Beyond Union Membership: Wage Formation and Collective Institutions

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Abstract

This paper examines how different forms of collective presence shape wage formation in a coordinated labour market. Using linked employer–employee data from Norway (2016–2023), we analyse how wages relate to firm-level productivity under varying configurations of collective bargaining coverage, workplace union density, and individual union membership. We document a positive but modest wage–productivity relationship once worker and firm fixed effects are included. Collective bargaining coverage is associated with weaker productivity responsiveness, particularly for white-collar workers, while union density and membership primarily affect wage levels. The findings highlight that collective presence is multidimensional, with distinct implications for wage formation.

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1. Introduction

Collective institutions play a central role in wage formation in many advanced economies. Trade unions, collective agreements, and coordinated bargaining systems shape not only wage levels, but also how wages respond to firm performance, productivity differences, and local labour market conditions (Freeman and Medoff, 1984; Calmfors and Driffill, 1988; Barth, Moene and Willumsen, 2014). In coordinated labour markets, wages are rarely determined solely through individual bargaining. Instead, collective agreements establish wage floors, bargaining procedures, and norms that structure wage formation across firms and worker groups (Bhuller et al., 2022).

Recent empirical work provides increasingly credible evidence that trade unions exert a positive causal effect on wages. Barth et al. (2020) exploit exogenous variation in union density induced by changes in tax deductions for union dues and find that increased unionisation raises both wages and productivity in Norwegian manufacturing firms. Using the same identification strategy, Kostøl and Svarstad (2025) show that higher workplace union density has a positive causal effect on wages across sectors, with particularly strong effects for women, implying that unions also contribute to reducing gender wage gaps. Together, these studies establish that unionisation matters for wage outcomes in a causal sense.

The existence of such effects, however, does not in itself clarify how collective institutions shape wage formation in practice. In coordinated labour markets, collective agreements are not primarily designed to generate uniform wage premia, but to regulate how local productivity differences and firm-level conditions are translated into pay. In such settings, weaker wage–productivity relationships may reflect institutional coordination rather than reduced worker bargaining power. Understanding this distinction requires moving beyond average wage effects and examining how wages co-vary with productivity under different institutional configurations.

Despite this institutional complexity, much of the empirical literature has focused on estimating union wage differentials using individual union status or similar single indicators of union presence (see, e.g., Parsley, 1980). In this strand of research, collective institutions are typically operationalised through a union dummy or measures of union density, allowing researchers to estimate average wage premia associated with unionisation. While such approaches have generated important insights, they typically treat collective presence as a single institutional dimension and abstract from the broader architecture of wage bargaining. Yet individual membership, workplace union density, and collective agreement coverage capture different aspects of collective organisation and need not have identical implications for how wages respond to firm performance or productivity differences. Treating these dimensions as interchangeable may therefore obscure important mechanisms through which collective institutions shape wage formation.

This paper adopts an explicitly descriptive approach to this question. Using linked employer–employee register data for Norway over the period 2016–2023, we examine how individual wages relate to firm-level productivity under different forms of collective presence. We

distinguish between three dimensions: individual union membership, workplace union density, and collective bargaining coverage. Rather than asking whether unions "raise wages" on average, we analyse how these institutional features condition the wage–productivity relationship and how their roles differ across worker groups.

The analysis yields three main findings. First, the relationship between wages and firm-level productivity is remarkably stable in the private sector as a whole, but exhibits systematic variation across institutional and sectoral contexts. Collective agreement coverage is associated with a weaker productivity–wage link in several industries and for specific worker groups, particularly among white-collar employees, but this moderation is not uniform across the economy. Rather than fundamentally reshaping the wage–productivity relationship in all settings, collective agreements appear to constrain the extent to which firm-level productivity differences are translated into individual pay under certain institutional configurations.

Second, union density and individual membership operate differently from collective agreements. While each dimension of collective presence is positively associated with wages on average, their effects primarily manifest through wage levels and within-firm distributional patterns rather than through systematic changes in productivity sensitivity. Union density strengthens the wage position of organised workers and may shift intra-firm wage differentials, while individual membership premia are most pronounced in covered firms. Treating union density as a proxy for collective bargaining therefore risks conflating mechanisms that operate through bargaining capacity with those embedded in formal agreement structures.

Third, the effects of collective presence are heterogeneous across worker groups and industries. Blue-collar wages exhibit a weak and relatively stable relationship with firm productivity across institutional regimes, whereas white-collar wages are more closely linked to firm performance in non-covered firms. Collective agreement coverage tends to reduce both the productivity sensitivity and the occupational wage premium of white-collar workers, contributing to wage compression within firms. These patterns suggest that collective institutions influence not only average wage levels, but also the structure and responsiveness of wage formation across occupations and sectors.

By distinguishing between different dimensions of collective presence, this paper contributes to a more nuanced understanding of how collective institutions shape wage formation in coordinated labour markets. While recent studies provide compelling causal evidence that unionisation raises wages, our findings show that collective institutions influence not only wage levels, but also the structure and responsiveness of wages to firm-level productivity. In particular, collective agreements constrain productivity sensitivity in specific sectors and occupational groups, while union density and individual membership primarily operate through wage levels and intra-firm distributional patterns. Overall, the results shows that collective presence is multidimensional, and that its economic effects depend on how different institutional components interact.

The remainder of the paper proceeds as follows. Section 2 reviews the related literature and situates our contribution, while Section 3 outlines the Norwegian institutional context. Section

4 then describes the data before we present our econometric specification in Section 5. Section 6 presents our results, before Section 7 concludes.

2. Related literature

A large empirical literature has examined the relationship between trade unions and wages, yet the conceptualization and measurement of union presence vary considerably across studies. Freeman and Medoff's (1984) influential framework conceptualized unions' "monopoly face" as the ability to exert bargaining power and push wages above competitive levels, framing unions primarily as wage-raising institutions. Early empirical work, particularly in the Anglo-American literature, analysed union presence through a binary distinction between union and non-union workers (Parsley, 1980), typically estimating union wage differentials. In an early survey of macro-level union wage estimates, Lewis (1983) shows that most studies operationalize union presence using either individual union status or measures of union density. He further demonstrates that the choice between these measures has systematic implications for both the magnitude and interpretation of estimated wage effects.

A closely related strand of the literature focuses on how unions affect the structure of wages rather than average wage levels. Using longitudinal data for the United States, Card (1996) shows that unions compress wage distributions by raising wages at the lower end while having smaller effects at the top, thereby reducing within-firm and within-occupation inequality. Similar conclusions emerge from panel data analyses that explicitly address selection into union jobs. Lemieux (1998), for example, finds that unions reduce residual wage dispersion even after accounting for worker fixed effects, by compressing returns to both observed and unobserved skills. Similar to the literature on union wage premiums, however, this literature typically operationalizes union presence using a single indicator, without systematically distinguishing between alternative dimensions of collective organization.

A related strand of research explicitly distinguishes between union membership and collective bargaining coverage, particularly in institutional settings where coverage extends beyond formal members. In the United States, several studies examine whether union members earn higher wages than covered non-members. Jones (1982) and Schumacher (1999) provide early evidence on this distinction, while Budd and Na (2000), using CPS data for private-sector workers covered by collective agreements, document a substantial membership wage premium of 12–14 percent even among covered workers. These findings suggest that individual membership may generate additional economic returns beyond formal coverage, challenging the view that covered non-members are pure free riders.

The distinctions between union memberships and collective bargaining coverage connects to the broader literature on insider–outsider mechanisms and union security arrangements. Theoretical contributions such as Booth (1985) and Booth and Chatterji (1993) model union membership as a strategic choice or social custom, where insiders may benefit from higher wages, stronger representation, or preferential access to information and training, while outsiders face weaker bargaining positions. This literature suggests that union membership may

reflect insider advantages and workplace influence beyond formal collective bargaining coverage.

Empirically, Robinson (1989) emphasises the joint determination of union status and wages, demonstrating that selection into union membership is non-random and that failing to account for this endogeneity can bias estimated wage effects. In response, a growing body of research has sought to strengthen causal identification of union effects using institutional reforms, instrumental variables, and quasi-experimental designs. Barth et al. (2020), exploiting exogenous variation in tax incentives for union membership, identify a positive causal effect of workplace union density on both wages and productivity in Norwegian manufacturing. Using similar identification strategies, Kostøl and Svarstad (2023, 2025) show that higher union density leads to wage compression at the workplace level, reducing wage differentials both across occupational groups and between men and women. Employing an alternative instrument, Svarstad and Kostøl (2022) further demonstrate that the productivity effects of union density are conditional on the presence of a collective agreement. Although not primarily focused on wage outcomes, this latter study illustrates the importance of distinguishing between different dimensions of collective presence in empirical analyses.

A further line of research examines the relationship between wages and firm performance, often interpreted as evidence of rent sharing. Using linked employer–employee data, several studies document that workers in more productive or profitable firms earn higher wages, even after controlling for worker characteristics and firm heterogeneity (Abowd et al., 1999; Card et al., 2018). This wage–productivity relationship is frequently understood as reflecting bargaining over firm-specific rents. Importantly, the strength of this relationship varies across institutional settings. Theoretically, coordinated bargaining systems may alter the relationship between wages and productivity by compressing wage differentials and reshaping the allocation of labour across firms and technologies (Barth et al., 2014). Yet this literature typically abstracts from the multidimensional nature of collective presence within firms, focusing either on rent sharing in general or on single measures of unionization.

A smaller strand of research further investigates how collective institutions shape this transmission mechanism. Gürtzgen (2009), analysing German linked employer–employee data, shows that wages are positively related to firm-level quasi-rents in non-covered firms and under firm-specific agreements, whereas industry-wide bargaining is associated with significantly weaker wage responsiveness to firm performance. In contrast, Barth et al. (2020) find evidence of enhanced rent sharing under stronger local union presence in the Norwegian manufacturing sector. Taken together, these studies suggest that collective institutions may influence not only average wage levels, but also the extent to which firm-level productivity differences are reflected in individual pay.

Despite this extensive literature, two limitations stand out. First, many studies implicitly treat union membership, collective bargaining coverage, and union density as interchangeable indicators of union presence, reflecting institutional settings where these dimensions largely overlap. Second, even when such distinctions are acknowledged, empirical analyses typically

examine one dimension at a time, rather than analysing how different aspects of collective presence interact in shaping wage formation.

Overall, the existing literature provides strong evidence that unions matter for wage levels, wage structures, and the transmission of productivity into pay. Yet it offers a fragmented picture of how these institutional dimensions operate simultaneously. Early contributions emphasize membership-based wage premia and insider–outsider mechanisms, while later work highlights collective bargaining coverage, union density, coordinated wage-setting, and rent sharing. Bringing these strands together requires an empirical framework that explicitly distinguishes between individual union membership, workplace union density, and collective bargaining coverage – dimensions that may coincide in some institutional contexts but are analytically distinct and potentially complementary in others.

3. Industrial relations in Norway

Wage formation in Norway takes place within a highly coordinated system of industrial relations, characterized by strong social partners, extensive collective bargaining, and a high degree of institutional complementarity (Barth et al., 2014). Although individual wage contracts formally exist at the worker level, wage outcomes are embedded in a dense framework of collective agreements that define wage floors, bargaining procedures, and norms for wage differentiation across firms and occupations. Collective institutions therefore shape not only wage levels, but also the way firm-level conditions and productivity differences are translated into pay.

Collective bargaining in Norway is organized along both vertical and horizontal dimensions. Vertically, agreements are negotiated between national employer associations and trade unions and subsequently implemented through sectoral and firm-level bargaining. Horizontally, coordination across bargaining areas is achieved through a model of pattern bargaining (Bhuller et al., 2022). Under this model, wage growth in the internationally exposed manufacturing sector sets a benchmark for subsequent wage settlements in other parts of the economy. The objective is to safeguard external competitiveness while ensuring that wage growth remains consistent with productivity developments in the tradable sector. Bargaining rounds in sheltered sectors are expected to align with this benchmark, generating coordinated wage outcomes across industries.

Importantly, coordination does not imply uniform wage setting. Most collective agreements combine centrally negotiated elements – such as minimum rates, wage scales, and general wage increases – with provisions for local negotiations at the firm or establishment level. These local negotiations allow wages to reflect firm-specific conditions, including productivity, profitability, and recruitment needs, but within constraints defined by the collective agreement. Wage formation thus operates within a structured framework that permits decentralised adjustment while maintaining overall coordination.

A distinctive institutional feature of Norway is the absence of a statutory minimum wage. Instead, minimum wages and core employment conditions are regulated through collective

agreements negotiated between employers' associations and trade unions. Unlike systems with widespread administrative extension of collective agreements, collective bargaining coverage in Norway does not automatically extend to all firms or workers within a sector. Coverage requires the establishment of a collective agreement at the workplace level, typically contingent on sufficient union representation among employees (Svarstad & Kostøl, 2022). Although some agreements have been extended in sectors exposed to social dumping, collective bargaining remains the default mechanism for wage regulation. As a result, collective bargaining coverage is a workplace-level characteristic with direct implications for binding wage floors and the scope of local wage bargaining.

This institutional design has two important implications. First, collective bargaining coverage cannot be inferred solely from sectoral affiliation; it depends on organization and bargaining at the workplace. Second, union density, individual union membership, and collective bargaining coverage are related but analytically distinct dimensions of collective presence. A workplace may have union members without being covered by a collective agreement, and conversely, collective agreements may cover non-members once established. These distinctions are central for understanding wage formation in practice and motivate treating different measures of collective presence separately in empirical analysis.

Trade unions operate at multiple levels within this system. At the individual level, union membership provides access to representation, legal support, and participation in collective decision-making. At the workplace level, union density affects the capacity to initiate and sustain collective bargaining and shapes the scope of local negotiations. At the institutional level, collective agreements establish binding wage floors and bargaining procedures that apply to all covered workers, irrespective of membership status. These institutional layers imply that union membership, union density, and collective bargaining coverage may influence wage formation through distinct mechanisms.

Overall, the Norwegian system combines strong coordination through pattern bargaining with decentralised wage setting at the workplace level. The absence of statutory minimum wages, the central role of collective agreements, and the requirement of local agreements for coverage make collective presence inherently multi-dimensional. In such a setting, the strength of the link between wages and firm-level productivity depends not only on firm performance, but also on whether and how collective agreements structure local bargaining and on the degree of workplace organization. These features provide an ideal setting for analyzing how different dimensions of collective presence shape both wage levels and the transmission of productivity into pay at the micro level.

4. Data

The analysis is based on linked employer–employee register data covering the Norwegian private sector over the period 2016–2023. The data combine individual-level information on wages and union membership with firm-level information on employment, productivity, and collective bargaining coverage. The linkage allows us to analyze wage outcomes at the

individual level while conditioning on firm characteristics and workplace-level institutional arrangements.

Individual-level information is drawn from administrative registers covering the full population of employees. Wage and employment information is obtained from "A-ordningen", which provides employer-reported data on earnings and contractual working hours for all employees. These data are supplemented with background information on age, gender, education, and occupation from Statistics Norway's population and education registers.

Hourly wages are constructed using reported monthly earnings, including bonuses and supplementary pay, and contractual working hours, yielding a measure that is comparable across workers and firms.

Firm-level information is obtained from administrative accounting from Statistics Norway, which provide annual data on value added, industry classification, and financial performance. Firm productivity is measured as value added per working hour and serves as indicator of firm performance.

A key feature of the data is the availability of detailed information on collective institutions at the workplace level. We distinguish between three dimensions of collective presence: individual union membership, workplace union density, and collective bargaining coverage. Individual union membership is defined as membership in a trade union during the calendar year, and is identified using information on tax-deductible union dues reported in individuals' annual tax reports. This measure captures individual attachment to collective representation but does not, by itself, imply the existence of collective bargaining at the workplace.

Workplace union density is measured as the share of employees at the firm who are union members. This variable proxies the collective strength of unions at the workplace and is relevant for the capacity to initiate and sustain collective bargaining, as well as for the scope of local negotiations within existing agreements. Union density is calculated at the firm-year level and varies both across firms and over time.

Collective bargaining coverage is defined at the firm level and reflects the existence of a local collective agreement between the employer (or the relevant employers' association) and a trade union, as proxied by firm membership in "Fellesordningen for AFP."[1] In line with Norwegian industrial relations, collective agreements define binding wage floors and bargaining procedures that apply to all covered workers, regardless of individual membership status. Importantly, collective bargaining coverage is not inferred from industry affiliation but is observed directly at the workplace level.

These three measures capture distinct, though related, dimensions of collective presence. A firm may have union members without being covered by a collective agreement, and collective

[1] Fellesordningen for AFP is a contractual early retirement pension scheme in the Norwegian private sector. Membership in the scheme requires that the firm is covered by a collective agreement, and the vast majority of private-sector collective agreements include provisions on contractual pension (AFP).

agreements may cover non-members once established. Treating these dimensions separately allows us to disentangle institutional features that are often conflated in empirical research.

To examine heterogeneity in wage formation, workers are classified into occupational groups based on standard occupational classifications, distinguishing between manual and white-collar occupations. This distinction is particularly relevant in the Norwegian context, where collective agreements and bargaining practices differ systematically across occupational groups.

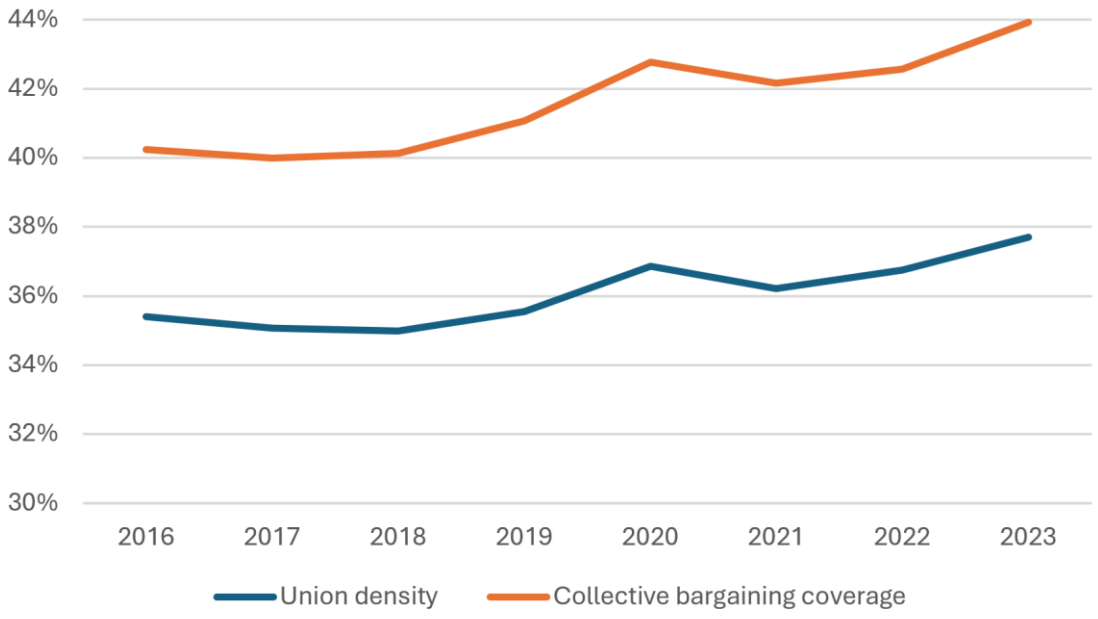
The resulting dataset has a panel structure with repeated observations of workers and firms over time. This structure allows us to document how wages co-vary with firm productivity under different configurations of collective presence, while controlling for observable worker and firm characteristics.

4.1 Descriptive statistics

Before turning to the regression analysis, we briefly examine the descriptive patterns in the data to provide context for the empirical results. Summary statistics of variables are reported in Table A1 in the Appendix.

Figure 1 shows the development of union density and collective bargaining coverage in the private sector over the period 2016–2023. Both indicators are relatively stable throughout the sample period. Union density fluctuates modestly around the mid-30 percent range, while collective bargaining coverage remains slightly above 40 percent. The absence of strong time trends suggests that the variation exploited in the regression analysis primarily reflects cross-firm differences and within-firm changes rather than aggregate institutional shifts over time.

Figure 1 | Development in union density and collective bargaining coverage over the sample period

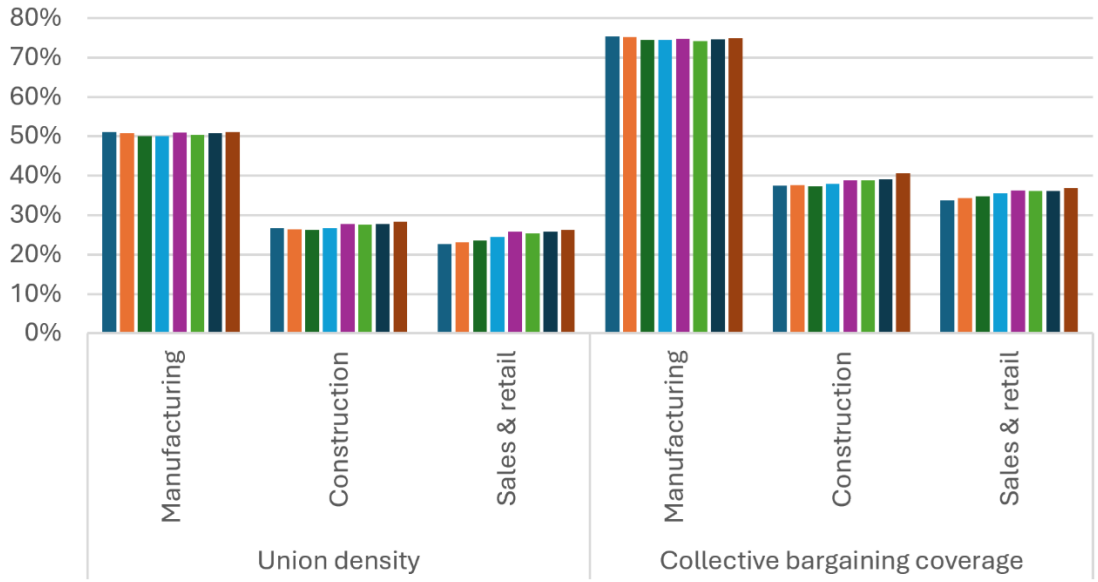


Note: The figure illustrates the development in average union density and collective bargaining coverage over the sample period.

In Figure 2, we report union density and collective bargaining coverage separately for manufacturing, construction, and sales and retail. Clear sectoral differences emerge. Manufacturing exhibits the highest levels of both union density and coverage throughout the period, consistent with its central role in coordinated wage bargaining. Construction occupies an intermediate position, with lower density and coverage than manufacturing but still substantial collective presence. Sales and retail display the lowest levels of both unionization and coverage, reflecting weaker collective institutions and a workforce composition characterized by a higher share of part-time and younger workers. These differences motivate the industry-specific analyses presented later in Section 6.1.

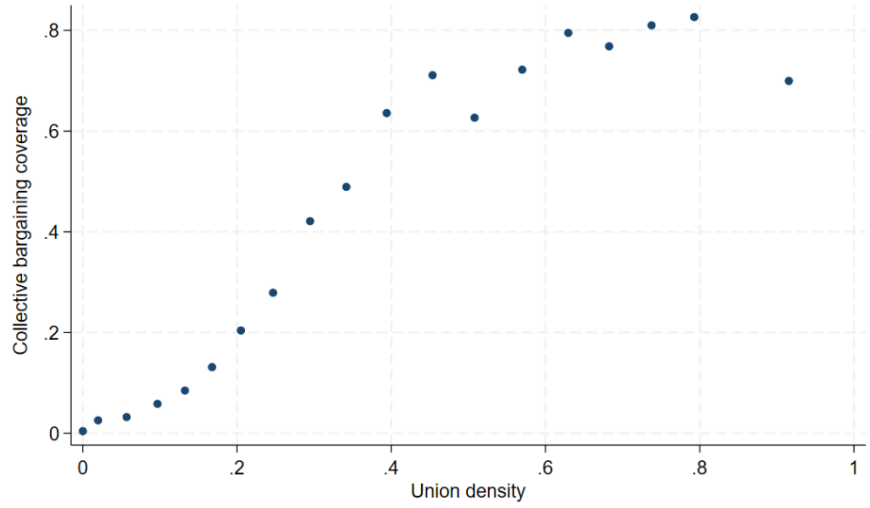
Figure 3 plots collective bargaining coverage against union density in a binned scatterplot at the firm-year level. The relationship is strongly positive and clearly nonlinear. At low levels of union density, coverage is rare, but once density reaches moderate levels, the probability of coverage increases sharply. At high levels of density, coverage approaches saturation. This pattern is consistent with the institutional requirement that collective agreements are established at the workplace level and typically contingent on sufficient union representation. At the same time, the relationship is far from perfectly deterministic, indicating meaningful variation in coverage conditional on union density. This empirical distinction illustrates the importance of treating union density and collective bargaining coverage as analytically separate dimensions of collective presence in the subsequent regression analysis.

Figure 2 | Union density and bargaining coverage in selected industries by year



Note: Average union density and collective bargaining coverage within industries over time. Manufacturing covers NACE codes 10–33, construction covers 41–43, and sales and retail cover 46–47.

Figure 3 | Union density and collective bargaining coverage. Binned scatterplot. N = 15,130,818



Note: The binned scatterplot shows the distribution of collective agreements across union density in our sample.

5. Methodology

The empirical analysis examines how individual wages are related to firm-level labour productivity and how this relationship varies with different forms of collective presence at the workplace. We estimate linear regressions using linked employer–employee data, relating individual wages to firm productivity, institutional characteristics, and a rich set of controls.

The dependent variable is the natural logarithm the hourly wage of individual i employed in firm j at time t, denoted by w_{ijt}. Firm-level labour productivity is measured as value added per hour worked and enters the model in natural logarithms, denoted by y_{jt}.

To allow the wage–productivity relationship to vary across institutional settings, we estimate a model in which labour productivity is interacted with alternative measures of collective presence, and where the collective measures are also allowed to interact with each other. The full empirical specification is given by:

$$
\begin{aligned}
(1) \qquad w_{ijt} = {} & \beta_y\, y_{jt} + \beta_{CA}\, CA_{jt} + \beta_U\, U_{it} + \beta_{UD}\, UD_{jt} + \beta_{y\times CA}\,(y_{jt}\times CA_{jt}) \\
& + \beta_{y\times U}\,(y_{jt}\times U_{it}) + \beta_{y\times UD}\,(y_{jt}\times UD_{jt}) \\
& + \beta_{CA\times U}\,(CA_{jt}\times U_{it}) + \beta_{CA\times UD}\,(CA_{jt}\times UD_{jt}) \\
& + \beta_{U\times UD}\,(U_{it}\times UD_{jt}) + \beta_{CA\times U\times UD}\,(CA_{jt}\times U_{it}\times UD_{jt}) \\
& + X_{it}'\gamma + \delta_t + \zeta_k + \lambda_i + \mu_j + \varepsilon_{ijt}
\end{aligned}
$$

Here, CA_{jt} is an indicator for collective bargaining coverage at the firm level. U_{it} is an indicator for individual union membership, while UD_{jt} denotes union density, measured as the share of union members among employees in the firm. X_{it} denotes a vector of individual worker characteristics, including education, age, age squared, gender, immigrant status, and part-time employment indicators. δ_t, ζ_k, λ_i and μ_j denote fixed effects at the year, industry (at the 5-digit NACE level), individual and firm level, respectively. ε_{ijt} represents the error term.

The interaction structure allows both the level of wages and the elasticity of wages with respect to productivity to vary with collective bargaining coverage, union membership, and workplace union density. Interactions between productivity and the different measures of collective presence capture how the wage–productivity relationship differs across institutional settings. In addition, interactions among the collective measures themselves capture how the association between wages and each dimension of collective presence depends on the presence of other collective institutions. The triple interaction term reflects whether the joint presence of collective agreements, high union density, and individual membership is associated with systematically different wage outcomes, independent of productivity. To facilitate interpretation of interaction effects, labour productivity and workplace union density are both centred around their sample means.

All models are estimated by ordinary least squares. Standard errors are clustered at the firm level to account for within-firm correlation in wage outcomes over time.

5.1 Selection and endogeneity

Union membership, union density, and collective bargaining coverage are not randomly assigned. Workers may sort into firms with collective agreements, firms with higher productivity may be more likely to sustain collective bargaining arrangements, and changes in unionisation may co-evolve with firm performance. These considerations motivate the inclusion of multiple layers of fixed effects in the empirical specification.

Individual fixed effects (λ_i) control for time-invariant worker characteristics, such as unobserved ability, preferences, or attachment to unions, that may be correlated with both wages and institutional affiliation. Firm fixed effects (μ_j) absorb persistent differences across firms, including long-run productivity levels, management practices, and bargaining traditions. Together, these fixed effects ensure that identification comes from within-individual and within-firm variation over time.

At the same time, the inclusion of fixed effects does not eliminate all sources of selection or endogeneity. Time-varying unobserved factors may simultaneously affect productivity, collective arrangements, and wages, and changes in institutional status may be endogenous to firm-level developments. The estimates should therefore be interpreted as conditional associations that are robust to time-invariant heterogeneity, rather than as causal effects.

6. Results

This section presents estimates from different variants of equation (1), relating individual hourly wages to firm-level productivity. We begin by documenting the baseline association between wages and productivity in the Norwegian private sector, before examining how this relationship is shaped by different forms of collective presence in subsequent specifications.

Table 1 reports baseline estimates of the relationship between individual (log) hourly wages and firm-level (log) labour productivity.[2] Across all specifications, wages are positively and statistically significantly associated with productivity, with significance levels indicated by stars. In pooled specifications without fixed effects, the estimated elasticity is around 0.15, implying that workers in more productive firms earn substantially higher wages. Restricting the sample to firms with at least 200 hours worked per week in *Model 1b* yields very similar estimates, suggesting that the baseline association in *Model 1a* is not driven by small firms.

Once year and industry fixed effects are included in *Model 1c*, the estimated elasticity is reduced by roughly half, and it declines further when individual fixed effects are introduced in *Model 1d*. In the most restrictive specification in *Model 1e*, which includes both individual and firm fixed effects, the coefficient on productivity remains positive and statistically significant, but is economically small. More specifically, in the most restrictive specification, a one percent increase in firm-level productivity is associated with an increase in hourly wages of only 0.01 percent.

While the estimated elasticity is economically small, it is consistent with several features of wage formation in practice. Firm-level profitability and productivity may fluctuate substantially over time, while wages tend to be considerably more stable and predictable. In particular, downward nominal wage adjustments are rare (Akerlof et al., 1996), even in periods of weak firm performance, implying an inherent asymmetry in how productivity shocks are translated into wages. Such rigidity mechanically dampens the estimated responsiveness of wages to productivity.

More broadly, the low elasticity is consistent with a coordinated wage-setting system in which wage growth is anchored by economy-wide benchmarks rather than firm-specific conditions. In Norway, pattern bargaining implies that wage settlements in the internationally exposed sector set the norm for the rest of the economy, limiting the extent to which local productivity differences are reflected in individual pay (Bhuller et al., 2022). This institutional framework suggests that wages may respond to productivity, but in a constrained and mediated manner.

Table 2 examines how the relationship between individual wages and productivity varies when different dimensions of collective presence are introduced separately, focusing throughout on the most restrictive specification with both individual and firm fixed effects. Across all three models, the estimated coefficient on productivity remains remarkably stable and statistically significant. When considered in isolation, each dimension of collective presence is associated with higher wages. By contrast, none of the interaction terms between productivity and the respective measures of collective presence are statistically significant in these specifications.

[2] The coefficients on the control variables display the expected patterns throughout, indicating that the model behaves as anticipated. Notably, the negative association between part-time work and hourly wages observed in pooled specifications disappears (and reverses slightly) once individual fixed effects are included, consistent with selection into part-time work rather than a within-individual wage penalty.

Table 1 | Hourly wages and labour productivity

	Model 1a	***Model 1b***	***Model 1c***	***Model 1d***	***Model 1e***
Log productivity	0.144***	0.152***	0.082***	0.025***	0.012***
	(22.13)	(19.03)	(18.73)	(11.68)	(5.38)
Medium skilled	0.104***	0.107***	0.090***	0.193***	0.195***
	(34.70)	(30.91)	(50.23)	(37.04)	(36.68)
High skilled	0.233***	0.239***	0.193***	0.155***	0.156***
	(61.62)	(54.72)	(63.75)	(31.89)	(31.74)
Top skilled	0.400***	0.411***	0.310***	0.249***	0.232***
	(33.98)	(32.23)	(62.32)	(47.83)	(45.26)
Age	0.040***	0.040***			
	(103.38)	(83.36)			
Age^2	-0.0004***	-0.0004***	-0.0004***	-0.0006***	-0.0005***
	(-77.51)	(-59.70)	(-83.10)	(-85.52)	(-84.64)
Male	0.106***	0.105***	0.084***		
	(53.42)	(45.66)	(48.75)		
Immigrant	-0.099***	-0.099***	-0.092***		
	(-44.60)	(-38.12)	(-43.69)		
Part-time	-0.116***	-0.102***	-0.065***	0.009***	0.014***
	(-26.29)	(-21.97)	(-24.14)	(5.11)	(8.30)
Fixed effects:					
Year			✓	✓	✓
Industry			✓	✓	
Worker				✓	✓
Firm					✓
N	11,991,242	10,364,464	10,364,464	9,937,429	9,936,743

*Note: All models use the logarithm of hourly wages as dependent variable. Model 1b and onwards restricts the sample to firms with at least 200 hours worked per week. t statistics in parentheses. Standard errors are clustered at the firm level. * p < 0.05, ** p < 0.01, *** p < 0.001.*

Table 2 | Hourly wages, labour productivity and collective presence

	Model 2a	***Modell 2b***	***Modell 2c***
Measure of collective presence (x):	*Union membership*	*Union density*	*Collective agreement*
Log productivity (y)	0.011***	0.013***	0.013***
	(4.62)	(7.52)	(7.11)
x	0.008***	0.018***	0.005*
	(6.40)	(3.54)	(2.57)
$x \cdot y$	0.003	−0.007	−0.002
	(1.77)	(−1.59)	(−0.71)
N	9,936,743	9,936,743	9,936,743

*Note: All models use the logarithm of hourly wages as dependent variable. The results shown here are based on a model that controls for educational attainment (four categories), age, age squared, gender, and indicators for part-time employment and immigrant status, and includes year, individual, and firm fixed effects. The sample is restricted to firms with at least 200 hours worked per week. Labour productivity and union density are centred around their sample means. Standard errors are clustered at the firm level. *p < 0.05, **p < 0.01, ***p < 0.001.*

Table 3 presents average marginal effects from the fully interacted specification, allowing the different dimensions of collective presence to operate jointly. The corresponding coefficient estimates are reported in Table A2 in the Appendix. The results confirm that the association between firm-level productivity and wages is highly stable across institutional regimes. Productivity is positively and significantly related to wages in all four combinations of union membership and collective agreement coverage. The estimated marginal effects imply that a ten percent increase in firm-level productivity is associated with an increase in hourly wages of around 1.3 percent, with only modest variation in magnitude across institutional regimes. The absence of stronger institutional moderation of the productivity–wage relationship at the aggregate level may mask potentially important heterogeneity across sectors with different production technologies, bargaining traditions, and degrees of wage standardization.

By contrast, union density plays a more substantive role in shaping wage outcomes, and its effects differ markedly across institutional settings. In non-covered firms, higher union density is associated with higher wages for union members, indicating that collective organisation can strengthen bargaining power even in the absence of a formal collective agreement. The estimates suggest that an increase in union density of ten percentage points is associated with wage differences on the order of half a percent for union members in non-covered firms. This pattern suggests that organisation may exert pressure on employers in wage-setting processes despite the lack of formally recognised union representation. For non-members in non-covered firms, the corresponding association is small and statistically insignificant. This indicates that the positive association between union density and wages in non-covered firms is concentrated among union members rather than reflecting a general spillover to non-members.

In covered firms, the relationship between union density and wages takes a different form. Higher union density is associated with lower wages for non-members, while remaining positively related to wages for union members, albeit with a smaller magnitude than in non-covered firms. This pattern is consistent with a reallocation of bargaining gains when wage negotiations are conducted with union representatives backed by a collective agreement. While direct discrimination between union members and non-members is not permitted, union representatives may influence which occupational groups are prioritised in local wage settlements, favouring groups with stronger representation within the union. The weaker association between union density and wages for union members in covered firms may further reflect that part of the wage premium associated with collective organisation is already realised through the presence of a collective agreement.

Finally, the marginal effects of collective agreement coverage and individual union membership reinforce this interpretation. Collective agreements are associated with higher wages for union members, corresponding to wage differences of around half a percent, while having no statistically significant direct association with wages for non-members. Similarly, individual union membership is associated with a meaningful wage premium only in covered firms, amounting to roughly 0.6 percent, with no significant difference observed in non-covered firms.

Taken together, the results in Table 3 indicate that the economic significance of collective presence arises primarily through its joint and mutually reinforcing dimensions, rather than through any single institutional feature in isolation. In the next subsection, we examine whether these patterns vary across industries.

Table 3 | Average marginal effects from the fully interacted model. N=9,936,743

		Non-covered firms	*Covered firms*
Productivity (y)	*Non-members*	0.012***	0.013***
		(6.08)	(4.65)
	Members	0.013***	0.014***
		(8.41)	(6.94)
Union density (UD)	*Non-members*	0.009	-0.034**
		(1.75)	(-3.41)
	Members	0.056***	0.036***
		(8.15)	(3.98)
Collective agreement (CA)	*Non-members*		0.001
			(0.70)
	Members		0.006**
			(2.89)
Union member (U)	-	0.001	0.006***
		(1.39)	(5.57)

*Note: The table reports estimated marginal effects on hourly wages for different groups. Table A2 in the Appendix presents the corresponding coefficient estimates for alternative model specifications. The results shown here are based on a model that controls for educational attainment (four categories), age, age squared, gender, and indicators for part-time employment and immigrant status, and includes year, individual, and firm fixed effects. The sample is restricted to firms with at least 200 hours worked per week. Labour productivity and union density are centred around their sample means. Standard errors are clustered at the firm level. *p < 0.05, **p < 0.01, ***p < 0.001.*

6.1 Industry heterogeneity

This subsection examines whether the patterns documented in Table 3 differ across selected industries. We focus on manufacturing, construction, and sales and retail, three large and economically important sectors that together account for a substantial share of private-sector employment. These industries are also well suited for a heterogeneity analysis, as they differ markedly in their institutional context, bargaining traditions, and workforce composition.

Manufacturing is characterised by strong traditions of collective organisation and coordinated wage-setting. Union density and collective agreement coverage are high, and the sector plays a central role in pattern bargaining as “wage-leader” in the Norwegian model for wage formation. Construction, by contrast, is marked by weaker collective attachment and lower levels of unionisation and collective bargaining coverage. The sector has also been shaped by substantial labour immigration, which has led to the extension of minimum wage provisions through the generalisation of collective agreements. Sales and retail exhibits the weakest collective institutions of the three sectors, with low union density and bargaining coverage, a

high prevalence of young and part-time workers, and a workforce with a relatively large share of immigrants.

Table 4 reports marginal effects from the fully interacted model for manufacturing. The results indicate a clear institutional moderation of the relationship between productivity and hourly wages. While productivity is positively and significantly associated with wages in both covered and non-covered firms, the estimated marginal effects are substantially smaller in covered firms, suggesting that collective agreements dampen the transmission of firm-level productivity to individual wages. Union density is positively associated with wages for union members in non-covered firms but has no significant effect for members in covered firms, while being negatively associated with wages for non-members in covered firms. Collective agreement coverage is not associated with higher wages for union members but is negatively associated with wages for non-members. Finally, individual union membership is associated with a substantial wage premium in covered firms but has no significant effect in non-covered firms. Taken together, the results for manufacturing point to a wage-setting regime characterized by coordination, wage compression, and internal redistribution rather than strong level effects.

Table 4 | Average marginal effects from the fully interacted model. Manufacturing. N=1,366,519

		Non-covered firms	*Covered firms*
Productivity (y)	*Non-members*	0.023***	0.010***
		(4.14)	(3.31)
	Members	0.023***	0.010***
		(4.26)	(4.04)
Union density (UD)	*Non-members*	0.018	-0.053***
		(1.55)	(4.26)
	Members	0.042***	0.010
		(3.73)	(0.69)
Collective agreement (CA)	*Non-members*		-0.016**
			(-3.35)
	Members		-0.003
			(-0.66)
Union member (U)	-	0.005	0.018***
		(1.01)	(9.86)

*Note: The table reports estimated marginal effects on hourly wages for different groups. The results shown here are based on a model that controls for educational attainment (four categories), age, age squared, gender, and indicators for part-time employment and immigrant status, and includes year, individual, and firm fixed effects. The sample is restricted to firms with at least 200 hours worked per week. Labour productivity and union density are centred around their sample means. Standard errors are clustered at the firm level. *p < 0.05, **p < 0.01, ***p < 0.001.*

Corresponding estimates for construction are reported in Table 5. In contrast to manufacturing, the productivity–wage relationship in construction shows little evidence of moderation by collective agreement coverage, but differs clearly between union members and non-members. Union density exhibits a pattern similar to that observed in manufacturing. Higher density is positively associated with wages for union members in non-covered firms, while being

negatively associated with wages for non-members in covered firms. For union members in covered firms, the association is small and statistically insignificant. Collective bargaining coverage is positively associated with wages for union members, but has no significant effect for non-members. Individual union membership, however, is associated with higher wages both in covered and non-covered firms, and the estimated premiums are larger than those observed in the private sector overall. Compared with manufacturing, collective agreement coverage and individual union membership are associated with more pronounced wage level differences in construction. This is an interesting finding, given the use of extension mechanisms in the sector, suggesting that collective institutions continue to shape wage outcomes beyond binding minimum standards.

Table 5 | Average marginal effects from the fully interacted model. Construction. N=1,328,891

		Non-covered firms	*Covered firms*
Productivity (y)	*Non-members*	0.018***	0.013**
		(4.23)	(3.30)
	Members	0.006	0.000
		(1.54)	(0.12)
Union density (UD)	*Non-members*	0.001	-0.058***
		(0.15)	(4.45)
	Members	0.026*	0.003
		(2.15)	(0.26)
Collective agreement (CA)	*Non-members*		0.003
			(0.71))
	Members		0.017**
			(3.46)
Union member (U)	-	0.009***	0.023***
		(4.61)	(8.93)

*Note: The table reports estimated marginal effects on hourly wages for different groups. The results shown here are based on a model that controls for educational attainment (four categories), age, age squared, gender, and indicators for part-time employment and immigrant status, and includes year, individual, and firm fixed effects. The sample is restricted to firms with at least 200 hours worked per week. Labour productivity and union density are centred around their sample means. Standard errors are clustered at the firm level. *p < 0.05, **p < 0.01, ***p < 0.001.*

Table 6 reports results for sales and retail, a sector characterised by relatively weak collective institutions. Productivity is positively and significantly associated with wages across all institutional regimes, although the estimated elasticity is lowest for union members in covered firms. Union density is positively associated with wages for union members in non-covered firms, but otherwise shows no significant relationship with wages. Collective agreement coverage is associated with higher wages for union members, but not for non-members. Individual union membership, however, is negatively associated with wages in non-covered firms and shows no significant association in covered firms.

Table 6 | Average marginal effects from the fully interacted model. Sales and retail. N=1,942,795

		Non-covered firms	*Covered firms*
Productivity (y)	*Non-members*	0.024***	0.022***
		(7.80)	(5.02)
	Members	0.019***	0.017**
		(5.19)	(3.43)
Union density (UD)	*Non-members*	0.008	-0.030
		(0.73)	(-1.64)
	Members	0.037***	0.008
		(3.93)	(0.37)
Collective agreement (CA)	*Non-members*		0.002
			(-0.68)
	Members		0.012***
			(3.99)
Union member (U)	-	-0.009***	0.002
		(-7.22)	(0.58)

*Note: The table reports estimated marginal effects on hourly wages for different groups. The results shown here are based on a model that controls for educational attainment (four categories), age, age squared, gender, and indicators for part-time employment and immigrant status, and includes year, individual, and firm fixed effects. The sample is restricted to firms with at least 200 hours worked per week. Labour productivity and union density are centred around their sample means. Standard errors are clustered at the firm level. *p < 0.05, **p < 0.01, ***p < 0.001.*

Overall, the sectoral results highlight that the role of collective presence in wage formation is highly context-dependent, with similar institutional mechanisms operating across industries but translating into different wage outcomes depending on sector-specific conditions. While the productivity–wage relationship is remarkably robust, the ways in which union membership, union density, and collective agreements shape wage levels and distribution vary across industries with distinct bargaining traditions and workforce compositions. In the next subsection, we explore whether these patterns also differ within industries by examining heterogeneity between blue-collar and white-collar workers, for whom the relevance and operation of collective institutions may differ even within the same sector.

6.2 Occupational heterogeneity: blue- and white-collar workers

This subsection examines whether the relationship between wages and firm-level productivity differs systematically between blue-collar and white-collar workers. To maintain interpretability, the analysis in this subsection focuses on collective agreement coverage as the relevant institutional dimension and examines how the wage–productivity relationship differs between blue-collar and white-collar workers in covered and non-covered firms.

We begin by presenting results for the private sector as a whole. Table 7 shows clear and systematic differences between blue-collar and white-collar workers in both wage levels and the link between wages and productivity. Across institutional regimes, white-collar workers

earn substantially higher wages than blue-collar workers. The estimated white-collar premium is large and highly statistically significant in both non-covered and covered firms but is consistently smaller in firms covered by collective agreements. This pattern suggests that collective agreement coverage is associated with a compression of wage differentials between occupational groups.

Productivity is positively and significantly associated with wages for both blue-collar and white-collar workers. However, the estimated elasticity is notably higher for white-collar workers than for blue-collar workers in both covered and non-covered firms, indicating a closer association between wages and firm-level productivity for white-collar occupations. At the same time, collective agreement coverage is associated with a slight increase in productivity sensitivity for blue-collar workers, but a reduction for white-collar workers, resulting in a convergence in wage–productivity elasticities across occupational groups. Taken together, the private-sector results indicate that collective agreements are associated with a dampening of the wage–productivity relationship for white-collar workers and a narrowing of occupational wage differentials.

Across manufacturing, construction, and sales and retail, the occupational patterns documented for the private sector largely carry over, albeit with important sector-specific nuances. In all three industries, white-collar workers earn substantially higher wages than blue-collar workers, while also exhibiting a stronger association between wages and firm-level productivity. Collective agreement coverage is consistently associated with a reduction in the white-collar wage premium and a weakening of the productivity–wage relationship for white-collar workers, indicating that collective agreements tend to compress occupational wage differentials and moderate productivity-based pay across sectors.

At the same time, the mechanisms through which collective agreements operate differ across industries. In manufacturing, collective agreements primarily dampen the productivity–wage relationship for white-collar workers and reduce occupational wage differentials, consistent with a highly coordinated wage-setting environment. In construction, collective agreements are more strongly associated with direct wage level effects for blue-collar workers, alongside a moderate reduction in productivity sensitivity, particularly for blue-collar workers. In sales and retail, institutional moderation is weaker and less systematic, with no clear or consistent effect on productivity sensitivity across occupational groups.

Taken together, the results point to a consistent pattern across specifications and levels of analysis. While the overall relationship between wages and firm-level productivity is remarkably stable, collective institutions shape how wage gains are distributed within firms rather than fundamentally altering the aggregate responsiveness of wages to productivity. Collective bargaining coverage primarily moderates productivity sensitivity for white-collar workers and compresses occupational wage differentials, while union density and individual membership operate through distributional channels that depend on institutional context. The heterogeneity analyses further show that these mechanisms are context-dependent, varying across industries with different bargaining traditions and workforce compositions. Overall, the findings show that treating union presence as a single dimension – such as union membership

or density – obscures important differences in how collective institutions shape wage formation, as these institutional components operate through distinct and context-dependent mechanisms.

Table 7 | Average marginal effects by industry and occupation group

		Private sector		***Manufacturing***		***Construction***		***Sales & Retail***	
		No CA	*CA*	*No CA*	*CA*	*No CA*	*CA*	*No CA*	*CA*
Productivity	*Blue collar*	0.008***	0.011***	0.009**	0.012***	0.012***	0.004	0.014***	0.019**
		(4.75)	(4.30)	(3.10)	(4.48)	(4.17)	(0.83)	(4.77)	(3.07)
	White collar	0.017***	0.012**	0.026***	0.013***	0.022***	0.015**	0.031***	0.027***
		(7.33)	(3.44)	(3.95)	(4.61)	(6.91)	(2.97)	(8.85)	(5.85)
Collective agreement	*Blue collar*	-	0.010***	-	0.004	-	0.012**	-	0.007**
			(5.08)		(0.76)		(2.74)		(3.15)
	White collar		-0.007**		-0.009*		0.001		-0.002
			(-2.66)		(-2.21)		(0.15)		(-0.62)
White collar worker	-	0.101***	0.084***	0.076***	0.063***	0.069***	0.058***	0.087***	0.077***
		(35.35)	(37.84)	(16.27)	(18.29)	(21.69)	(11.47)	(22.86)	(22.75)
N		*9,936,743*		*1,366,519*		*1,328,891*		*1,942,795*	

*Note: The table reports estimated marginal effects on hourly wages for different groups. The results shown here are based on a model that controls for educational attainment (four categories), age, age squared, gender, and indicators for part-time employment and immigrant status, and includes year, individual, and firm fixed effects. The sample is restricted to firms with at least 200 hours worked per week. Labour productivity and union density are centred around their sample means. Standard errors are clustered at the firm level. *p < 0.05, **p < 0.01, ***p < 0.001.*

7. Conclusion

This paper examines how different dimensions of collective presence at the workplace shape wage formation in a coordinated labour market. Using linked employer–employee register data for Norway over the period 2016–2023, we analyse how individual wages relate to firm-level productivity under varying configurations of collective bargaining coverage, workplace union density, and individual union membership. Our analysis is explicitly descriptive and focuses on how collective institutions condition the wage–productivity relationship rather than on average union wage premia. The results yield three main conclusions.

First, the overall wage–productivity elasticity in the Norwegian private sector is positive but economically small once individual and firm fixed effects are included. This is consistent with a coordinated wage-setting regime in which firm-level productivity differences are only partially translated into individual pay. Across specifications, the wage–productivity link remains remarkably stable, indicating that wages respond to productivity, but within a constrained institutional framework.

Second, collective bargaining coverage plays a distinct role in shaping wage formation. In several settings, collective agreements are associated with a weaker relationship between wages and firm productivity – particularly for white-collar workers, suggesting institutional moderation of productivity-based pay. At the same time, collective coverage is associated with

higher wage level effects for certain groups, especially blue-collar workers in construction and sales and retail. These findings indicate that collective agreements do not simply raise wages uniformly, but structure both the level and the responsiveness of wages.

Third, union density and individual membership operate through partially different channels. Workplace union density is associated with wage differentials that depend on institutional context, particularly benefiting members in non-covered firms and redistributing wage gains within covered firms. Individual union membership yields meaningful wage premia primarily in covered firms and, in the occupational analysis, white-collar wage premia are systematically reduced under collective agreement coverage. The occupational results further show that white-collar workers exhibit a stronger wage–productivity link than blue-collar workers, but that collective agreements compress both occupational wage differentials and productivity sensitivity.

Taken together, the findings illustrates that collective presence is inherently multi-dimensional. Union membership, union density, and collective bargaining coverage are analytically distinct and have different implications for wage levels, wage dispersion, and the transmission of productivity into pay. Analyses that rely on a single proxy for union presence risk conflating these mechanisms. In coordinated labour markets, collective institutions shape not only how much workers earn, but how productivity differences are translated into wages across firms, sectors, and occupational groups.

Data Availability Statement

The data that support the findings of this study are available from Statistics Norway. Restrictions apply to the availability of these data, which were used under license for this study. Researchers affiliated with an approved research institution, or a public authority can apply to data from Statistics Norway (https://www.ssb.no/en/data-til-forskning/utlan-av-data-til-forskere).

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Appendix

Table A1 | Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Log hourly wage	15,130,802	5.580	.413	.369	11.722
Union density	15,130,818	.361	.280	0	1
Collective bargaining coverage	15,159,404	.417	.493	0	1
Hours worked per week (at the firm)	15,130,818	25,172	78,148	1	716,593
Part-time share	15,130,818	.305	.460	0	1
Age	15,130,818	40.073	13.861	0	118
Male	15,130,818	.627	.484	0	1
Immigrant	15,130,818	.227	.419	0	1
Medium skill	15,130,818	.374	.484	0	1
High skill	15,130,818	.213	.409	0	1
Top skill	15,130,818	.102	.303	0	1
White collar	15,130,818	.403	.491	0	1

Table A2 | Complete regression results for Table 3

	Model 3a	*Model 3b*
Productivity (y)	0.025***	0.0119***
	(13.73)	(6.51)
Collective agreement (CA)	0.00988***	0.00236
	(6.06)	(1.34)
Union member (U)	-0.00186	0.000232
	(-1.96)	(0.25)
Union density (UD)	0.0605***	0.00958
	(14.54)	(1.84)
Interactions:		
$CA \times y$	-0.00352	0.000937
	(-1.42)	(0.43)
$U \times y$	0.00169	0.00173
	(1.39)	(1.45)
$UD \times y$	-0.0129	-0.0107*
	(-1.87)	(-2.07)
$CA \times U$	0.00585***	0.00412**
	(3.78)	(2.75)
$CA \times UD$	-0.0453***	-0.0434***
	(-5.61)	(-4.95)
$UD \times U$	0.0490***	0.0468***
	(7.78)	(8.26)
$CA \times U \times UD$	0.0206	0.0233*
	(1.85)	(2.03)
Controls:		
Age^2	-0.000540***	-0.000527***
	(-79.86)	(-80.81)
Part-time	0.00996***	0.0145***
	(5.69)	(8.58)
Medium skilled	0.193***	0.194***
	(37.89)	(37.53)
High skilled	0.155***	0.156***
	(32.49)	(32.23)
Top skilled	0.246***	0.232***
	(48.32)	(45.85)
Fixed effects:		
Year		
Individual		
Firm		
N	9,937,429	9,936,743

*Note: The sample is restricted to firms with at least 200 hours worked per week. Labour productivity and union density are centred around their sample means. Marginal effects in Table 3 are calculated from Model 3b. Standard errors are clustered at the firm level. *p < 0.05, **p < 0.01, ***p < 0.001.*