationally representative study that includes detailed information on about 20,000 individuals from all industries. This data allows us to minimize observable selection biases and provide in-depth insights into the working conditions of low-wage workers.

Based on the BAuA Working Time Survey, we link the issue of low pay to working time as a specific element of working conditions and job quality. Our research question is thus: How do the working-time patterns of low-wage workers differ from those of – *ceteris paribus* – higher paid workers? Using a propensity score matching approach, we isolate the influence of low-wage work from other factors such as age, gender, education or the industry in which individuals works. The remainder of this article is organized as follows: The next section reviews the current state of research. In section 3, theoretical assumptions are presented. Section 4 describes the data and section 5 explains the econometric method to match low-wage and higher-wage workers. Section 6 contains the empirical results, while section 7 discusses these results and offers some conclusions.

2 Literature review

A significant amount of empirical literature has examined both low-wage work and the working conditions of the low-paid. Kalleberg (2011) and the volume edited by Gauthé and Schmitt (2010), particularly the section compiled by Mason and Salverda (2010), provide comprehensive overviews of the situation of low-wage workers and those in 'bad jobs', respectively. They emphasize that low pay or jobs in low-paid industries, respectively, are often associated with less favourable working conditions. The probability that workers are low-paid is generally greater for women than for men, for younger employees than older ones, and for less skilled than more skilled individuals. In addition, a higher share of low-paid workers can be found in specific industries, particular in services such as hotels, restaurants, retail or call centres.

Literature that emphasizes working-time patterns in the low-wage sector, however, is limited: Mason and Salverda (2010) showed that workers in low-paid occupations such as service and sales workers or plant and machine operators and assemblers are less likely than workers in other occupations to be able to influence their own work schedules. They based their analysis on data from the European Working Conditions Survey (EWCS). However, as they were unable to identify the wage of the employees, some workers in low-paid occupations might well have earned more than the two-thirds threshold commonly used to define a low wage. Gauthé and Schmitt (2010) assembled qualitative case studies from retail, room cleaning, cleaning and nursing in hospitals, food-processing and call centres that allowed them to compare the situation in the United States, the United Kingdom, Germany, France, The Netherlands and Denmark in those specific industries. Regarding retail, Carré et al. (2010, p. 220) highlighted work schedules 'as a primary dimension of job outcomes'. They found that employees in the retail sector have to cope with low schedule predictability and limited control over schedules. Carré et al. (2010) also noted that the regulatory and institutional framework retailers operate in makes a marked difference in the implementation of work schedules. For the United

States, Golden (2001) showed that access to flexible work arrangements that allow workers to vary when they start and end their workdays is greater for managerial and professional occupations, while labourers, assemblers, transport and material movers, machine operators, and teachers in primary and secondary education have the least. When workers did have access to flexible working schedules, they achieved this more through informal arrangements than through formal flextime programs. Henly and Lambert (2014) analysed the situation of female employees in low-skilled retail jobs. For their study, they collaborated with a large, national US women's apparel retailer. Using data from firm records and 156 voluntary participants in a telephone survey, their results hint towards limited advance notice of their schedule, last minute changes, mismatch between scheduled working time and realized working time reports and having different working days from week to week.

The literature review indicated only a limited number of studies that analyse working-time patterns in the low-wage sector. Furthermore, most of this research is based on case studies; their results thus cannot be generalized. Against this backdrop, we extend current research on working conditions and job quality by contributing representative evidence of the interrelation between low-wage work and working time arrangements by using micro-level data from a representative survey of employees.

3 Theoretical assumptions

Conceptually, jobs are characterized by a set of tasks and by specific working conditions. The latter are multidimensional bundles of rewards and burdens and reflect the quality of a job (Kalleberg, 2011, p. 5). However, a theoretical rationale for investigating how working-time patterns vary across low and higher wage categories is missing. For this reason, our theoretical contribution aims at a better understanding of this relationship by extending various economic and sociological approaches by the aspect of working time.

The economic literature often uses earnings and fringe benefits as key indicators in the debate about good and bad jobs (see for instance Acemoglu, 2001). Approaches on compensating wage differentials then allow for an interrelation between economic rewards and non-economic working conditions independent of other important factors such as age, gender and human capital (Abowd & Ashenfelter, 1981; Rosen, 1986; Smith, 1979). A wage differential is – *ceteris paribus* – defined as the additional amount of earnings or fringe benefits workers must be offered in order to motivate them to accept undesirable job characteristics. Thus, wages directly depend on working conditions. Wages compensate, amongst other things, for risks to life and health, risks of layoff and subsequent unemployment, but also for special working-time scheduling and related requirements (Abowd & Ashenfelter, 1981; Rosen, 1986; Smith, 1979). Regarding working-time patterns there should be a trade-off between wages and long working hours and overtime, atypical working times such as shift and weekend work, and working time autonomy such as employees' influence on the beginning or end of the working day or on breaks, home office work or work on demand. The following hypotheses can be derived from the theory of compensating wage differentials:

- H1: Employees who have to work long hours and overtime are paid more in return.
- H2: Atypical working times are compensated by higher wages.
- H3: Higher wages countervail a comparatively lower level of autonomy at work.

Sociological approaches take a different perspective on the labour market and employment relations by assuming that various aspects of job quality covary (Kalleberg, 2011, p. 11; Poggio, 2007). Recent approaches of employment systems (Hendry, 2003; Kaufman, 2013) refer back to theories of labour market segmentation (Doeringer & Piore, 1971) and theorize that seg-

mentation processes result from a firm's internal organization of labour within the framework of the institutional setting. Firms must find solutions to both of the significant problems of human resource allocation – sufficient availability and motivation of employees. These issues are dealt with by taking advantage of several employment systems existing within a firm (Hendry, 2003; Kaufman, 2013). They arise due to the different job requirements, the current situation on external labour markets, and employees' options for (future) action, which are determined by their resources in terms of social networks and their human capital endowment. Finally, employment systems are also characterized by legal regulations, collective agreements and norms, and institutionally established arrangements which lead to varying degrees of social closure of groups of employees in the labour market (Sørensen, 1977, 1983). For these reasons, employment systems differ in their degree of 'openness' or 'closeness' to external labour markets and directly affect workers' employment situations and career options. Since employment relations are determined by the relative employers' and employees' power to control tasks, negotiate the conditions of employment, and terminate a job, favourable and unfavourable working conditions occur cumulatively. In open employment systems, the problem of availability of workers is limited to the quantitative dimension and thus to the existence of a sufficiently large number of employees in external labour markets. Thus, employers tend to make little or no investments in these workers' human capital and employees can be recruited and dismissed according to the current workload without so-called 'sunk costs'. Employees in open employment systems have little individual power of action on the labour market due to the competitive situation in their occupational field, even if they are well qualified, or they are low or inadequately qualified. Additionally, they have little bargaining power to collectively negotiate and improve their working conditions (ibid.). Therefore, they often perform routine tasks in standardized jobs with low responsibilities. Thus, this employment system is characterized by frequent transitions between (atypical forms of) employment and unemployment, low wages and unfavourable noneconomic working conditions (Abowd & Ashenfelter, 1981; Rosen, 1986; Smith, 1979). With regard to the working time pattern, this means that employees in open employment systems are more likely to work longer hours and have more atypical working times and/or unpredictable schedules. Additionally, they are more willing to accept unfavourable working time conditions, because they want to signal their effort to their employers in order to be promoted to higher paid and better jobs. It can therefore be hypothesized:

- H4: Low-wage workers have to work overtime more frequently than higher paid employees.
- H5: Atypical working times are comparatively more common in low-wage work.
- H6: Low-wage workers face less autonomy in their work arrangements.

In the following we will describe the data and the empirical approach before we present our findings on working-time patterns in the low-wage sector and test the hypotheses.

4 Data

We employ data from the BAuA Working Time Survey 2015, a nationwide representative study of the German working population. The survey is designed and commissioned by the Germany's Federal Institute for Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin). 20,030 individuals were asked about their working time, working conditions, health and demographics in detail (Häring, Schütz, Gilberg, Kleudgen, Wöhrmann, & Brenscheidt, 2016). Data were collected in computer-assisted telephone interviews between May and October 2015. A dual-frame design, including telephone numbers from landline and mobile networks, was applied. Telephone numbers were generated at random. To be eligible to participate, individuals at the time of the interview had to be 15 years of age or older and in paid employment for at least 10 hours per week. Individuals who had inter-

rupted their employment for no longer than three months, for instance because of maternity leave or periods of sickness, were included in the study. However, employees who had interrupted their employment for a period longer than three months or who were in vocational training or military, civilian, or voluntary service were excluded. In order to compensate for survey-related selectivity and to ensure representativeness, weights are provided that adjust the BAuA-Working Time Survey to the basic values of the 2014 Microcensus of the Federal Statistical Office (Häring et al., 2016).

Together with socio-demographic and occupational data, the survey covers a broad range of indicators of individual characteristics, households, and working conditions as well as working hours and working time arrangements. Thus, the survey provides a comprehensive and unique set of variables for highlighting those crucial factors that influence employees' working time. There is no other data source offering similar information to analyse the working-time patterns of low-wage workers. For our analysis, we restricted the sample to employees between 18 and 65 years of age. Self-employed are excluded from the survey. Additionally, we dropped individuals who refused to answer the questions on wages and hours worked. These restrictions leave us with a sample of 13,886 cases.

In order to analyse working-time patterns in the low-wage sector, we differentiate between low-wage workers and higher-paid workers. As in previous research on low-wage work (Bosch & Kalina, 2008; Kalina & Weinkopf, 2015, 2017), we use the low pay threshold, which is defined as two-thirds of the median gross hourly wage. The BAuA Working Time Survey data makes it possible to calculate gross hourly wages based on the gross monthly wages and weekly actual working hours multiplied by the factor 4.33. We use actual instead of contractual working hours in the denominator, because the gross monthly wages in the numerator are based on this figure and the BAuA Working Time Survey does not contain information on the amount of overtime pay. Using the contractual working time would thus lead to biased estimates for hourly wages. Derived from this calculation, we generate a dummy variable to specify whether an employee is paid at and below or above the low-pay threshold. In 2015, the low-wage threshold in our sample amounted to a gross hourly wage of 11.08 euros. This figure is slightly above the findings of Kalina and Weinkopf (2017), who use the German Socio-Economic Panel and establish a low-wage threshold of 10.22 euros for the same year. The difference can be explained by slight differences in the calculation of hourly wages and the fact that their data includes people who work fewer than 10 hours per week and who often hold so-called Minijobs; these jobs allow employees to earn 450 euros per month free of income tax and social security contributions (in return receiving health insurance and optional pension insurance); such jobs are known to pay particularly low hourly wages (ibid.). The share of low-wage workers in our sample amounts to 20.7 percent. This is in line with findings from research using other datasets. Kalina and Weinkopf (2017) report a share of 22.6 percent. The OECD (2018) puts the share of low-wage full-time workers at 19.4 percent for 2015, Eurostat (2016) reports a share of 22.5 percent for 2014 including all employees, albeit this data is limited to companies with ten and more workers.

5 Method

As mentioned in the introduction and the literature review, the characteristics of low-wage workers differ from those of the workforce in general.² To correct for these selection effects, we use propensity score matching to minimize observable selection biases (Rosenbaum &

² This is also visible in the BAuA Working Time Survey data. Descriptions of characteristics of low-paid and higher-paid employees are shown in Table A1 in the appendix.

Rubin, 1983). The matching approach allows for the comparison of jobholders in the low-wage sector to a control group, which is similar to the aforementioned group in regard to those characteristics that have been identified as relevant. The matching approach follows the principle of an 'effects-of-causes analysis' (Holland, 1986) and makes it possible to isolate the effect of low-wage work on working-time patterns from other influence factors such as age, gender, household characteristics and specific industries. This ensures that 'statistical twins' are compared only regarding their working time arrangements. Matching is a non-parametric method that requires fewer assumptions than parametric regression and is thus more robust to biases due to specification errors.

Before the matching procedure is used in the following analyses, the plausibility of two central assumptions – the conditional independence assumption (CIA) and the stable unit treatment value assumption (SUTVA) – has to be checked (Rosenbaum & Rubin, 1983). A precondition for causal analysis is that the assignment of individuals to the treatment and the control group happens at random, so that the groups do not differ in their characteristics and no self-selection of individuals into one of the groups takes place. Analyses based on survey data, in contrast to experimental research, do not allow one to assume such a random assignment to the group of low-paid and higher-paid employees. However, the CIA can be met by selecting covariates that are unaffected by the outcome variables in order to form the control group. In addition, no self-selection of employees in the respective groups on the basis of the preferences regarding working time arrangements should take place. We consider the CIA as fulfilled, because our dataset contains a wide range of socio-demographic variables as well as information on households and job characteristics, which explain both low-wage work and working time arrangements. The SUTVA consists of two components. The first is that the treatment is defined identically for all units to form distinct groups, which is the case in our analysis. The second component is that the treatment assignment of an individual does not affect the potential outcomes of any other individual, which means, that no 'spill-over' effects should occur. This assumption can be considered fulfilled because the assignment to the treatment and to the control group is not based on a social policy measure, a legal requirement, etc., of which employees are directly aware, but based on the low-wage threshold obtained indirectly from monthly wages and weekly working hours.

The process of matching is carried out on the basis of propensity scores, which are obtained from a selection model. For this purpose, a logit model has been estimated that mirrors the probability of subjects being included in the group of low-wage workers. The corresponding dummy variable assumes the value 0 for the higher-paid group. The value 1 is assigned to low-paid employees. Relevant covariates must be included in the selection model, which explain employees' affiliation to the group of low-paid workers and which have to be adjusted regarding their distribution for further causal analysis. Our selection of covariates is based on previous findings from labour market research and on labour market theories. The central indicators are various individual and household characteristics as well as information about the job. Individual characteristics include sex, nationality, age, and the highest professional degree. Determinants describing the household comprise the marital status, information on children below the age of 18 years and the place of residence. Jobs are characterized by the form of employment, information on further jobs, tenure, the type of contract, temporary work, job tasks, the existence of work councils in the company, the size of company and industries. Results of the multivariate logit analysis are shown in Table A2.

The generated propensity score is used to establish the control group.³ This is done with the help of various matching algorithms.⁴ The analyses are based on a caliper matching method combined with the ‘nearest neighbour’ method. For this, over-sampling of up to five nearest neighbours is applied. This ensures that five higher-paid workers with those structurally identical features, which have been identified as relevant, are assigned to each low-wage worker. Over-sampling allows for reducing the variance of parameter estimates as well as sensitivity to eventual irrelevant parameters (Caliendo & Kopeinig, 2008). Matching is carried out with a maximum deviation distance of $\Psi = 0.001$ to ensure a strong balancing of all covariates under scrutiny, and thereby to attain a high bias reduction (Dehejia & Wahba, 2002).⁵

The quality of matching is crucial for the validity of the results generated (ibid.). To this end, a sufficient number of subjects need to be present in the dataset so as to enable control groups that reflect the socio-demographic and occupational characteristics of low-wage workers. This is necessary in order to comply with the ‘common support’ condition (Caliendo & Kopeinig, 2008). Before matching, 2,830 employees in low-wage work and 11,056 employees not working for low wages were included in the dataset. The large number of cases in the latter group, from which the controls were drawn, is an ideal foundation for the matching quality. To assess the matching quality, various statistical values and tests are available that help to establish whether the matching process has led to a satisfactory balancing between identified variables, which is necessary to fruitfully compare low-wage workers to the control group (Caliendo & Kopeinig, 2008; Dehejia & Wahba, 2002). All assessments with regard to balancing the covariates presented in Table 1 revealed positive results; the matching procedures that were applied can therefore be considered successful.⁶

Table 1: Overall measures of covariate imbalance

Sample	Pseudo R ²	Likelihood ratio test Chi ²	Likelihood ratio test p-value	Rubin’s B ¹	Rubin’s R ¹	Mean bias ²	Median bias ²
Before matching	0.355	4985.06	0.000	166.6	1.09	26.5	21.4
After matching	0.006	43.34	0.372	19	1.35	2.4	2.2

Note: ¹ Rubin (2001) recommends that B should be less than 25 and that R be between 0.5 and 2 for the samples to be considered sufficiently balanced. ² A score of less than 5 percent indicates that the matching process has sufficiently minimized the differences with regard to the identified variables (Caliendo and Kopeinig, 2008: 48). Descriptive statistics and balancing of the covariates are shown in Table A3 in the appendix.

Source: BAuA Working Time Survey 2015; all indications are weighted, own calculations.

6 Results

We will present our results on working-time patterns in the low-wage sector along three topical clusters: duration of working time and overtime, atypical working time, and working time autonomy. Within each cluster, we will provide results on several indicators from the BAuA Working Time Survey.⁷

³ The implementation is done using the PSCORE program by Becker and Ichino (2002) along with the PSMATCH2 procedure by Leuven and Sianesi (2003) and the Stata statistics software.

⁴ Caliendo and Kopeinig (2008) offer a survey of matching algorithms.

⁵ The sensitivity of results with regard to the selected matching process has been tested in great detail. The analysis included 1-Nearest-Neighbour processes with and without replacement alongside 5 and 10 NN, Kernel and Radius methods without maximum deviation distances and values of $\Psi = 0.001$, $\Psi = 0.0005$ and $\Psi = 0.0001$.

⁶ Descriptive statistics and balancing of the covariates are shown in Table A3 in the appendix.

⁷ To assess to what extent the results depend on the way the low-pay threshold is defined, we modified the measure and set the limit 10 percent higher and 10 percent lower. Results in Tables A4 to A6 in the appendix indicate only slight deviations as far as the direction of influence of the coefficients and the significances are concerned.

Duration of working time and overtime

Low-wage workers report an average contractual weekly working time of 33.29 hours (Table 2). This roughly equals the value of the control group of 33.47 hours. However, both groups significantly differ in average actual weekly working time, by 2.27 hours. Low-paid workers indicate 38.06 actual working hours, the controls 35.79 hours. Accordingly, the average weekly overtime of the low-paid is considerably higher, at a value of 4.64 hours per week compared to the control group (2.9 hours). Most overtime hours are compensated by time off, but those of low-wage workers are compensated that way to a significantly lesser extent. There are no statistically significant differences between both groups in terms of whether overtime is paid out or not compensated. However, among those whose overtime hours are not compensated, low-paid workers report a significantly greater number of unpaid hours (8.89 hours per week for low-wage workers compared to 6.72 hours for the control group). In both groups, the main reasons for overtime are (1) that the amount of work cannot be done within the contractually agreed working time and (2) operational reasons. Private reasons – for example, the desire to earn additional income – are less common. There are no statistically significant differences between low-wage workers and the control group in regard to these reasons. However, enjoyment of work as a reason for overtime is mentioned significantly more often by the control group (16.6 percent) compared to about 13.1 percent by low-paid workers. Based on these results, hypothesis H1, that unfavourable working conditions are compensated by higher wages, must be rejected. The results are, however, in line with hypothesis H4, that a complementary relation between both aspects exists.

Table 2: Matching results on duration of working time and overtime

Item		Low-wage workers	Control group	Difference	Std. Err.	Z-score	Cases
Contractual weekly working time		33.286	33.468	-0.181	0.271	-0.67	2291
Actual weekly working time		38.061	35.791	2.270***	0.378	6.00	2407
Weekly overtime		4.643	2.896	1.746***	0.184	9.51	2407
Compensation¹	Overtime is compensated by time off (1=yes)	0.736	0.776	-0.04**	0.019	-2.10	1299
	Overtime is partly or fully paid (1=yes)	0.430	0.413	0.016	0.023	0.71	1299
	Overtime is not compensated (1=yes)	0.182	0.159	0.024	0.015	1.62	1284
	Amount of unpaid weekly overtime	8.89	6.72	2.17*	1.122	1.93	118
Main reason for overtime	Amount of work cannot be done within the contractually agreed working time (1=yes)	0.341	0.315	0.026	0.024	1.05	956
	Operational requirements, e.g., longer scheduled working hours (1=yes)	0.176	0.174	0.002	0.02	0.08	956
	Other operational reasons	0.300	0.294	0.006	0.025	0.25	956
	Private reasons, e.g., additional income (1=yes)	0.052	0.050	0.002	0.013	0.16	956
	Enjoyment of work (1=yes)	0.131	0.166	-0.035*	0.017	-2.04	956

¹ Multiple answers were allowed.

* p < 0.10, ** p < 0.05, *** p < 0.01

Source: BAuA Working Time Survey 2015; own calculations.

Atypical working time

Low-wage workers have to work significantly more during atypical working hours, including weekend and shift work (Table 3). 76.4 percent of low-wage workers and 80.5 percent of the higher-paid controls state that they usually work between 7 am and 7 pm. The difference is statistically significant. 54.8 percent of low-paid workers, but significantly fewer controls (45.8 percent) report working on Saturday. Among those who indicated that they work on Saturday, the low-paid also mention a significantly higher incidence per month. Working on Sunday is also more common among low-paid workers (28.6 percent) compared to the control group (23.2). Similar to Saturday work, the per-month incidence of working on Sundays is higher among the low-paid. Regarding shift work, 10.5 percent of the low-paid only do early or late shift work, but not between 7 am and 7 pm. This is significantly more often the case than in the control group (7.2 percent). This result is especially explained by significantly more rotating-day shift work performed by low-wage workers. No systematic differences between the two groups exist regarding shifts with night work. The results clearly contradict the assumption in hypothesis H2, that atypical working times are compensated for by higher wages. On the contrary, hypothesis H5, which stated that atypical working times are comparatively more common in low-wage work, cannot be rejected.

Table 3: Matching results on atypical working time

Item	Low-wage workers	Control group	Difference	Std. Err.	Z-score	Cases	
Working hours usually between 7 am and 7 pm (1=yes)	0.764	0.805	-0.041***	0.012	-3.42	2374	
Weekend work (1=yes)	0.548	0.458	0.090***	0.016	5.47	2189	
Weekend work	Working on Saturday (1=yes)	0.263	0.226	0.037**	0.015	2.48	2189
	Incidence of working on Saturday per month)	2.214	2.101	0.113**	0.047	2.38	1177
	Working on Sunday (1=yes)	0.286	0.232	0.054***	0.013	4.07	2189
	Incidence of working on Sunday per month)	2.190	2.018	0.172**	0.078	2.20	522
Only early or late shift work (working hours not between 7 am and 7 pm) (1=yes)	0.105	0.072	0.034***	0.01	3.67	2374	
Shift work	Day shifts (without night work) (1=yes)	0.071	0.056	0.056*	0.009	1.80	2374
	Shifts with night work (1=yes)	0.060	0.068	-0.008	0.008	-0.98	2374

* p < 0.10, ** p < 0.05, *** p < 0.01

Source: BAuA Working Time Survey 2015; own calculations.

Working time autonomy

Results on flexible working time are shown in Table 4. Low-wage workers have significantly less influence on the beginning or end of the working day than the control group. Just over 60 percent of employees in both groups report having core working hours. About 31 percent can use gliding time. Thus, no differences between the two groups of workers occur. 7.1 percent of employees in the control group do home office work, whereas in the low-wage sector it is just 4.4 percent. This difference is statistically significant. The incidence of home office work per month in this group is also statistically lower compared to the control group. About

59 percent of workers in both groups report having a working-time account. About 77.5 percent of low-wage workers and 72.8 percent of controls indicate that the start of the working day is specified by the employer. However, there are no significant differences regarding the question of whether the end of the working day specified by the employer. About 13 percent of the low-paid and about 10 percent of the controls work on demand. Whereas this difference is significant, it is not in terms of the incidence per month. Working hours change significantly more frequently due to operational reasons among low-wage workers compared to the control group. Low-paid workers can decide significantly less often when to take a break. However, 29.2 percent of the low-paid, but significantly fewer workers in the control group (25.9 percent) state that breaks are cancelled. These findings contradict hypothesis H3, that higher wages counteract a comparatively lower autonomy at work, but they are in line with hypothesis H6, that low-wage workers enjoy less autonomy in their work arrangements.

Table 4: Matching results on working time autonomy

Item	Low-wage workers	Control group	Difference	Std. Err.	Z-score	Cases
Influence on the beginning or end of the working day (0=very little influence; 5=very strong influence)	2.311	2.573	-0.262***	0.048	-5.50	2399
Gliding time (1=yes)	0.307	0.322	-0.015	0.016	-0.90	2351
Home office work (1=yes)	0.044	0.071	-0.027***	0.008	-3.30	2387
Incidence of home office work per month	1.904	2.610	-0.706**	0.322	-2.2	54
Working time account (1=yes)	0.583	0.594	-0.011	0.018	-0.60	2326
Start of working day specified by the employer (1=yes)	0.775	0.728	0.047***	0.012	3.97	2404
End of working day specified by the employer (1=yes)	0.631	0.611	0.020	0.016	1.29	2402
Work on demand (1=yes)	0.128	0.101	0.027***	0.01	2.75	2407
Incidence of work on demand per month	6.121	7.769	-1.647	1.463	-1.13	156
Change of working hours due to operational reasons (1=often, 2=sometimes, 3 rarely, 4=never)	2.743	2.810	-0.067*	0.038	-1.78	2402
Influence of breaks (0=(very) little influence; 1=partial influence; 2=(very) strong influence)	1.060	1.169	-0.109***	0.028	-3.84	2402
Cancellation of breaks (0=seldom; 1=often)	0.292	0.259	0.033**	0.014	2.29	2304

* p < 0.10, ** p < 0.05, *** p < 0.01

Source: BAuA Working Time Survey 2015; own calculations.

7 Discussion of results and conclusions

In many industrialized countries, the low-wage sector has grown in recent decades. On average, more than one out of six employees in EU member countries earns an hourly wage that is below two thirds of the median wage (Eurostat, 2016). The wage level itself, however, is only one out of a variety of working conditions. Kalleberg (2011) points to the significance of the interrelation of different working conditions and highlights the potential polarization into 'good jobs' and 'bad jobs'.

From a theoretical perspective, the way in which working conditions are linked is not clear-cut. Approaches on compensating wage differentials modify the basic assumptions of neo-

classical theory and emphasize a compensatory interrelation between economic rewards and non-economic working conditions. Additional wages can thus equalize undesirable job characteristics (Abowd & Ashenfelter, 1981; Rosen, 1986; Smith, 1979). On the other hand, structural theories of labour market segmentation and employment systems assume that the workforce is divided into different and separated segments, which leads to a polarization of working conditions along the divergence of wages. In more closed employment systems, higher-paid jobs are associated with a higher level of job security and good working conditions, while open employment systems are characterized by low pay, instable jobs and unfavourable working conditions (Hendry, 2003; Kaufman, 2013).

Against this backdrop, we have analysed the coincidence of low-wage work and working time. The arrangement of working time is considered a highly significant aspect of job quality (ILO, 2018) because it has immediate consequences for employees' health status (Bannai & Tamakoshi, 2014; Kivimäki et al., 2015; Sparks & Cooper, 1997), the risk of occupational accidents (Dembe et al., 2005, Fischer et al., 2017), and the amount of socially valuable times (Wirtz et al., 2011). For this purpose, we used the BAuA Working Time Survey 2015, a representative study of the German working population, containing detailed information on about 20,000 individuals from all industries. As in other datasets, we have found that the probability that workers are low-paid is generally greater for women than for men, for younger employees than for older ones, for the less skilled higher than for more highly skilled individuals. In addition, a higher share of low-paid workers can be found in specific industries, particular in services. Given these well-known selection effects regarding low-wage employment, we deployed a propensity score matching approach to minimize observable selection bias. This means that we assigned higher-paid employees, who are as similar as possible, as a control group to low-paid workers. A limitation to the propensity score method is that we could only control for observable characteristics to form a structurally equal higher-paid group to the low-wage workers. Unobserved factors, which affect assignment into one of both groups, can lead to biased estimations of treatment effects.

To sum up our most important results in a nutshell: While average contractual weekly working time is quite the same for both the low-wage workers and the controls, the low-paid workers have significantly longer average actual working hours, which results in considerably higher average weekly overtime. Among those whose overtime hours were not compensated, low-paid workers reported a significantly greater number of unpaid hours. Regarding atypical working hours, low-wage workers are significantly more exposed to working hours outside normal working hours between 7 am and 7 pm. They also have to work more often on Saturdays or Sundays and on more weekends per month and do more rotating day-shift work. In addition to unfavourable working hours, low-wage workers also enjoy less autonomy regarding their work schedule. They have less influence on the beginning or end of their working day and on their breaks, including a higher probability of breaks being cancelled. For instance, the start of the working day was more often specified by the employer. Finally, their work schedule was also less predictable. They work on demand more often and their working hours change significantly more frequently due to operational reasons.

Our results support the hypotheses derived from theories of segmented labour markets, that working conditions occur in a complementary way. Employees earning low wages additionally face greater risks of having unfavourable working time conditions. We do not find any evidence that wages compensate for unfavourable working-time patterns.

Risks obviously cumulate for low-wage workers. Low-wage jobs are more likely to be characterized by atypical employment, monotony and heteronomy. However, even after accounting for heterogeneities by matching low-paid workers and similar higher-paid workers, unfavourable

rable working conditions remain with regard to working-time patterns. Given that low-wage workers can be found at above average levels in industries such as retail, which themselves are correlated with detrimental working time arrangements, the challenges stemming from precarious working-time patterns may to a much greater extent be present on an individual level. This is especially the case because low-wage work is a persistent rather than transitional phenomenon. The existing evidence suggests that those who receive low wages have a higher probability of being low-paid in the future, too (see Schnabel, 2016 for an overview). This phenomenon becomes even more pronounced the larger a country's low-wage sector is – as is the case in Germany, but also in many other developed countries (Clark & Kanellopoulos, 2013).

The working time arrangements of low-wage workers may be under further pressure from future developments (ILO, 2018; Taylor, Marsh, Nicol, & Broadbent, 2017). Among these is the spreading of zero-hour contracts and other forms of on-call work, as well as the growing relevance of information and communication technologies (ICTs). In the United Kingdom, the Taylor Review has addressed the issue of zero-hour contracts and concluded that while the necessity for businesses to have access to sufficient flexibility and businesses should have the ability to offer zero- or short-hours contracts, or to request that an individual works longer hours than those guaranteed in their contract, it needs to be ensured that employers 'have to compensate the most vulnerable workers (those on low wages) for the additional flexibility demanded of them' (Taylor et al., 2017). Regarding the growing relevance of ICTs, it is particularly the emergence of a 'gig economy', which describes work brokered through online web platforms. This will pose completely different challenges to working-time regulation, which goes along with the question of the employment relationship associated with this kind of work.

Appendix

Table A1: Descriptions of characteristics of low-paid and higher-paid employees (values in percent)

Item	Low-wage workers	Higher-paid workers	p-value ¹
Female	56.65	42.27	0.000
Foreign	10.12	8.61	0.005
Age			0.000
18–29 years	27.98	13.01	
30–44 years	33.83	37.43	
45–59 years	33.03	42.12	
60–65 years	5.16	7.44	
Marital status²			0.000
Single	42.58	31.72	
Married	41.01	54.40	
Civil union	1.62	1.32	
Divorced/widowed	14.78	12.55	
Children under 18 years in the household	33.88	34.80	0.301
Highest professional degree			0.000
No professional degree	15.67	2.75	
Vocational degree	67.78	52.36	
Technical school, master	7.55	13.17	
Polytechnic degree	2.75	9.65	
University degree	5.11	21.04	
Another degree	1.14	1.03	
Place of residence²			0.000
East Germany	31.49	14.57	
West Germany	65.99	83.74	
Unknown	2.53	1.69	
Form of employment²			0.000
Full-time	57.77	77.08	
Part-time	23.65	19.18	
Marginal employment	18.58	3.75	
Additional jobs			0.000
No additional job	91.67	94.27	
One additional job	7.40	5.18	
More than one additional jobs	0.93	0.55	
Tenure (in years)	6.53	13.47	0.000
Type of contract (1 = fixed-term contract)	21.35	7.44	0.000
Temporary work (1 = yes)	6.19	1.59	0.000
Job tasks			
Mainly working at an office workplace (1 = yes)	19.41	49.99	0.000
Execution of work is specified in detail (1 = frequently)	36.01	26.71	0.000
Own work can be planned and organized (1 = frequently)	59.74	76.96	0.000
The allocated workload can be influenced (1 = frequently)	29.79	35.50	0.000
Work tasks that must be carried out can be influenced (1 = frequently)	27.78	35.28	0.000
Work council²			0.000
Existent	38.42	68.84	
Not existent	57.99	30.74	
Unknow	3.58	0.42	

Item	Low-wage workers	Higher-paid workers	p-value ¹
Size of company²			0.000
Fewer than 9 employees	21.51	9.21	
10–49 employees	35.10	23.54	
50–499 employees	30.97	38.29	
More than 500 employees	8.79	27.35	
Unknown	3.64	1.61	
Industry²			0.000
Agriculture, forestry and fishing	1.34	0.62	
Manufacturing (excluding construction)	16.37	29.93	
Construction	6.68	5.37	
Trade, transport, hospitality and information	31.12	16.50	
Financing, rental, business services	10.47	12.28	
Public and private services	25.35	31.56	
Private households	5.31	2.17	
Unknown	3.35	1.57	

¹ T-tests and chi-square independence tests were performed to determine whether the differences between the two groups are significant.

² The percentages do not add up to 100 due to rounding inaccuracies.

All indications are weighted.

Source: BAuA Working Time Survey 2015, own calculations.

Table A2: Estimates of the probability of working in a low-wage job

Item	Marginal effect	Standard error
Gender (1 = female)	0.074***	(0.010)
Nationality (1 = foreign)	-0.005	(0.020)
Age (Ref.: 18–29 years)		
30–44 years	-0.048***	(0.016)
45–59 years	-0.044***	(0.016)
60–65 years	-0.019	(0.023)
Marital status (Ref.: Single)		
Married	-0.021*	(0.012)
Civil union	-0.001	(0.031)
Divorced/widowed	0.009	(0.017)
Children under 18 years in the household (1 = yes)	-0.005	(0.010)
Highest professional degree (Ref.: no professional degree)		
Vocational degree	-0.171***	(0.025)
Technical school, master	-0.249***	(0.027)
Polytechnic degree	-0.308***	(0.028)
University degree	-0.342***	(0.026)
Another degree	-0.169***	(0.055)
Place of residence (Ref.: East Germany)		
West Germany	-0.169***	(0.010)
Unknown	-0.134***	(0.037)
Form of employment (Ref.: Full-time)		
Part-time	0.044***	(0.012)
Marginal employment	0.324***	(0.029)
Additional jobs (Ref.: No additional job)		
One additional job	-0.130***	(0.017)
More than one additional job	-0.101***	(0.035)

Item	Marginal effect	Standard error
Tenure (in years)	-0.006***	(0.000)
Type of contract (1 = fixed-term contract)	0.091***	(0.013)
Temporary work (1 = yes)	0.126***	(0.024)
Job tasks		
Mainly working at an office workplace (1 = yes)	-0.119***	(0.009)
Execution of work is specified in detail (1 = frequently)	0.027***	(0.009)
Work can be planned and organized (1 = frequently)	-0.024**	(0.010)
The allocated workload can be influenced (1 = frequently)	-0.005	(0.010)
Work tasks that must be carried out can be influenced (1 = frequently)	-0.019**	(0.010)
Work council (Ref.: Not existent)		
Existent	-0.102***	(0.011)
Unknown	0.086*	(0.050)
Size of company (Ref.: Less than 9 employees)		
10–49 employees	-0.040***	(0.014)
50–499 employees	-0.043***	(0.014)
More than 500 employees	-0.096***	(0.017)
Unknown	-0.054*	(0.031)
Industry (Ref.: Manufacturing (excluding construction))		
Agriculture, forestry and fishing	0.180***	(0.063)
Construction	0.035*	(0.021)
Trade, transport, hospitality and information	0.097***	(0.013)
Financing, rental, business services	0.059***	(0.015)
Public and private services	0.045***	(0.012)
Unknown	0.095***	(0.029)
Number of observations	13,886	
Pseudo R ²	0.335	
AIC	10879.86	
BIC	11196.48	
Wald-test	1841.25	
p-value	0.000	
Correct classification	85.61	
Log-Pseudolikelihood	-5397.92	

All indications are weighted; standard errors in parentheses;

* p < 0.10, ** p < 0.05, *** p < 0.01

Source: BAuA Working Time Survey 2015, own calculations.

Table A3: Descriptive statistics and balancing of the covariates

Variable	Before/ after matching	Mean		%bias	%reduction bias	t-test		V _e (T)/ V _e (C)
		Treated	Control			t-score	p> t	
Sex	before	0.609	0.456	31.1		14.67	0	1.01
	after	0.587	0.581	1.1	96.6	0.37	0.715	0.99
Nationality	before	0.043	0.034	4.4		2.17	0.03	1.24
	after	0.042	0.043	-0.7	83.5	-0.24	0.809	0.97
Age: 18–29 years	before	0.202	0.075	37.2		20.16	0	2.26**
	after	0.176	0.181	-1.4	96.3	-0.43	0.67	0.98
Age: 30–44 years	before	0.289	0.309	-4.6		-2.16	0.031	0.95
	after	0.303	0.321	-3.9	14.6	-1.34	0.181	0.95
Age: 45–59 years	before	0.442	0.531	-17.9		-8.51	0	0.99
	after	0.453	0.431	4.5	74.9	1.57	0.118	1
Age: 60–65 years	before	0.066	0.082	-6.1		-2.83	0.005	0.82
	after	0.066	0.066	0.1	99	0.02	0.982	1
Marital status: Single	before	0.353	0.257	20.8		10.16	0	1.19
	after	0.340	0.349	-2	90.2	-0.68	0.494	0.99
Marital status: Married	before	0.475	0.594	-24		-11.45	0	1.05
	after	0.485	0.462	4.6	80.9	1.58	0.114	1.01
Marital status: Civil union	before	0.018	0.013	3.9		1.93	0.053	1.36*
	after	0.018	0.017	0.6	84	0.2	0.841	1.05
Marital status: Divorced/widowed	before	0.153	0.134	5.3		2.55	0.011	1.12
	after	0.155	0.169	-4	23.6	-1.33	0.184	0.94
Children under 18 years in the household	before	0.330	0.351	-4.4		-2.09	0.037	0.97
	after	0.331	0.340	-1.9	57.9	-0.65	0.518	1
Highest professional degree: Vocational degree	before	0.664	0.428	48.7		22.81	0	1.13
	after	0.676	0.663	2.8	94.2	1.01	0.314	0.99
Highest professional degree: Technical school, master	before	0.099	0.141	-13		-5.92	0	0.72*
	after	0.109	0.115	-1.7	86.7	-0.62	0.536	0.95

Variable	Before/ after matching	Mean		%bias	%reduction bias	t-test		V_e(T)/ V_e(C)
		Treated	Control			t-score	p> t	
Highest professional degree: Polytechnic degree	before	0.039	0.126	-31.8		-13.31	0	0.35**
	after	0.046	0.03	2.7	91.7	1.24	0.217	1.18
Highest professional degree: University degree	before	0.070	0.274	-56.1		-23.35	0	0.36**
	after	0.080	0.077	0.8	98.6	0.37	0.713	1.04
Highest professional degree: Another degree	before	0.009	0.010	-0.8		-0.36	0.715	0.93
	after	0.009	0.015	-5.3	-587.5	-1.65	0.1	0.70*
Highest professional degree: no professional degree	before	0.116	0.018	40		24.92	0	5.01**
	after	0.076	0.088	-5.2	86.9	-1.62	0.106	0.89
Place of residence: West Germany	before	0.595	0.795	-44.7		-22.57	0	1.57*
	after	0.611	0.618	-1.6	96.4	-0.52	0.603	1.01
Place of residence: East Germany	before	0.387	0.188	45.1		22.9	0	1.64*
	after	0.371	0.361	2.3	95	0.72	0.471	1.02
Place of residence: Unknown	before	0.387	0.188	45.1		22.9	0	1.64*
	after	0.371	0.361	2.3	95	0.72	0.471	1.02
Form of employment: Full-time	before	0.549	0.759	-45.2		-22.49	0	1.29*
	after	0.604	0.603	0.3	99.2	0.11	0.91	1
Form of employment: Part-time	before	0.270	0.207	14.8		7.2	0	1.24
	after	0.277	0.287	-2.3	84.5	-0.75	0.453	0.97
Form of employment: Marginal employment	before	0.180	0.033	49		29.58	0	3.64**
	after	0.117	0.109	2.7	94.5	0.89	0.372	1
Type of contract	before	0.188	0.062	38.6		21.32	0	2.51**
	after	0.155	0.163	-2.4	93.8	-0.74	0.462	0.96
Temporary work	before	0.048	0.010	22.9		13.83	0	4.59**
	after	0.046	0.036	5.4	76.2	1.59	0.111	1.26*
Tenure (in years)	before	7.546	14.857	-72.4		-31.77	0	0.55*
	after	8.305	8.275	0.3	99.6	0.12	0.906	1.04

Variable	Before/ after matching	Mean				t-test		V _e (T)/ V _e (C)
		Treated	Control	%bias	%reduction bias	t-score	p> t	
Additional jobs: No additional job	before	0.915	0.941	-10.1		-5.07	0	1.41*
	after	0.914	0.902	4.9	51.8	1.51	0.131	0.82
Additional jobs: One additional job	before	0.074	0.052	9		4.49	0	1.39*
	after	0.075	0.085	-4	55.8	-1.23	0.219	0.84
Additional jobs: More than one additional job	before	0.011	0.007	4.6		2.34	0.019	1.62*
	after	0.010	0.013	-3.1	31.4	-0.95	0.34	0.77*
Work council: Existent	before	0.375	0.716	-72.9		-35.37	0	1.31*
	after	0.408	0.401	1.6	97.8	0.52	0.6	1
Work council: Not existent	before	0.596	0.281	67		32.66	0	1.40*
	after	0.575	0.578	-0.8	98.8	-0.26	0.793	1
Work council: Unknown	before	0.029	0.003	20.6		13.41	0	8.22**
	after	0.017	0.021	-2.9	85.8	-0.94	0.347	0.84
Mainly working at an office work- place	before	0.232	0.571	-73.7		-33.45	0	0.85
	after	0.260	0.257	0.8	98.9	0.29	0.768	1.01
Execution of work is specified in detail	before	0.35866	0.22983	28.6		14.11	0	1.36*
	after	0.355	0.345	2.2	92.2	0.73	0.466	1.01
Own work can be planned and organized	before	0.619	0.812	-43.8		-22.25	0	1.61*
	after	0.641	0.645	-0.9	97.9	-0.29	0.774	1.01
The allocated workload can be influenced	before	0.302	0.371	-14.6		-6.84	0	0.91
	after	0.309	0.297	2.6	82.4	0.92	0.359	1.01
Work tasks that must be carried out can be influenced	before	0.275	0.377	-21.9		-10.15	0	0.86
	after	0.280	0.297	-3.5	84	-1.25	0.212	0.99
Size of company: Fewer than 9 employees	before	0.225	0.087	38.7		20.79	0	2.30**
	after	0.214	0.218	-1.3	96.5	-0.4	0.687	0.99
Size of company: 10–49 employees	before	0.34	0.228	26.2		12.91	0	1.34*
	after	0.339	0.338	0.3	98.8	0.11	0.916	1
Size of company: 50–499 employees	before	0.310	0.382	-15.3		-7.18	0	0.89
	after	0.319	0.308	2.2	85.7	0.78	0.437	1.03

Variable	Before/ after matching	Mean		%bias	%reduction bias	t-test		V_e(T)/ V_e(C)
		Treated	Control			t-score	p> t	
Size of company: More than 500 employees	before	0.091	0.288	-51.9		-22.04	0	0.44**
	after	0.104	0.109	-1.5	97.2	-0.63	0.528	0.96
Size of company: Unknown	before	0.029	0.015	10.1		5.34	0	1.98*
	after	0.025	0.026	-1	90.2	-0.32	0.751	0.95
Industry: Agriculture, forestry and fishing	before	0.013	0.005	7.7		4.18	0	2.33**
	after	0.012	0.016	-3.7	52.2	-1.04	0.299	0.78*
Industry: Manufacturing (exclu- ding construction)	before	0.159	0.266	-26.4		-11.9	0	0.69*
	after	0.175	0.152	5.7	78.6	2.15	0.032	1.14
Industry: Construction	before	0.057	0.041	7.4		3.71	0	1.38*
	after	0.065	0.068	-1.3	82.5	-0.39	0.696	0.95
Industry: Trade, Transport, Hospi- tality and Information	before	0.299	0.156	34.6		17.69	0	1.53*
	after	0.265	0.273	-1.9	94.5	-0.62	0.535	0.99
Industry: Financing, rental, busi- ness services	before	0.110	0.131	-6.4		-2.97	0.003	0.86
	after	0.113	0.102	3.1	50.8	1.15	0.251	1.11
Industry: Public and private services	before	0.281	0.369	-18.8		-8.73	0	0.85
	after	0.290	0.314	-5.1	72.9	-1.79	0.073	0.96
Industry: Private households	before	0.051	0.017	18.6		10.43	0	2.90**
	after	0.051	0.050	0.3	98.3	0.09	0.93	1.01
Industry: Unknown	before	0.030	0.015	10.6		5.65	0	2.04**
	after	0.029	0.024	2.9	72.9	0.92	0.357	1.16

* p < 0.10, ** p < 0.05, *** p < 0.01

Source: BAuA Working Time Survey 2015; own calculations.

Table A4: Robustness checks for matching results on duration of working time and overtime

Item		Difference based on actual working time (as in tables 2 to 4)	Difference based on actual working time – 10 percent lower low-pay threshold	Difference based on actual working time – 10 percent higher low-pay threshold
Contractual weekly working time		–0.181	–0.214	–0.283
Actual weekly working time		2.270***	2.147***	1.870***
Weekly overtime		1.746***	1.812***	1.590***
Compensation ¹	Overtime is compensated by time off (1=yes)	–0.04**	–0.035*	–0.022
	Overtime is partly or fully paid (1=yes)	0.016	0.040	0.028
	Overtime is not compensated (1=yes)	0.024	–0.018	0.019
	Amount of unpaid weekly overtime	2.170*	4.101***	3.007***
Main reason for overtime	Amount of work cannot be done within the contractually agreed working time (1=yes)	0.026	0.026	0.022
	Operational requirements, e.g., longer scheduled working hours (1=yes)	0.002	0.032	0.026*
	Other operational reasons	0.006	–0.013	–0.017
	Private reasons, e.g., additional income (1=yes)	0.002	–0.013	0.017
	Enjoyment of work (1=yes)	–0.035*	–0.033*	–0.042**

¹ Multiple answers were allowed.

* p < 0.10, ** p < 0.05, *** p < 0.01

Source: BAuA Working Time Survey 2015; own calculations.

Table A5: Robustness checks for matching results on atypical working time

Item		Difference based on actual working time (as in tables 2 to 4)	Difference based on actual working time – 10 percent lower low-pay threshold	Difference based on actual working time – 10 percent higher low-pay threshold
Working hours usually between 7 am and 7 pm (1=yes)		-0.041***	-0.026*	-0.038***
Weekend work (1=yes)		0.090***	0.079***	0.091***
Weekend work	Working on Saturday (1=yes)	0.037**	0.020*	0.042***
	Incidence of working on Saturday per month	0.113**	0.156***	0.105**
	Working on Sunday (1=yes)	0.054***	0.059***	0.049***
	Incidence of working on Sunday per month	0.172**	0.208***	0.198**
Only early or late shift work (working hours not between 7 am and 7 pm) (1=yes)		0.034***	0.034***	0.035***
Shift work	Day shifts (without night work) (1=yes)	0.056*	0.012	0.013
	Shifts with night work (1=yes)	-0.008	-0.020**	-0.010

* p < 0.10, ** p < 0.05, *** p < 0.01

Source: BAuA Working Time Survey 2015; own calculations.

Table A6: Robustness checks for matching results on working time autonomy

Item	Difference based on actual working time (as in tables 2 to 4)	Difference based on actual working time – 10 percent lower low-pay threshold	Difference based on actual working time – 10 percent higher low-pay threshold
Influence on the beginning or end of the working day (0=very little influence; 5=very strong influence)	-0.262***	-0.230***	-0.219***
Gliding time (1=yes)	-0.015	-0.000	-0.029**
Home office work (1=yes)	-0.027***	-0.019**	-0.029***
Incidence of home office work per month	-0.706**	0.331	0.096
Working time account (1=yes)	-0.011	-0.026	-0.015
Start of working day specified by the employer (1=yes)	0.047***	0.023	0.058***
End of working day specified by the employer (1=yes)	0.020	-0.013	0.031*
Work on demand (1=yes)	0.027***	0.030**	0.021**
Incidence of work on demand per month	-1.647	-0.193	1.236
Change of working hours due to operational reasons (1=often, 2=sometimes, 3 rarely, 4=never)	-0.067*	-0.030	-0.026
Influence of breaks (0=(very) little influence; 1=partial influence; 2=(very) strong influence)	-0.109***	-0.105***	-0.130***
Cancellation of breaks (0=seldom; 1=often)	0.033**	0.051***	0.005

* p < 0.10, ** p < 0.05, *** p < 0.01

Source: BAuA Working Time Survey 2015; own calculations.

References

- Abowd J. & Ashenfelter O. (1981). Anticipated unemployment, temporary layoffs, and compensating wage differentials. In S. Rosen S. (Hrsg.), *Studies in labor markets*, (S. 141-170). Chicago: University of Chicago Press.
- Acemoglu D. (2001). Good jobs versus bad jobs, *Journal of Labor Economics*, 19(1), 1–19. <https://doi.org/10.1086/209978>.
- Autor D. & Dorn D. (2013). The growth of low-skill service jobs and the polarization of the US labor market. *The American Economic Review*, 103(5), 1553–1597. DOI: 10.1257/aer.103.5.1553.
- Bannai A. & Tamakoshi A. (2014). The association between long working hours and health: a systematic review of epidemiological evidence. *Scandinavian Journal of Environmental Health*, 40(1), 5–18. DOI: 10.5271/sjweh.3388.
- Becker S. & Ichino A. (2002). Estimation of average treatment effects based on propensity scores. *The Stata Journal*, 2(4), 358–377. <https://doi.org/10.1177%2F1536867X0200200403>.
- Bosch G. & Kalina T. (2008). Low wage work in Germany: an overview. In G. Bosch & C. Weinkopf (Hrsg.), *Low-wage work in Germany* (S. 19-112). New York: Russell Sage Foundation.
- Caliendo M. & Kopeinig S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*, 22(1), 31–72. <https://doi.org/10.1111/j.1467-6419.2007.00527.x>.
- Card D., Heining J. & Kline P. (2013). Workplace heterogeneity and the rise of West German wage inequality. *Quarterly Journal of Economics*, 128(3), 967–1015. <https://doi.org/10.1093/qje/qjt006>.
- Carré F., Tilly C., Van Klaveren M. & Dahm D. (2010). Retail jobs in comparative perspective. In J. Gauthier, & J. Schmitt (Hrsg.), *Low-wage work in the wealthy world* (pp. 211-268). New York: Russell Sage Foundation.
- Clark, K. & Kanellopoulos, N. (2013). Low pay persistence in Europe. *Labour Economics*, 23, 122–134. <https://doi.org/10.1016/j.labeco.2013.04.014>.
- Costa, G. (2003). Shift work and occupational medicine: an overview. *Occupational Medicine*, 53(2), 83–88. <https://doi.org/10.1093/occmed/kqg045>.
- Costa G., Sartori S. & Åkerstedt T. (2006). Influence of flexibility and variability of working hours on health and well-being. *Chronobiology International*, 23(6), 1125–1137. DOI: 10.1080/07420520601087491.
- Dehejia R. & Wahba S. (2002). Propensity score-matching methods for nonexperimental causal studies. *Review of Economics and Statistics*, 84(1), 151–161. <https://doi.org/10.1162/003465302317331982>.
- Dembe, A., Erickson J. & Banks S. (2005). The impact of overtime and long work hours on occupational injuries and illnesses: new evidence from the United States. *Occupational Environmental Medicine*, 62(9), 588–597. <http://dx.doi.org/10.1136/oem.2004.016667>.

Doeringer P. & Piore M. (1971). *Internal labour markets and manpower analysis*. Lexington: Sharpe.

Eurostat (2016). *Earnings statistics*. https://ec.europa.eu/eurostat/statistics-explained/index.php/Earnings_statistics#Low-wage_earners (September 17, 2019).

Fischer D., Lombardi DA., Folkard S., Willetts J. & Christiani DC. (2017). Updating the "risk index": a systematic review and meta-analysis of occupational injuries and work schedule characteristics. *Chronobiology International*, 34(10), 1423–1438. doi: 10.1080/07420528.2017.1367305.

Frost P., Kolstad H. & Bonde J. (2009). Shift work and the risk of ischemic heart disease: a systematic review of the epidemiologic evidence. *Scandinavian Journal of Work, Environment & Health*, 35(3), 163–179. DOI: 10.5271/sjweh.1319.

Gautié J. & Schmitt J. (Hrsg.). (2010). *Low-wage work in the wealthy world*. New York: Russell Sage Foundation.

Golden L. (2001). Flexible work schedules. Which workers get them? *American Behavioral Scientist*, 44(7), 1157–1178. <https://doi.org/10.1177%2F00027640121956700>.

Goos M. & Manning A. (2007). Lousy and lovely jobs: the rising polarization of work in Britain. *Review of Economics and Statistics*, 89(1), 118–133. <https://doi.org/10.1162/rest.89.1.118>.

Halpin B. & Smith V. (2017). Employment management work: a case study and theoretical framework. *Work and Occupations*, 44(4), 339–375. <https://doi.org/10.1177%2F0730888417720714>.

Harrington JM. (2001). Health effects of shift work and extended hours of work. *Occupational Environmental Medicine*, 58(1), 68–72. <http://dx.doi.org/10.1136/oem.58.1.68>.

Häring A., Schütz H., Gilberg R., Kleudgen M., Wöhrmann AM. & Brenscheidt F. (2016). *Methodenbericht und Fragebogen zur BAuA-Arbeitszeitbefragung 2015*. Dortmund: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin. DOI: 10.21934/baua:bericht20160812.

Hendry C. (2003). Applying employment systems theory to the analysis of national models of HRM. *International Journal of Human Resource Management*, 14(8), 1430–1442. <https://doi.org/10.1080/0958519032000145837>.

Henly J. & Lambert S. (2014). Unpredictable work timing in retail jobs: implications for employee work-life conflict. *ILR Review*, 67(3), 986–1016. <https://doi.org/10.1177/0019793914537458>.

Holland P. (1986). Statistics and causal inference. *Journal of the American Statistical Association*, 81(396), 945–960. DOI: 10.1080/01621459.1986.10478354.

ILO (2018). *Ensuring decent working time for the future*. International Labour Conference, 107th Session. Genf: International Labour Office.

- Jansen N., Kant I., Nijhuis F., Swaen G. & Kristensen T. (2004). Impact of worktime arrangements on work-home interference among Dutch employees. *Scandinavian Journal of Environmental Health*, 30(2), 139–148. DOI: 10.5271/sjweh.771.
- Joyce K., Pabayo R., Critchley JA. & Bambra C. (2010). Flexible working conditions and their effects on employee health and wellbeing. *Cochrane Database of Systematic Reviews*. Hoboken, NJ: John Wiley & Sons.
- Kalina T. & Weinkopf C. (2015). Niedriglohnbeschäftigung 2013: Stagnation auf hohem Niveau. IAQ-Report 2015-03. Duisburg: Institut Arbeit und Qualifikation.
- Kalina T. & Weinkopf C. (2017). Niedriglohnbeschäftigung 2015 - bislang kein Rückgang im Zuge der Mindestlohneinführung. IAQ-Report 2017-06. Duisburg: Institut Arbeit und Qualifikation.
- Kalina T. & Weinkopf C. (2018). Niedriglohnbeschäftigung 2016 - beachtliche Lohnzuwächse im unteren Lohnsegment, aber weiterhin hoher Anteil von Beschäftigten mit Niedriglöhnen. IAQ-Report 2018-06. Duisburg: Institut Arbeit und Qualifikation.
- Kalleberg AL. (2011). *Good jobs, bad jobs: the rise of polarized and precarious employment systems in the United States, 1970s to 2000s*. New York: Russell Sage Foundation.
- Kaufman B. (2013). The economic organization of employment: systems in human resource management and industrial relations. In A. Grandori (Hrsg.), *Handbook of economic organization. Integrating economic and organization theory*, (S. 289-311). Cheltenham: Edward Elgar. <https://doi.org/10.4337/9781782548225.00026>.
- Kim, C. & Sakamoto, A. (2008). The rise of intra-occupational wage inequality in the United States, 1983 to 2002. *American Sociological Review*, 73(1), 129–157. <https://doi.org/10.1177/000312240807300107>.
- Kivimäki M., Jokela M., Nyberg ST., Singh-Manoux A., et al. (2015). Long working hours and risk of coronary heart disease and stroke: a systematic review and meta-analysis of published and unpublished data for 603.838 individuals. *Lancet*, 386(10005), 1739–1746. doi: 10.1016/S0140-6736(15)60295-1.
- La Valle, I., Arthur, S., Millward, C., Scott, J. & Clayden, M. (2002). *Happy families? Atypical work and its influence on family life*. Bristol: The Policy Press.
- Leuven, E. & Sianesi, B. (2003). PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing. Accessed at <http://ideas.repec.org/c/boc/bocode/s432001.html> (September 17, 2019).
- McCrate, E. (2018). *Unstable and on-call work schedules in the United States and Canada*. Conditions of Work and Employment Series 99. Geneva: International Labour Organization.
- McCrate, E., Lambert, S.J., & Henly J.R. (2019). Competing for hours: Unstable work schedules and underemployment among hourly workers in Canada. *Cambridge Journal of Economics*, Doi: <https://doi.org/10.1093/cje/bey053>.

- Mason, G. & Salverda, W. (2010). Low pay, working conditions, and living standards. In J. Gautié & J. Schmitt (Hrsg.), *Low-wage work in the wealthy world*, pp. 35-90. New York: Russell Sage Foundation.
- McKnight, A., Stewart, K., Himmelweit, SM. & Palillo, M. (2016). *Low pay and in-work poverty: preventative measures and preventative approaches*. Brussels: European Commission.
- OECD, (2018). Wage levels (indicator). Accessed at <https://doi.org/10.1787/0a1c27bc-en> (September 17, 2019).
- O'Sullivan, M., Lavelle, J., McMahon, J., Ryan, L., Murphy, C., Turner, T. & Gunnigle, P. (2019). *Zero Hours and On-Call Work in Anglo-Saxon Countries*. Singapore: Springer Publishing.
- Poggi, A. (2007). Do Satisfactory Working Conditions Contribute to Explaining Earning Differentials in Italy? A Panel Data Approach. *LABOUR*, 21, 713-733. <https://doi.org/10.1111/j.1467-9914.2007.00394.x>.
- Rosen, S. (1986). The theory of equalizing differences. In O. Ashenfelter & R. Layard (Hrsg.), *Handbook of labor economics* (pp. 641-692). Amsterdam: Elsevier B.V. [https://doi.org/10.1016/S1573-4463\(86\)01015-5](https://doi.org/10.1016/S1573-4463(86)01015-5).
- Rosenbaum, P. & Rubin, D. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70(1), 41–55. <https://doi.org/10.1093/biomet/70.1.41>.
- Rubin, D. (2001). Using propensity scores to help design observational studies: application to the tobacco litigation. *Health Services & Outcomes Research Methodology*, 2(3-4), 169–188.
- Schnabel, C. (2016). Low-wage employment: are low-paid jobs stepping stones to higher paid jobs, do they become persistent, or do they lead to recurring unemployment? *IZA World of Labor*, 276, 1–10.
- Slany, C., Schütte, S., Chastang, JF., Parent-Thirion, A., Vermeulen, G. & Niedhammer, I., (2014). Psychological work factors and long sickness absence in Europe. *International Journal of Occupational and Environmental Health*, 20(1), 16–25. DOI: 10.1179/2049396713Y.0000000048.
- Smith, R. (1979). Compensating wage differentials and public policy: a review. *Industrial and Labor Relations Review*, 32(3), 339–352. <https://doi.org/10.1177/001979397903200304>.
- Sørensen, A. (1977). The structure of inequality and the process of attainment. *American Sociological Review*, 42(6), 965–978.
- Sørensen, A. (1983). Processes of Allocation to Open and Closed Positions in Social Structure. *Zeitschrift für Soziologie*, 12(3), 203–224. <https://doi.org/10.1515/zfsocz-1983-0302>.
- Sparks, K. & Cooper, C. (1997). The effects of hours of work on health: a meta-analytic review. *Journal of Occupational and Organizational Psychology*, 70(4), 391–408. <https://psycnet.apa.org/doi/10.1111/j.2044-8325.1997.tb00656.x>.
- Taylor, M., Marsh, G., Nicol, D. & Broadbent, P. (2017). *Good work: the Taylor review of modern working practices*. London: Department for Business, Energy and Industrial Strategy.

Väänänen, A., Koskinen, A., Joensuu, M., Kivimäki, M., Vahtera, J., Kouvonen, A. & Jäppinen, P. (2008). Lack of predictability at work and risk of acute myocardial infarction: an 18-year prospective study of industrial employees. *American Journal of Public Health*, 98(12), 2264–2271. doi: 10.2105/AJPH.2007.122382.

Wirtz, A., Nachreiner, F. & Rolfes, K. (2011). Working on Sundays: effects on safety, health, and work-life balance. *Chronobiology International*, 28(4), 361–370. doi: 10.3109/07420528.2011.565896.

Suggested citation

Dütsch, Matthias; Bruttel, Oliver: 2021. Cumulative risks in a segmented labour market: Working-time patterns of low-wage workers. Dortmund: Federal Institute for Occupational Safety and Health. baua: Focus.