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New evidence on the pay gap in temporary agency work in Germany

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Abstract
Using the 2023 Earnings Survey (*Verdiensterhebung*), which, unlike its predecessor, covers all employees of the sampled establishments, we provide new evidence on the hourly pay gap of temporary agency workers in Germany several years after the 2017 reform of the Temporary Agency Work Act. The raw gap of about 18% is considerably smaller than in earlier data and is more than fully explained by differences in worker and job characteristics, particularly tenure, education, and skill requirements. Conditional on these characteristics, the gap is close to zero or even favours agency workers. We also find that hourly wages in temporary agency work vary less with age, gender, nationality, and part-time status, suggesting that wage-setting structures differ between agency and non-agency employment.

Keywords Temporary agency work, Earnings inequality, Wage gap, Oaxaca–blinder decomposition
JEL Classification: J31, J50, J71

1 Introduction

Temporary agency work plays a distinct role in the German labour market. In 2023, around 2% of all employees subject to social security contributions were employed via temporary work agencies (Statistik der Bundesagentur für Arbeit 2024b). Compared with standard employment relationships, agency work is typically characterised by high worker turnover and strong cyclical sensitivity. For many workers, it can serve as an entry point (or re-entry point) into employment, especially for job seekers, individuals at risk of unemployment, and labour market returnees (Lehmer and Ziegler 2010; Schäfer et al. 2020). At the same time, agency work is disproportionately concentrated among younger workers, men, foreign nationals, and workers with comparatively low levels of formal qualification (Statistik der Bundesagentur für Arbeit 2024b).

Firms use agency work for a variety of reasons. A prominent motive is the ability to adjust labour input flexibly in response to temporary demand fluctuations. Agency work may also be used to bridge short-term absences, cover production peaks, or screen workers before offering regular employment. While the screening function is well established, the evidence on whether agency work serves as a stepping stone into regular employment is mixed (Hveem 2013; Jahn and Rosholm 2014). Related contributions for Germany examine the role of temporary agency work in firms' adjustment and broader labour-market dynamics (Jahn and Bentzen 2012; Baumgarten and Kvasnicka 2017; Walwei and Muschik 2023). Moreover, when temporary agency work is used to a moderate extent, productivity gains may arise because agency workers can be deployed flexibly and existing resources can be utilised more efficiently (Hirsch and Mueller 2012; Hirsch 2016; Nielen and Schiersch 2016).

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Despite these potential benefits, the wage position of agency workers has long been debated. A recurrent finding in the literature is that agency workers earn less than comparable non-agency workers, but the size of the estimated disadvantage varies considerably across datasets, observation periods, and wage concepts. Using administrative data on the daily wages of full-time workers, Jahn (2010) reports a raw gap that widened from 36% in 1997 to 45% in 2004. After controlling for worker and job characteristics, occupation, previous employment histories, and individual fixed effects, a gap of about 20% remains, which falls to about 15% when the decline in earnings before entry into agency work is taken into account. Using similar data for 2000–2008, Jahn and Pozzoli (2013) confirm substantial pay penalties for workers with little experience in the agency sector, but show that these penalties decline with the time spent in the sector. For 2018, Bachmann et al. (2024) estimate a raw gap in monthly earnings of −0.42 log points based on administrative data, which shrinks to between −0.14 and −0.22 log points once observed characteristics are taken into account. As administrative data contain no information on working hours, these estimates also reflect the shorter working hours of agency workers. Based on hourly wages from the 2018 Structure of Earnings Survey (*Verdienststrukturerhebung*, VSE), the same authors obtain a raw gap of −0.29 log points and adjusted gaps of only −0.03 log points (regression) and practically zero (matching). The official evaluation of the 2017 reform of the Temporary Agency Work Act, which draws on a range of data sources up to 2020, concludes that the pay gap between agency workers and the core staff of user firms had not narrowed measurably as a result of the reform (Brändle et al. 2022). As an international example, Bergeaud et al. (2024) document an average wage gap of about 3% between French agency workers and in-house workers in the same establishment and occupation, but also substantial heterogeneity, with agency workers earning more than in-house workers in over one quarter of establishment-by-occupation cells.

The aim of this paper is to provide new evidence on the hourly pay gap between agency and non-agency workers in Germany in 2023. Hourly wages provide a more appropriate measure of pay differences than monthly earnings because they represent the "price" per unit of labour paid, whereas monthly earnings are the product of hourly wages and hours worked ("price times quantity"). Two features distinguish our analysis from earlier work. First, it is based on data that cover *all* employees of the sampled establishments rather than a subsample of employees selected by the establishments themselves. Second, we are the first to examine hourly pay differences between agency and non-agency workers several years after the 2017 reform of the Temporary Agency Work Act (*Arbeitnehmerüberlassungsgesetz*, AÜG), which was explicitly intended to improve the pay of agency workers.

Our analysis is based on the 2023 Earnings Survey (*Verdiensterhebung*, VE), conducted by the Statistical Offices of the Federation and the German states (Statistische Ämter der Länder und des Bundes 2023). The VE is the only large-scale dataset for Germany that contains information on working hours required to calculate hourly wages. Its key advantage is that the sampled establishments are legally obliged to report earnings and working hours for all of their employees. In the VE's predecessor, the VSE, on which the most recent evidence on hourly pay differences is based, establishments reported only for a random subsample of their employees drawn within each establishment, but it is unclear to what extent randomization was enforced by the Statistical Offices.[1] As a result, the VE 2023 covers roughly 8.8 million employees in about 64,800 establishments, compared with about one million employees in some 60,000 establishments in the VSE 2018 (Bachmann et al. 2024). The selective reporting in the VSE gives rise to several potential biases that are particularly relevant for agency workers. First, any deviation from strictly random selection within establishments – for example, a tendency to report employees in stable employment relationships with complete personnel records – would lead to an under-representation or a selective representation of workers with short tenure and frequent entries and exits, which is precisely the profile of agency workers. Second, the number of agency workers in the VSE is small – fewer than 10,000 in the 2018 analysis sample of Bachmann et al. (2024), compared with more than 100,000 in our data – which limits the precision of detailed decompositions and subgroup analyses. In the VE, there is no selection of employees within establishments, the only sampling stage is the selection of establishments with known inclusion probabilities, and the reported information is in most cases extracted directly from the establishments' payroll systems.

The second distinguishing feature concerns the timing of our analysis relative to the 2017 reform of the AÜG, which was the outcome of a long political debate. The first Hartz reform, whose provisions on agency work became fully effective in 2004, had largely deregulated agency work. It abolished the maximum assignment duration

[1] In the VSE, establishments reported only for a subsample of their employees, with sampling intervals ranging from every second employee in establishments with 10 to 49 employees to every 40th employee in establishments with 1,000 or more employees (Forschungsdatenzentren der Statistischen Ämter des Bundes und der Länder 2020). The selection was mostly carried out by the establishments themselves, which applied a prescribed start number and sampling interval to their payroll lists. According to the quality report for the 2014 wave, whose sampling design was retained in 2018, non-response at this second stage could neither be quantified nor corrected (Statistisches Bundesamt 2016; Forschungsdatenzentren der Statistischen Ämter des Bundes und der Länder 2020).

and the ban on synchronising employment contracts with assignments, and it made equal pay the default from the first day of an assignment unless a collective agreement provided otherwise (Sect. 2). Since practically the entire sector subsequently applied collective agreements, the equal-pay principle remained largely without practical effect, while agency employment expanded rapidly and pay gaps did not narrow (Jahn 2010). A sequence of corrections followed. Prompted by cases in which dismissed employees were re-employed as agency workers on less favourable terms, the 2011 amendment of the AÜG, which also transposed the EU Temporary Agency Work Directive (2008/104/EC), introduced a "revolving door" clause and created the legal basis for a binding wage floor in the sector, which applied from 2012. The 2013 coalition agreement of CDU/CSU and SPD then announced a maximum assignment duration of 18 months and equal pay after nine months. These rules were passed by the Bundestag in October 2016 and took effect on 1 April 2017. According to the government bill, the reform aimed to refocus agency work on its core function of meeting temporary labour needs, to prevent its misuse, to strengthen the position of agency workers, in particular with respect to pay, and to strengthen the role of collective agreements (Deutscher Bundestag 2016; Brändle et al. 2022).

There are several reasons to expect that the effects of the reform on relative pay unfolded only gradually and are therefore not captured by the previous contribution by Bachmann et al. (2024) based on the VSE 2018. First, under the transitional provision of § 19(2) AÜG, assignment periods before 1 April 2017 were not counted. The mandatory equal-pay entitlement after nine months could therefore apply from January 2018 at the earliest, and the maximum assignment duration could not become binding before October 2018. In April 2018, the reference month of the VSE 2018 analysed by Bachmann et al. (2024), the equal-pay rule had thus been in force for only a few months, and the maximum assignment duration not at all. Second, the direct reach of the new rules is limited because most assignments are short and because collective agreements may defer equal pay to up to 15 months if sector-specific supplements are paid (Brändle et al. 2022). Effects on the wage structure of agency work as a whole are therefore likely to operate mainly indirectly, through collective bargaining over pay scales and sector supplements and through adjustments in assignment durations and in the take-over of agency workers by user firms. Third, the new rules were widely regarded as complex and as creating considerable legal uncertainty, which raised implementation costs for agencies and user firms (Brändle et al. 2022). Consistent with these considerations, the evaluation, which relied on data up to 2020, found no measurable reduction in the pay gap attributable to the reform (Brändle et al. 2022). The longer-term effects of the new provisions could therefore not yet have been visible in the 2018 data analysed by Bachmann et al. (2024). Our 2023 data allow us to examine hourly pay differences six years after the reform, providing a substantially longer-term perspective on the wage structure of temporary agency work.

Beyond these two main features, we extend the evidence in Bachmann et al. (2024) by providing a more detailed analysis of the contributions of individual worker and job characteristics such as tenure, education, skill requirements, and occupation to pay differences between agency and non-agency workers, both through differences in characteristics and through differences in their remuneration. We also examine how our results change when the sample is restricted to workers with short tenure and to establishments covered by sectoral collective agreements. Finally, we provide the first evidence on pay differences between agency and non-agency workers in marginal employment, which yields the notable finding of a reverse pay gap in favour of agency workers.

Our results suggest that by 2023, there were generally no significant differences in hourly pay between agency and non-agency workers with similar worker and job characteristics. Compared with the earlier German evidence, our estimates are markedly more favourable to agency workers. The raw hourly wage gap of about −18% for all employees and −23% for full-time employees is roughly ten percentage points smaller than the corresponding gaps of −28% and −32% in the VSE 2018 (Bachmann et al. 2024), even though the composition of agency workers and jobs became more unfavourable. In regression specifications that are directly comparable to those of Bachmann et al. (2024), the conditional gap changes from −0.03 log points in 2018 to +0.10 log points in 2023, whereas the gap after matching is close to zero in both years. Although our analysis does not provide direct causal evidence, our results are consistent with the hypothesis that the reform of the AÜG in 2017, together with the collective agreements it encouraged, strengthened the relative wage position of agency workers. This improvement occurred even as their share of the overall workforce declined, partly reflecting weak cyclical conditions in the sectors that rely most intensively on agency work.

When assessing the external validity of these findings, the specific conditions of 2023 should be kept in mind. Burdened by high inflation, rising interest rates, and weak foreign demand in the wake of Russia's war against Ukraine, German real GDP declined by 0.3% in 2023, and the annual average unemployment rate rose by 0.4 percentage points to 5.7% (Statistik der Bundesagentur für Arbeit 2024a). Thus, whereas 2018 marked the late phase of a long expansion, 2023 was a year of economic

stagnation in a labour market that nevertheless remained comparatively tight. Agency work was hit disproportionately: employment in the sector fell by almost 5% between June 2022 and June 2023 (Statistik der Bundesagentur für Arbeit 2024a), particularly because of the weakness of manufacturing (Statistik der Bundesagentur für Arbeit 2026). Two features of this environment are important for interpreting our results. On the one hand, weak demand for agency work should, if anything, have put pressure on agency pay and shifted the composition of agency employment towards less favourable characteristics, so that cyclical conditions are unlikely to have flattered the relative wage position of agency workers in 2023. On the other hand, 2023 was the first year in which the statutory minimum wage of 12 euros, raised from 9.82 euros in the course of 2022, applied throughout. Because agency workers are concentrated in the lower part of the wage distribution, this compression at the bottom is likely to have contributed to the narrowing of the raw pay gap relative to 2018. Our results should therefore be read as describing the relative wage position of agency workers under the combined effect of the post-2017 regulatory framework, near-universal collective bargaining coverage in the sector, and a substantially higher wage floor. Whether this position persists under different cyclical conditions and with a smaller bite of the minimum wage is a question that future waves of the VE will allow to address.

2 Institutional background

In the German institutional context, wage comparisons require particular care because temporary agency work is subject to specific regulation under the Temporary Agency Work Act (*Arbeitnehmerüberlassungsgesetz*, AÜG) and is characterised by exceptionally high collective bargaining coverage. The high level of collective bargaining coverage in the agency-work sector can be traced partly to the Hartz reforms, which came into effect in 2004. These reforms introduced the principle that agency workers should receive the same pay and essential working conditions as comparable employees at the user firm, while allowing deviations from this principle if the employment relationship was governed by an applicable collective agreement. This exemption created strong incentives for temporary work agencies to adopt collective agreements, resulting in their widespread use in the sector after 2003. According to Brändle et al. (2022), more than 80% of temporary work agencies are covered by collective agreements, and the proportion of agency workers covered is even higher. Collective agreements in the temporary agency sector are negotiated on the employers' side by the relevant employers' associations and on the workers' side by the *DGB-Tarifgemeinschaft Zeitarbeit*, a bargaining alliance of trade unions affiliated with the German Trade Union Confederation (*Deutscher Gewerkschaftsbund*, DGB). Among other provisions, these agreements typically specify an average contractual working week of 35 hours, which is shorter than the average working week of full-time employees in Germany.

The regulatory framework was tightened considerably by the 2017 reform of the AÜG, which increased both the restrictions and the administrative requirements associated with temporary agency work (Statistik der Bundesagentur für Arbeit 2024b). Most importantly, the reform introduced a general maximum assignment duration of 18 consecutive months for an agency worker at the same user firm. It also strengthened the equal-pay principle by requiring agency workers to receive the same remuneration as comparable employees of the user firm after nine months of assignment. Collectively agreed exceptions remain possible: sectoral agreements may permit longer assignment periods, while supplementary-pay agreements may provide for a gradual convergence towards equivalent pay over a period of up to 15 months. In addition, contracts between agencies and user firms must explicitly identify the arrangement as temporary agency work and specify the worker concerned. Violations may result in substantial fines for the agency, the user firm, or both.

Between 2017 and 2023, the number of temporary agency workers declined from 995,000 to 754,000 (Statistik der Bundesagentur für Arbeit 2024b). Although this decline may partly reflect the stricter regulatory and administrative requirements imposed on agencies and user firms by the 2017 reform of the AÜG, weak economic conditions in Germany – particularly in sectors that traditionally rely heavily on agency work – are also likely to have contributed. Temporary agency employment is widely regarded as an early indicator of the business cycle because firms can adjust their use of agency workers relatively quickly in response to changes in demand (Statistik der Bundesagentur für Arbeit 2024b). The German economy had already begun to lose momentum before the onset of the COVID-19 pandemic in 2020. After 2022, the decline in temporary agency employment was particularly pronounced in manufacturing, which had previously accounted for the largest share of demand for agency workers (Statistik der Bundesagentur für Arbeit 2026).

3 Data

3.1 The 2023 earnings survey (Verdiensterhebung, VE)

Our analysis is based on the 2023 Earnings Survey (*Verdiensterhebung*, VE), conducted by the Statistical Offices of the Federation and the German states (Statistische Ämter der Länder und des Bundes 2023). The VE replaced the earlier Structure of Earnings Survey (VSE) from 2022 onward and relies on a similar but expanded

design. A key innovation of the VE is that establishments included in the survey are required to report information for *all employees* rather than for a random subsample. This yields a very large and informative dataset covering roughly 8.8 million employees in about 64,800 establishments. By contrast, under the VE's predecessor, the VSE – which was used in the earlier study of the wage gap in temporary agency work by Bachmann et al. (2024) – firms reported information only for a random subset of their employees, often representing just a fraction of their total workforce.

The VE is the only large-scale German micro dataset that simultaneously provides detailed information on monthly earnings and paid working hours, which allows the construction of hourly wage measures. By contrast, administrative data sources such as those of the Institute for Employment Research (IAB) do not contain reliable working-hours information because their primary purpose is to determine social-security contributions and entitlements.

Given the statutory obligation for sampled establishments to participate, the Earnings Survey (Verdiensterhebung, VE) is expected to exhibit high data validity. A further important reason for the high validity of the data is that, in most cases, the reported information is automatically extracted from establishments' internal human resources and payroll systems. This applies in particular to information on pay, working hours, and characteristics of the establishment and the employment relationship. Potential limitations may arise only for variables such as qualifications if establishments do not keep employee records sufficiently up to date. If such a problem exists, it would also affect other data sources, in particular administrative data held by the IAB.

3.2 Sample definition and key variables

The VE is a survey of establishments with employees subject to social security contributions in economic sections A ("Agriculture, forestry and fishing") through S ("Other service activities") according to the German Classification of Economic Activities WZ 2008. Establishments in "Public administration" (section O) as well as most establishments in "Education" (section P) are not surveyed directly. Instead, these sectors are covered via the personnel stock statistics, which do not include the same information as in other sectors. Establishments that do not employ any workers subject to social security contributions but have at least one marginally employed worker are also not surveyed directly. Due to the incomplete or merely imputed information, we exclude establishments in "Public administration" (section O), establishments in "Education" (section P) as well as establishments that do not employ any workers subject to social security contributions from our analysis.

The analyses of the pay gap between workers employed in temporary agency work and workers outside this sector are based on VE April 2023 data. These data include only individuals who received earnings in April 2023, have information on paid working hours, and were in an employment relationship throughout the entire month.[2] Temporary agency work is identified in the VE via a separate indicator for worker agency assignment (*Arbeitnehmerüberlassung*).

Importantly, information on temporary agency workers is collected from the temporary work agencies that formally employ them, rather than from the user firms in which they are deployed. Consequently, the VE does not identify the user firm and provides no information on its industry, size, collective bargaining coverage, or other characteristics. All establishment-level information we use therefore refers to the reporting temporary work agency and not to the user firm.

For our analysis, we use the monthly earnings paid in April 2023, the working hours worked in that month including overtime, and a range of additional characteristics described below. In all analyses, the hourly wage is constructed by dividing monthly earnings by the number of hours worked in April, including overtime. All descriptive statistics and econometric analyses are computed using the VE survey weights, which correct for differences in sampling probabilities across units (Statistische Ämter der Länder und des Bundes 2023).

For analytical purposes, we further restrict the dataset to limit potential distortions from outliers. Specifically, we exclude individuals whose monthly gross earnings are either below 150 euros or above 15,000 euros. According to the data documentation, observations with monthly wages below 150 euros may reflect short-time work or other irregular employment situations. We also winsorize hourly wages at the 99th percentile, replacing all higher values with the percentile cutoff of 71.30 euros per hour. This threshold lies well outside the range relevant for comparisons between typical agency and non-agency workers. Our restrictions remove extreme observations that could otherwise exert a disproportionate influence on our regression analyses (which are based on least squares procedures), even though they are of little substantive relevance to the comparison between agency and non-agency workers. Observations with monthly earnings below 150 euros account for 0.98 percent of the original sample, while those with monthly earnings above 150,000 euros account for approximately 0.69 percent.

Although we report only a subset of our full results, we originally conducted the analysis separately for three different subsamples: (i) employees subject to social

[2] Our estimates therefore refer to the reporting month of April 2023 and do not capture potential seasonal variation over the year.

security contributions – total (i.e., full-time or part-time), (ii) employees subject to social security contributions – full-time only, (iii) marginally employed workers ("mini-job" employment). Marginally employed workers are not included in the other two groups, while the second group (full-time workers) is a subset of the first group representing the core segment of the labour market. In the main text, we focus primarily on groups (i) and (ii). Results for marginally employed workers are reported in the Sect. 7. More comprehensive results, including additional analyses for monthly earnings, are available in our technical report (Biewen et al. 2025).

4 Characteristics of workers in and out of temporary agency work

Table 1 reports descriptive statistics for agency and non-agency workers. Using hourly wages as the basis for comparing agency and non-agency workers yields a raw (unadjusted) pay gap of approximately −18% to the disadvantage of agency workers (columns 1 and 2 of Table 1). The gap is slightly larger for the subgroup of full-time employees (columns 3 and 4 of Table 1). Figure 1 illustrates heterogeneity in the raw gap by age group and skill requirement level. The disadvantage of agency workers is typically more pronounced for higher task levels and in older age groups, whereas the gap is reversed for younger workers, particularly those with lower task levels.

There are clear differences in personal and job characteristics between agency and non-agency workers (lower part of Table 1). Agency workers have, on average, lower weekly working hours, which is particularly pronounced among full-time employees. A plausible explanation is the very high collective bargaining coverage in the agency sector and the widespread use of sectoral collective agreements that stipulate a 35-hour workweek. Agency workers are also systematically different in socio-demographic characteristics and job histories. They are younger on average, less likely to be female, have substantially shorter tenure with the current establishment, and more frequently hold foreign nationality. Finally, agency workers are much more likely to work in low skill-requirement jobs ("helpers") and to have lower levels of formal education. Taken together, these differences suggest that raw wage gaps are likely to be partly driven – and may even be largely explained – by compositional differences between the two groups.

Note that our measure of hourly pay includes overtime remuneration as well as shift-work, Sunday, and public holiday premiums. We do not examine these components separately because they affect only approximately 10% of both agency and non-agency workers. Overtime remuneration differs little between the two groups, amounting to approximately 13 euros per overtime hour for agency workers and 14 euros for non-agency workers. Shift-work, Sunday, and public holiday premiums per hour worked are somewhat higher for agency workers, at around 4 euros per hour, compared with less than 2 euros per hour for non-agency workers.

Compared with the 2018 VSE results reported by Bachmann et al. (2024), the raw hourly wage gap is

Table 1 Descriptive statistics (means)

	All employees (subject to social security)		Full-time employees	
	Non-agency	Agency	Non-agency	Agency
Hourly wage (euros)	23.59	19.38	24.89	19.16
Weekly working hours	34.09	32.64	38.31	33.76
Full-time indicator	0.69	0.86	–	–
Age	44.47	38.61	43.45	38.65
Female	0.47	0.28	0.32	0.24
Tenure (years)	10.65	1.21	10.58	1.21
Skill-requirement level				
Helper	0.15	0.60	0.12	0.60
Skilled worker	0.54	0.34	0.54	0.34
Specialist	0.16	0.04	0.18	0.04
Expert	0.14	0.02	0.16	0.02
Education				
Lower secondary (no vocational degree)	0.09	0.40	0.08	0.40
Lower secondary (with vocational degree)	0.54	0.44	0.54	0.45
Upper secondary (no tertiary degree)	0.02	0.03	0.02	0.02
Upper secondary (with vocational degree)	0.15	0.07	0.15	0.07
University / University of Applied Sciences	0.21	0.06	0.22	0.06
Foreign nationality	0.22	0.49	0.21	0.50
Number of observations	7,910,524	102,172	6,146,698	86,395

Notes: Statistics are weighted using VE survey weights. "Agency" refers to employees in *temporary agency work*; "Non-agency" refers to employees outside *temporary agency work*. Tenure is measured in years. Employees subject to social security contributions (no "mini-jobs"). Authors' calculations based on VE 2023

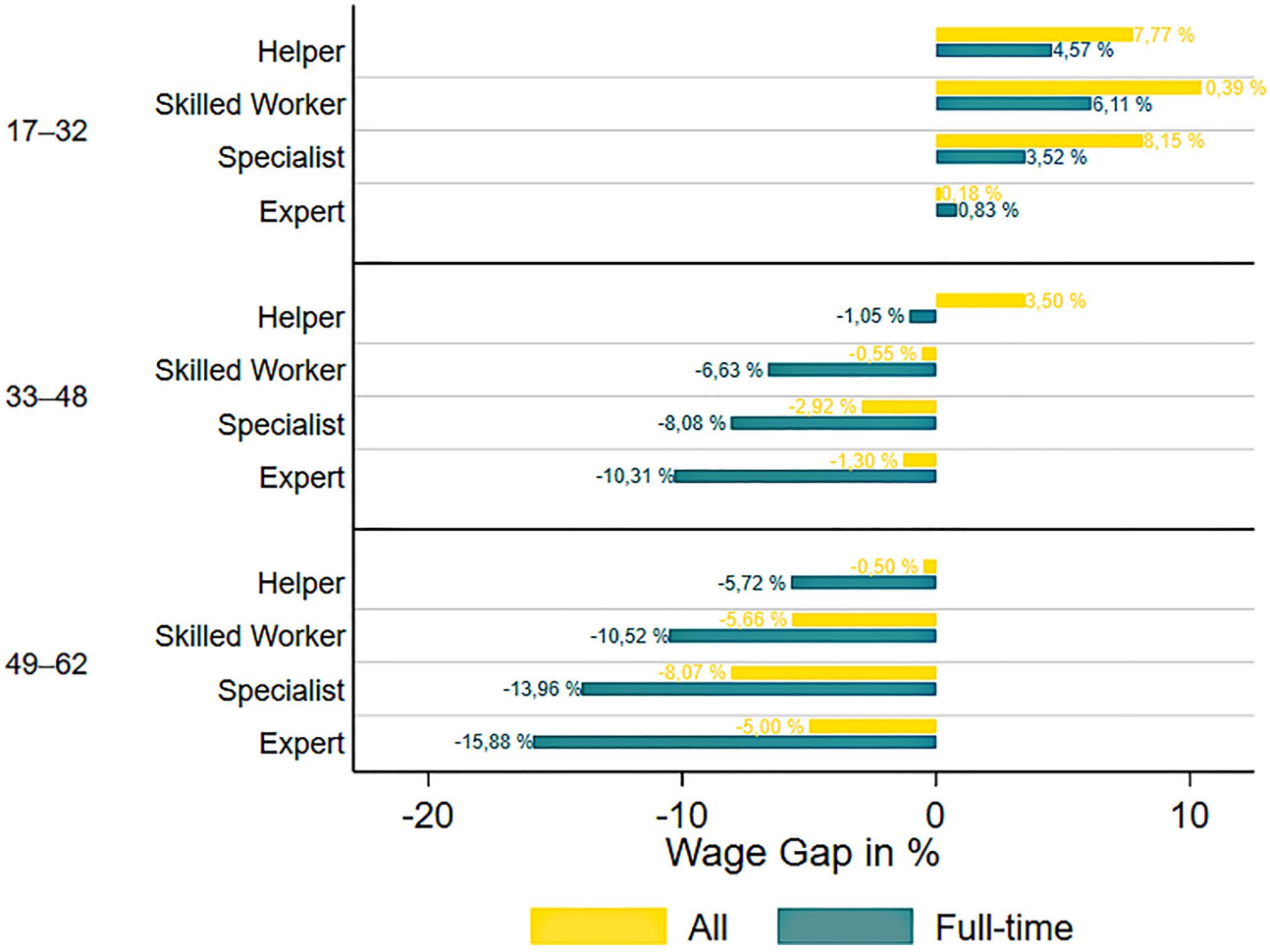


Fig. 1 Hourly wage gap within age and skill-requirement group. Notes: the figure reports raw differences in average log hourly wages between agency and non-agency workers within the same age group and skill-requirement level. Employees subject to social security contributions (no "mini-jobs"). Source: authors' calculations based on VE 2023

substantially smaller in the 2023 VE. Bachmann et al. (2024) report a gap of −28% for all employees and −32% for full-time employees, compared with about −18% and −23% in our data, respectively.

At the same time, the composition of agency employment has changed since the 2018 wave of the VSE analysed by Bachmann et al. (2024). The share of agency workers employed as helpers increased from 45% to 60% , while the share employed as skilled workers declined from 46% to 34%. The share of agency workers without a vocational degree rose from 24% to 40%, and average tenure declined from about two years to 1.2 years. By contrast, changes in age, gender, and the full-time share were comparatively small. These developments point to a shift towards lower observed qualifications, skill-requirement levels, and tenure among agency workers, which is likely due to the disproportionate decline of agency work in the manufacturing sectorsee Sect. 2 and Statistik der Bundesagentur für Arbeit (2026). The smaller raw wage gap in 2023 therefore cannot be attributed to a more favourable composition of agency employment.

5 Econometric analysis of hourly wages

The aim of the econometric analysis is to quantify the part of the pay gap that remains after controlling for observable differences between agency and non-agency workers. We focus on mean-based econometric methods because the mean provides a comprehensive measure of average pay differences across groups. Unlike the median, which reflects only the midpoint of the wage distribution, the mean incorporates all observations and is therefore sensitive to differences throughout the distribution. Because mean pay corresponds to total pay divided by the number of workers, comparisons of means directly capture differences in total remuneration between agency and non-agency workers in worker subgroups defined by covariates.

5.1 Linear regression model

We begin with a sequence of linear wage regressions based on an extended Mincer-type earnings function. The baseline specification is:

$$\ln s_i = \tau' \mathbf{X}_i + \lambda z_i + \upsilon_i, \tag{1}$$

where s_i denotes the hourly wage of worker i. The indicator z_i equals one if worker i is employed in *temporary agency work* and zero otherwise. The vector $\mathbf{X}_i$ collects control variables commonly used in the wage determination literature (age and age squared, gender, foreign nationality, a part-time indicator, tenure and tenure squared) and is extended stepwise by education, skill-requirement level, and occupation. The error term is υ_i. The coefficient λ can be interpreted as the (approximate) percentage wage difference between agency and non-agency workers.

For transparency, we estimate the following nested model specifications:

- **Model 1:** No controls (only the agency indicator).
- **Model 2:** Age, gender, foreign nationality, part-time, tenure.
- **Model 3:** Model 2 + education.
- **Model 4:** Model 3 + skill-requirement level.
- **Model 5:** Model 4 + occupation (37 occupations, KldB2010).

Table 2 summarizes the estimated pay gap across specifications. Table A1 and A2 in the appendix report the complete regression results. Adding controls substantially reduces the estimated gap and, from Model 3 onward, can reverse its sign. For all employees, the coefficient on the agency-work indicator changes from about −0.18 log points in Model 1 to roughly +0.10 log points in Model 4 (i.e., after controlling up to skill requirement). Adding occupation (Model 5) reduces this premium again, yielding estimates close to zero. Taken together, the results in Table 2 suggest that hourly pay differences between agency and non-agency workers shrink to zero or even reverse when differences in worker and job characteristics are taken into account.

A comparison with the VSE 2018 results reported by Bachmann et al. (2024) shows a similar role of observed characteristics, but a positive conditional wage differential in 2023.[3] In both studies, adding controls for education and skill requirement accounts for most of the raw hourly wage gap. Whereas a small negative coefficient remains in the VSE 2018, the coefficient turns positive in the VE 2023.

5.2 Oaxaca–blinder decomposition

Next, we use an Oaxaca–Blinder decomposition (Blinder 1973; Oaxaca 1973) to separate the raw pay gap into an "explained" component attributable to differences in observable characteristics and an "unexplained" component attributable to differences in coefficients (returns) and unobserved factors.

Let $\bar{\mathbf{X}}^A$ and $\bar{\mathbf{X}}^N$ denote the vectors of mean characteristics for agency workers (A) and non-agency workers (N), and let $\hat{\beta}^A$ and $\hat{\beta}^N$ denote the corresponding estimated coefficient vectors from separate wage regressions. We focus on the decomposition variant that uses the coefficient vector of *group 1* as the reference, where group 1 is the non-agency group (see Jann 2008). We use the Oaxaca–Blinder variant that evaluates the "explained"

Table 2 Estimated pay gap from linear regressions (hourly wages)

	(1)	(2)	(3)	(4)	(5)
Panel A: All employees					
Agency work	−0.18***	−0.07***	0.05***	0.10***	0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	8,012,696	8,012,696	8,012,696	8,012,696	8,012,696
R-squared	0.00	0.15	0.38	0.46	0.51
Panel B: Full-time employees					
Agency work	−0.24***	−0.10***	0.03***	0.09***	0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	6,233,093	6,233,093	6,233,093	6,233,093	6,233,093
R-squared	0.01	0.12	0.37	0.45	0.51

Notes: The table reports the estimated coefficient on the agency-work indicator. Standard errors clustered at the establishment level are reported in parentheses. Model 1 includes no control variables. Model 2 controls for age, gender, foreign nationality, part-time employment, and tenure. Model 3 additionally controls for educational attainment. Model 4 additionally controls for task requirement level. Model 5 additionally controls for occupation. Employees subject to social security contributions; marginally employed workers ("mini-jobs") are excluded. *, **, and *** denote significance at the 10, 5, and 1% level. Source: Authors' calculations based on VE 2023

[3] Bachmann et al. (2024) report coefficients of −0.285 and −0.026 for all employees and −0.339 and −0.045 for full-time employees in their baseline and richest hourly-wage specifications, respectively. The latter includes controls up to task skill requirement, but not occupation, and therefore corresponds to Model 4.

component at the non-agency wage structure, i.e., the coefficient vector for non-agency workers is taken as the reference. This is a natural choice as the latter represent the vast majority of the labour market.

Defining the average log-wage gap as $\Delta = \bar{y}^A - \bar{y}^N$ with $y = \ln s$, the decomposition can be written as:

$$\Delta = \underbrace{\left(\bar{\mathbf{X}}^A - \bar{\mathbf{X}}^N\right)' \hat{\beta}^N}_{\text{explained (characteristics)}} + \underbrace{\left(\bar{\mathbf{X}}^A\right)' \left(\hat{\beta}^A - \hat{\beta}^N\right)}_{\text{unexplained (coefficients)}} . \quad (2)$$

Table 3 reports a Blinder–Oaxaca decomposition of the hourly wage gap (log hourly wages) between temporary agency workers and non-agency workers for all employees subject to social security contributions, using the richest specification (Model 5), which also controls for occupation. The observed gap amounts to about −0.18 log points, i.e. agency workers earn roughly 18 log-percent less per hour on average. Strikingly, the gap is more than fully accounted for by differences in observed characteristics: the explained component equals −0.24 log points, corresponding to 135.47% of the overall gap. In other words, agency workers tend to have less favourable observables, which by themselves would predict an even larger hourly wage disadvantage. The most important contributors to the explained part are differences in task level (54.17% of the gap), tenure (47.50%), and education (30.25%). Differences in occupations contribute as well, but are comparatively small (6.15%), indicating that occupational sorting explains only a limited share once the broader job and worker characteristics are controlled for.

Table 3 Blinder–Oaxaca decomposition (all employees subject to social security contributions)

	Coef.	s.e.	(Un)explained (%)
Overall			
Non-agency workers	3.08***	0.00	
Agency workers	2.90***	0.01	
Difference	−0.18***	0.01	
Explained	−0.24***	0.01	135.47
Unexplained	0.06***	0.01	−35.47
Explained component (characteristics)			
Age	−0.01***	0.00	6.30
Male	0.02***	0.00	−11.70
Foreign nationality	−0.02***	0.00	8.99
Part-time	0.01***	0.00	−6.16
Tenure	−0.08***	0.00	47.50
Education	−0.05***	0.00	30.25
Task level	−0.10***	0.00	54.17
Occupation	−0.01***	0.00	6.15
Unexplained component (coefficients)			
Age	−0.37***	0.02	211.50
Male	−0.05***	0.01	29.07
Foreign nationality	0.01**	0.00	−5.23
Part-time	0.01***	0.00	−4.47
Tenure	−0.01**	0.00	2.87
Education	−0.01**	0.01	6.38
Task level	−0.01**	0.01	8.14
Occupation	−0.09**	0.04	48.39
Constant	0.58***	0.04	−332.12

Notes: Authors' calculations based on VE 2023. The outcome is the log hourly wage. Employees subject to social security contributions (no "mini-jobs"). Model 5: Age, gender, foreign nationality, part-time employment, tenure, educational attainment, task level, and occupation. *, **, *** denote significance at the 10, 5, and 1% level

The "unexplained" component in Table 3 illustrates how differences in the remuneration of observed characteristics contribute mechanically to the overall hourly wage gap. The coefficient effects associated with age and gender tend to *widen* the gap, whereas differences in the remuneration of foreign nationality, part-time work, and tenure *narrow* it. The contributions of education and task level are comparatively small in the unexplained part in this specification. The dominant factor is age, which serves here as a proxy for labour market experience. Temporary agency workers receive markedly lower returns to a given age or experience profile than comparable non-agency workers. In Table 3, this mechanical contribution of the age coefficient amounts to 211.50% of the observed gap. This effect, however, is more than offset by the countervailing contribution of the regression constant (−332.12%). The regression constant captures pay differences for the reference person, which we interpret as differences in the baseline level of pay between agency and non-agency work.[4] Put differently, although the age-pay gradient is flatter in temporary agency work, agency workers appear to receive a higher baseline component of hourly pay (i.e., wage components not tied to age or other characteristics).[5]

Additional, smaller differences in pay setting concern male gender (29.07% of the gap), foreign nationality (−5.23%), part-time work (−4.47%), and occupation (48.39%). The latter indicates some heterogeneity in how occupations are priced across sectors, although its contribution is not large enough to change the overall picture. The negative contributions for nationality and part-time work imply that these characteristics are penalized less in temporary agency work than outside it. A plausible explanation is that temporary work agencies typically remunerate workers based on collective agreements,

[4] The reference person is generally defined as having a low or the lowest level of wage-relevant characteristics so that coefficients capture "wage premia", see Table A 1. Exceptions are foreign nationality and part-time status, where we define German nationality and full-time employment as the reference. In the latter case, the coefficients represent "wage penalties" rather than "wage premia".

[5] Under an alternative interpretation, contributions of the constant in an Oaxaca-Blinder decomposition may reflect differences in unobservables between the two groups. This interpretation does not seem to fit well in our application, since agency workers would generally be expected to have less favourable, rather than more favourable, unobserved characteristics than non-agency workers.

which tend to compress pay schedules and limit wage differentiation by individual characteristics.

Overall, the decomposition implies that temporary work agencies pay slightly higher hourly wages for workers with identical observed characteristics, which translates into a countervailing contribution of the unexplained component. In Table 3, the unexplained part equals −35.47% of the observed gap, whereas the gap is explained to more than 100% (135.47%) by the less favourable characteristics of temporary agency workers.

5.3 Statistical twins: propensity score matching

As a complementary approach that avoids functional-form assumptions about the wage equation, we construct "statistical twins" using one-to-one nearest-neighbor propensity score matching (PSM, Leuven and Sianesi 2003). The idea is to compare each agency worker to observationally similar non-agency workers by matching on the estimated probability of being employed in temporary agency work.

Let z_i be the indicator for agency work and $\mathbf{X}_i$ the vector of observed characteristics. We estimate propensity scores using a probit model,

$$\Pr(z_i = 1 \mid \mathbf{X}_i) = \Phi(\mathbf{X}_i'\delta), \tag{3}$$

where $\Phi(\cdot)$ denotes the standard normal cumulative distribution function. We then match each agency worker to one non-agency worker with a similar propensity score within the region of common support and compute the average difference in log hourly wages between the matched groups. The computed average is analogous to the term $(\bar{\mathbf{X}}^A)'\hat{\beta}^N$ in the Oaxaca–Blinder decomposition (2), except that the propensity score matching estimator avoids the linearity and homogeneity assumptions underlying the linear regression model. The resulting unexplained hourly wage gap after propensity score matching can thus be directly compared to the unexplained part in the Oaxaca–Blinder decomposition, i.e. $(\bar{\mathbf{X}}^A)'(\hat{\beta}^A - \hat{\beta}^N)$ in Eq. (2).

Table 4 Propensity score matching (hourly wages)

	Agency workers	Non-agency workers	Difference
Panel A: All employees			
Unmatched	2.903	3.079	−0.18***
Matched	2.903	2.908	−0.01
Observations	102,172	7,910,524	
Panel B: Full-time employees			
Unmatched	2.896	3.133	−0.24***
Matched	2.896	2.915	−0.02***
Observations	86,395	6,146,698	

Notes: The table compares average log hourly wages between agency workers and non-agency workers before and after propensity score matching. Model 5: Age, gender, foreign nationality, part-time employment, tenure, educational attainment, task requirement level, and occupation. The matching procedure uses single nearest-neighbor matching. The reported numbers of observations refer to the respective samples before matching. All observations lie within the region of common support. Employees subject to social security contributions (no "mini-jobs"). *, **, and *** denote significance at the 10, 5, and 1% level. Source: Authors' calculations based on VE 2023

Figures A1 A1 and A2 in the appendix document a high degree of common support between agency and non-agency workers. In both samples, the propensity-score distributions overlap throughout the relevant range, and no observations are excluded because of insufficient support. The concentration of observations at low propensity scores reflects the comparatively small share of workers employed in temporary agency work.

To assess the matching quality, we compare the covariate distributions of agency workers and their matched non-agency counterparts. The balancing statistics reported in Table A3 and A4 in the appendix indicate a high degree of similarity between the matched groups. For both samples, the absolute standardised bias remains below 3% for every covariate and below 1% for most characteristics. Although some conventional t-tests remain statistically significant due to the large sample size, the remaining differences are economically small.

Table 4 summarizes the resulting matched comparisons. Consistent with the regression evidence, matching on socio-demographics, tenure, education, skill requirement, and occupation reduces the raw hourly wage gap sharply. For all employees subject to social security contributions, the raw gap of about −18% falls to roughly zero after matching on Model 5 covariates. For full-time employees, the corresponding gap declines from about −24% to around −2%.

The matched estimates are similar to the results reported by Bachmann et al. (2024). They obtain differences in log hourly wages of +0.004 for all employees and −0.010 for full-time employees after matching. The corresponding estimates in Table 4 are −0.01 and −0.02. Thus, both studies find that the remaining hourly wage gap is close to zero after workers are matched on observed characteristics.

6 Sensitivity analysis

6.1 The role of tenure

Because tenure may partly reflect the accumulation of establishment- and industry-specific human capital, we examine how sensitive our results are to restricting the sample to workers with no more than three years of tenure.

Table 5 reports the corresponding Oaxaca–Blinder decomposition for employees with tenure of three years or less. The observed hourly wage gap is substantially smaller than in the full sample and amounts to about −0.07 log points. As in the main analysis, the gap is more than fully accounted for by differences in observed

Table 5 Propensity score matching (employees with tenure of three years or less)

	Agency workers	Non-agency workers	Difference
Panel A: All employees			
Unmatched	2.900	2.973	−0.07***
Matched	2.900	2.892	0.01
Observations	93,383	2,589,437	
Panel B: Full-time employees			
Unmatched	2.894	3.026	−0.13***
Matched	2.894	2.900	−0.01
Observations	78,970	2,030,913	

Notes: The table compares average log hourly wages between agency workers and non-agency workers before and after propensity score matching. Model 5: Age, gender, foreign nationality, part-time employment, tenure, educational attainment, task requirement level, and occupation. The matching procedure uses single nearest-neighbor matching. The reported numbers of observations refer to the respective samples before matching. In each sample, one agency-worker observation is excluded because it lies outside the region of common support. Employees subject to social security contributions (no "mini-jobs"). *, **, and *** denote significance at the 10, 5, and 1% level. Source: Authors' calculations based on VE 2023

characteristics. The explained component equals about −0.14 log points, corresponding to 196.82% of the overall gap, while the unexplained component amounts to approximately +0.07 log points and therefore counteracts the observed wage disadvantage of agency workers.

The composition of the explained component is also broadly similar to that in the full sample. Differences in task level and education remain the most important contributors, accounting for 116.07% and 67.38% of the observed gap, respectively. By contrast, the contribution of tenure falls markedly to 11.76%, compared with 47.50% in the unrestricted sample. This is consistent with the narrower range of tenure imposed by the sample restriction. Differences in occupation and foreign nationality make smaller positive contributions, whereas gender and part-time employment partly offset the explained gap.

The unexplained component displays the same general pattern as in the main decomposition. Differences in the remuneration of age tend to widen the gap. This contribution amounts to 536.69% of the observed gap. However, it is more than offset by the countervailing contribution of the regression constant (−734.06%). Put differently, while the age–pay gradient is flatter in temporary agency work, agencies appear to pay a higher baseline component of hourly wages for the reference worker, i.e., wage components not tied to age or the other included characteristics. The tenure coefficient also contributes to narrowing the gap, while the remaining coefficient effects are smaller or imprecisely estimated.

Overall, restricting the comparison to workers with relatively short tenure leaves the main conclusion unchanged: the less favourable observed characteristics of agency workers would predict a larger hourly wage disadvantage than is actually observed, while differences in coefficients offset a substantial part of this predicted gap.

Table 6 Blinder-Oaxaca decomposition (employees with three years of tenure or less)

	Coef.	s.e.	(Un)explained (%)
Overall			
Non-agency workers	2.97***	0.00	
Agency workers	2.90***	0.01	
Difference	−0.07***	0.01	
Explained	−0.14***	0.01	196.82
Unexplained	0.07***	0.01	−96.82
Explained component (characteristics)			
Age	−0.01***	0.00	7.16
Male	0.02***	0.00	−22.79
Foreign nationality	−0.01***	0.00	16.93
Part-time	0.01***	0.00	−17.27
Tenure	−0.01***	0.00	11.76
Education	−0.05***	0.00	67.38
Task level	−0.09***	0.00	116.07
Occupation	−0.01***	0.00	17.58
Unexplained component (coefficients)			
Age	−0.39***	0.02	536.69
Male	−0.04***	0.01	53.40
Foreign nationality	0.00	0.00	−1.18
Part-time	0.01***	0.00	−12.62
Tenure	0.02***	0.00	−30.31
Education	0.00	0.01	3.76
Task level	−0.01**	0.01	15.13
Occupation	−0.05	0.04	72.38
Constant	0.54***	0.05	−734.06

Notes: Authors' calculations based on VE 2023. The outcome is the log hourly wage. The sample is restricted to employees with tenure of three years or below who are subject to social security contributions (no "mini-jobs"). Model 5: Age, gender, foreign nationality, part-time employment, tenure, educational attainment, task level, and occupation. *, **, *** denote significance at the 10, 5, and 1% level

To examine whether this conclusion is robust to relaxing the functional-form assumptions of the wage equation, we repeat the propensity score matching analysis for workers with no more than three years of tenure. Again, we observe substantial overlap in the propensity-score distributions for both all employees and full-time employees (see supplementary appendix). Only one agency-worker observation in each sample lies outside the region of common support. The balancing statistics also indicate a high degree of similarity between the matched groups: the absolute standardised bias does not exceed 3% in either sample and remains below 1% for most covariates (see supplementary appendix for more details).

Table 6 reports the corresponding matched comparisons. The unmatched hourly wage gap is substantially smaller than in the unrestricted sample, declining from about −18% to −7% for all employees and from about −24% to −13% for full-time employees. After matching, the remaining difference is approximately zero in both samples, compared with about −1% and −2%,

respectively, in the unrestricted sample. Thus, restricting the comparison to workers with relatively short tenure reinforces the finding that hourly wage differences largely disappear once observable characteristics are taken into account.

6.2 The role of collective bargaining

Because temporary agency work is characterised by high collective bargaining coverage, differences in wage-setting institutions may contribute to the observed pay gap. We therefore examine to what extent the results change when we restrict the sample to workers employed in establishments covered by sectoral collective agreements.

Table 7 reports the corresponding Oaxaca–Blinder decomposition for employees in establishments covered by collective agreements. The observed hourly wage gap is larger than in the unrestricted sample and amounts to about −0.26 log points, compared with approximately −0.18 log points in the main analysis. Differences in observed characteristics account for most, but not all, of this gap. The explained component equals about −0.24 log points, corresponding to 89.97% of the overall gap, while the unexplained component amounts to approximately −0.03 log points. Unlike in the unrestricted sample, the unexplained component therefore slightly widens rather than narrows the observed wage gap.

Table 7 Blinder–Oaxaca decomposition (employees in establishments covered by sectoral collective agreements)

	Coef.	s.e.	(Un)explained (%)
Overall			
Non-agency workers	3.16***	0.00	
Agency workers	2.90***	0.01	
Difference	−0.26***	0.01	
Explained	−0.24***	0.01	89.97
Unexplained	−0.03**	0.01	10.03
Explained component (characteristics)			
Age	−0.02***	0.00	6.29
Male	0.02***	0.00	−7.31
Foreign nationality	−0.01***	0.00	5.38
Part-time	0.01***	0.00	−4.28
Tenure	−0.09***	0.00	34.74
Education	−0.06***	0.00	21.36
Task level	−0.10***	0.00	39.57
Occupation	0.02***	0.00	−5.77
Unexplained component (coefficients)			
Age	−0.33***	0.02	126.53
Male	−0.04***	0.01	15.48
Foreign nationality	0.02***	0.00	−7.64
Part-time	0.01***	0.00	−3.23
Tenure	0.00	0.00	1.10
Education	−0.01**	0.01	5.49
Task level	−0.02***	0.01	6.23
Occupation	−0.03	0.04	10.97
Constant	0.38***	0.05	−144.91

Notes: Authors' calculations based on VE 2023. The outcome is the log hourly wage. The sample is restricted to employees in establishments covered by sectoral collective agreements who are subject to social security contributions (no "mini-jobs"). Model 5: Age, gender, foreign nationality, part-time employment, tenure, educational attainment, task level, and occupation. Standard errors are clustered atthe establishment level. *, **, *** denote significance at the 10, 5, and 1% level

The composition of the explained component is broadly similar to that in the main analysis. Differences in task level, tenure, and education remain the most important contributors, accounting for 39.57%, 34.74%, and 21.36% of the observed gap, respectively. Their relative contributions are smaller than in the unrestricted sample, where they account for 54.17%, 47.50%, and 30.25%. Differences in age and foreign nationality make smaller positive contributions, whereas gender, part-time employment, and occupation partly offset the explained gap.

The unexplained component displays a pattern similar to the main decomposition. Differences in the remuneration of age make the largest contribution to widening the wage gap, while the regression constant provides a substantial countervailing contribution. Differences in the remuneration of foreign nationality and part-time employment also narrow the gap, whereas those associated with gender, education, and task level tend to widen it. However, the countervailing contributions are no longer sufficient to offset the remaining coefficient effects.

We interpret this finding as indicating that the larger differences in baseline pay between agency and non-agency workers in the unrestricted sample are attributable to the higher collective bargaining coverage of agency workers, as collectively covered establishments generally offer higher baseline wage levels than uncovered establishments. Nevertheless, even when the comparison is restricted to agency and non-agency workers covered by sectoral collective agreements, agency wages remain less strongly related to age (and thus work experience), gender, nationality, and occupation. This suggests that wage-setting in agency employment is more standardised and less differentiated according to individual worker characteristics than in non-agency employment, independently of the fact that our comparison is restricted to workers paid under collective bargaining agreements. One possible explanation is the generally shorter-term nature of agency employment relationships, which may provide employers with less information about workers' individual productive abilities.

To assess whether these findings are robust to relaxing the functional-form assumptions of the wage equation, we repeat the propensity score matching analysis for employees in establishments covered by collective agreements. Table 8 reports the corresponding matched

Table 8 Propensity score matching (hourly wages, employees in establishments covered by collective bargaining agreements)

	Agency workers	Non-agency workers	Difference
Panel A: All employees			
Unmatched	2.899	3.163	−0.26***
Matched	2.899	2.983	−0.08***
Observations	86,847	4,211,382	
Panel B: Full-time employees			
Unmatched	2.891	3.224	−0.33***
Matched	2.891	2.993	−0.10***
Observations	73,216	3,241,787	

Notes: The table compares average log hourly wages between agency workers and non-agency workers before and after propensity score matching. Model 5: Age, gender, foreign nationality, part-time employment, tenure, educational attainment, task requirement level, and occupation. The matching procedure uses single nearest-neighbor matching. The reported numbers of observations refer to the respective samples before matching. All observations lie within the region of common support. Employees subject to social security contributions (no "mini-jobs"). *, **, and *** denote significance at the 10, 5, and 1% level. Source: Authors' calculations based on VE 2023

comparisons.[6] The unmatched hourly wage gap is larger than in the unrestricted sample, increasing from about −18% to −26% for all employees and from about −24% to −33% for full-time employees. Matching substantially reduces these differences, but remaining gaps of approximately −8% and −10%, respectively, remain, compared with approximately −1% and −2% in the unrestricted sample. Thus, when the comparison is restricted to establishments covered by collective agreements, observable characteristics account for a smaller share of the wage gap and a substantial wage disadvantage of agency workers remains. This suggests that the near-zero gap in the unrestricted sample is attributable to the higher collective bargaining coverage of agency workers, who benefit from the generally higher wage levels associated with such agreements.

7 Results for marginally employed workers

To complement the main analysis, we report results for marginally employed workers ("mini-job" employees), who are excluded from the sample of employees subject to social security contributions. Marginally employed workers account for 5.8% of all temporary agency workers in our sample, closely matching the corresponding figure of 6% reported by the Federal Employment Agency (Statistik der Bundesagentur für Arbeit 2024b). To the best of our knowledge, this is the first study to examine pay differences between marginally employed agency and non-agency workers in Germany or elsewhere.

Table 9 Blinder-Oaxaca decomposition (marginally employed workers)

	Coef.	s.e.	(Un)explained (%)
Overall			
Non-agency workers	2.63***	0.00	
Agency workers	2.87***	0.04	
Difference	0.24***	0.04	
Explained	0.03**	0.01	11.23
Unexplained	0.22***	0.03	88.77
Explained component (characteristics)			
Age	0.00	0.00	0.10
Male	0.00***	0.00	0.53
Foreign nationality	−0.01***	0.00	−4.05
Tenure	−0.00	0.00	−0.28
Education	−0.00**	0.00	−0.96
Task level	−0.01**	0.00	−2.07
Occupation	0.04***	0.01	17.95
Unexplained component (coefficients)			
Age	0.03	0.05	11.56
Male	−0.02***	0.01	−8.21
Foreign nationality	0.02***	0.01	9.22
Tenure	−0.00	0.00	−0.87
Education	0.00	0.02	1.94
Task level	0.03*	0.02	14.14
Occupation	0.09**	0.04	37.67
Constant	0.06	0.05	23.33

Notes: Authors' calculations based on VE 2023. The outcome is the log hourly wage. The sample is restricted to marginally employed workers ("mini-jobs"). Model 5: Age, gender, foreign nationality, tenure, educational attainment, task level, and occupation. Standard errors are clustered at the establishment level. *, **, *** denote significance at the 10, 5, and 1% level

Table 9 presents the Oaxaca–Blinder decomposition for marginally employed workers. Unlike employees subject to social security contributions, marginally employed agency workers earn *higher* hourly wages than comparable non-agency workers. The observed advantage amounts to approximately 0.24 log points. Differences in observed characteristics account for only 0.03 log points, or 11.23% of this wage advantage, while the unexplained component amounts to 0.22 log points, corresponding to 88.77%.

Differences in occupational composition contribute approximately 0.04 log points, or 17.95% of the observed wage advantage, indicating that marginally employed agency workers are concentrated in comparatively better-paid occupations. This contribution is partly offset by differences in foreign nationality, education, and task level, which would predict somewhat lower hourly wages for agency workers. The remaining observed characteristics make only minor contributions to the explained component.

Within the unexplained component, differences in occupation-specific remuneration make the largest

[6] See the supplementary appendix for more information on common support and balancing statistics in this specification. All observations lie within the region of common support. The balancing statistics indicate broadly similar covariate distributions in the matched groups, although the remaining differences are somewhat larger than in the unrestricted sample. The absolute standardised bias remains below 6.2% in both samples and below 3% for most covariates.

contribution, accounting for approximately 37.67% of the observed wage difference. Differences in the remuneration associated with task level and foreign nationality also widen the hourly wage advantage of agency workers, whereas the coefficient effect associated with being male partly narrows it. The contributions of age, tenure, education, and the regression constant are not statistically significant and should therefore not be interpreted substantively.

Overall, the decomposition indicates that the higher hourly wages of marginally employed agency workers are not primarily attributable to more favourable observed characteristics. Instead, they are mainly associated with differences in occupational composition and in the remuneration of occupations and other observed characteristics.

To assess whether these findings are robust to relaxing the functional-form assumptions imposed on the wage equation, we conduct a propensity score matching analysis for marginally employed workers. Table 10 reports the corresponding matched comparison.[7] The unmatched hourly wage advantage of agency workers amounts to about 0.24 log points. After matching, the remaining difference declines to approximately 0.13 log points but remains statistically significant. Thus, accounting for observable characteristics substantially reduces, but does not eliminate, the hourly wage advantage of marginally employed agency workers.

Table 10 Propensity score matching (hourly wages, marginally employed workers)

	Agency workers	Non-agency workers	Difference
Unmatched	2.8744	2.6308	0.24***
Matched	2.8744	2.7396	0.13***
Observations	4,359	477,722	

Notes: The table compares average log hourly wages between agency workers and non-agency workers before and after propensity score matching. Model 5: Age, gender, foreign nationality, tenure, educational attainment, task requirement level, and occupation. The matching procedure uses single nearest-neighbor matching. The reported numbers of observations refer to the respective samples before matching. All observations lie within the region of common support. The sample is restricted to marginally employed workers (mini-jobs). *, **, and *** denote significance at the 10, 5, and 1% level. Source: Authors' calculations based on VE 2023

8 Summary and conclusion

Using the 2023 Earnings Survey (VE), this paper provides new evidence on the hourly wage gap between temporary agency workers and non-agency workers in Germany. A descriptive comparison initially yields an unadjusted hourly wage gap of about −18% among all employees subject to social security contributions and about −23% among full-time workers, to the disadvantage of agency work. However, these differences already narrow markedly, or even reverse, when comparisons are restricted to jobs within the same education and task (requirement) level. Depending on the task level, the resulting differentials range between +4% and −5%.

More comprehensive econometric analyses indicate that the hourly wage gap between temporary agency and non-agency employment is almost completely eliminated once differences in individual characteristics and features of the employment relationship are taken into account. The results from linear regression models even suggest a reversal of the conditional hourly wage gap in favour of agency workers. For example, the Oaxaca-Blinder decomposition in Table 3 for all employees subject to social security contributions yields an explained gap of −24%, which, together with the observed raw gap of −18% , implies a reversed unexplained pay gap to the advantage of agency workers of around +6%. By contrast, the results obtained using the more flexible matching approach suggest that the unexplained hourly wage gap between agency and non-agency workers is close to zero.

At the same time, when we compare agency and non-agency workers only within firms covered by collective bargaining agreements, we find an hourly wage gap of approximately −8% to −10% to the disadvantage of agency workers. This result suggests that the near-zero adjusted wage gap in the unrestricted sample is partly attributable to the substantially higher collective bargaining coverage of agency workers. The collective agreements applying in the agency-work sector appear to provide comparatively high baseline wages, thereby improving the average relative wage position of agency workers even though their wages remain lower than those of comparable non-agency workers within the collectively covered segment.

Compared with the previous literature, our results paint a more favourable picture of the relative wage position of agency workers. Differences from earlier findings may partly reflect differences in wage concepts, observation periods, and data quality. First, we focus on hourly wages, whereas several earlier studies analyse daily or monthly earnings, which also capture differences in paid working hours. Consistent with this distinction, Bachmann et al. (2024) find a substantially smaller gap for hourly wages than for monthly earnings. We show, however, that hourly wage gaps have also narrowed relative to the evidence presented by Bachmann et al. (2024) for 2018, despite the fact that the composition of agency workers shifted towards less favourable characteristics between 2018 and 2023. Second, the previous literature often refers to considerably earlier periods than considered by us. For example, Jahn and Pozzoli (2013) analyse the years 2000 to 2008 and show that the wage disadvantage declines with experience in temporary agency work. By contrast, our data refer to the post-2017 institutional

[7] See supplementary appendix for information on overlap and covariate balance.

environment, in which Equal Pay regulation may have contributed to smaller wage differences. Third, our observation year falls into a period of increased wage compression at the bottom of the distribution. Following the increase of the statutory minimum wage to 12 euros in October 2022, the lowest pay grade of the collective agreements for agency work rose to 13.00 euros in April 2023. Because agency workers are concentrated in the lower part of the wage distribution, this development is likely to have contributed to the narrowing of the raw gap relative to 2018.

Taken together, our results are consistent with the interpretation that the tightening of equal-pay regulation contributed to narrowing the wage gap between agency and non-agency workers, even though we are unable to provide direct causal evidence for this and cannot fully separate its effects from those of the higher wage floor in 2023. The regulatory framework creates strong incentives for temporary work agencies to conclude collective agreements with the *DGB-Tarifgemeinschaft Zeitarbeit*, a bargaining alliance of trade unions affiliated with the German Trade Union Confederation (*Deutscher Gewerkschaftsbund*, DGB). Moreover, the 2017 reform introduced stricter limits on assignment durations and shortened the period after which the statutory equal-pay principle generally applies. Both changes may have contributed directly to the narrowing of the previously observed wage gap. This interpretation is further supported by the fact that demand for temporary agency work declined substantially in recent years, which should have put wages paid in this sector under more pressure in the absence of regulatory protection.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12651-026-00447-z.

Supplementary material 1

Author contributions

Martin Biewen and Philipp Kugler contributed equally to the study design, analysis, and writing. Alexa Weikinger contributed to analysis and writing.

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Data availability

This study uses confidential microdata from the 2023 Earnings Survey (***Verdiensterhebung***, VE), accessed on-site at the Research Data Centres of the Federal Statistical Office and the Statistical Offices of the Federal States. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States of Germany, DOI: https://doi.org/10.21242/62361.2023.04.00.1.1.0 , own calculations. The data cannot be shared by the authors but are available to researchers upon application to the Research Data Centres.

Declarations

Competing interests

The authors declare that they have no competing interests.

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