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Wages, fringe benefits and worker turnover

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Abstract

Linked employer–employee data from Norway are utilised to study how employers use wages and fringe benefits in managing their workforce. The analysis shows that on average across all establishments, we observe a positive correlation between wages and fringe benefits. This indicates the presence of labour market frictions and thus is not supportive of the classical frictionless hedonic wage model. Higher wages and more fringe benefits reduce the worker turnover rate. Fringe benefits have stronger negative impact on the excess worker turnover rate than indicated by the reported monetary value.

JEL classification: C23; J21; J32; J41; J63; M12
Keywords: Labour market search; Hedonic wages; Fringe benefits; Worker turnover unbalanced linked employer–employee panel data

1. Introduction

This paper studies how establishments use wages and fringe benefits as instruments in achieving their desired supply of labour. Our analysis also provides evidence on the presence of frictions in the hedonic wage framework. To our knowledge, our study is the first study to use linked employer–employee data to test how worker turnover reacts to a general fringe benefit measure covering several kinds of fringe benefits.[1] Although we

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recently have seen an increased interest in fringe benefits as part of firms' compensations policy, studies of fringe benefits are not abundant, and our study supplements a thin literature.

We argue that fringe benefits and wages should be treated as separate elements in establishments' payment policies towards their employees, and that although fringe benefits often are associated with goods having monetary values for workers, fringe benefits should be treated as nonwage job amenities. If this assertion is correct, the hedonic wage framework, formalised in Rosen's (1974) article on hedonic prices, provides the analytical tools for analysing wages and fringe benefits.

In the basic hedonic wage framework with no unobserved worker heterogeneity, frictions do not exist (for instance, as in Rosen, 1974). By offering a contract providing utility above the market solution, an establishment captures the complete supply of labour in the market. Similarly, by offering a contract providing less utility than the market solution, an establishment looses all its labour supply. In this case, all establishments offer contracts providing equal utility, no incentive for search-on-the-job exists and no mobility occurs. All else equal, then high-wage establishments should offer low levels of fringe benefits, while low-wage establishments should offer high levels of fringe benefits. Conditional on unobserved worker heterogeneity, wages and fringe benefits are thus negatively correlated in frictionless hedonic models.

The introduction of search frictions and on-the-job-search into the hedonic wage framework (Hwang et al., 1998)[2] implies that homogeneous establishments offer job bundles providing unequal utility and thus an endogenous distribution of contracts offering different utility arise. Establishments offering low wages and few fringe benefits experience high worker turnover and low labour supply, while establishments offering high wages and many fringe benefits experience low worker turnover and large labour supply. For these latter establishments, lower profit per worker is compensated by having more workers.

The existence of labour market frictions makes it possible to observe, conditional on unobserved worker heterogeneity, a positive relationship between wages and fringe benefits. Thus, if we observe a negative relationship, we cannot reject the existence of frictions, but observing a positive relationship supports the existence of labour market frictions.

[1] The book *Employee Benefits and Labor Markets in Canada and the United States* (Alpert and Woodbury, 2000) was published in 2000 and the April issue of *Journal of Labour Economics* included a special supplement on compensation strategy and design (Olson, 2002; Carrington et al., 2002). Previous empirical studies of worker turnover and fringe benefits have focused on the relationship between worker turnover, employer-provided health insurance (Madrian, 1994; Kapur, 1998; Dey and Flinn, 2000; Gilleskie and Lutz, 2002) and pensions (e.g., Ippolito 1987, 2002; Even and Macpherson, 1996). Particularly with respect to health insurance, focus has been on the issue of job-lock. Madrian (1994) identifies a 25% mobility reduction caused by private employer-provided health insurance. In contrast with the US system of private health insurance, many European countries, e.g., Norway, have public-provided health insurance.

[2] The Hwang, Mortensen and Reed model incorporates hedonic wages into the equilibrium search framework of Burdett and Mortensen (1998).

By utilising linked employer–employee data on 565,325 Norwegian wage earners during 1996−1997, we are able to shed light on the existence of labour market frictions, as well as on how wages and fringe benefits affect worker turnover.

Our analysis shows that on average, high-wage establishments offer more fringe benefits than low-wage establishments. This result indicates the presence of labour market frictions, and thus, it is supportive of friction models á la the Hwang et al. model. Higher wages and more fringe benefits reduce worker turnover. By paying 10% more fringe benefits than expected, an establishment achieves nearly the same reduction in the worker turnover rate as by paying a 10% wage premium. We also find evidence for stronger worker preferences for fringe benefits than indicated by the reported value of these benefits.

The paper is structured as follows. Section 2 discusses why fringe benefits can be regarded as nonwage job commodities. Sections 3 and 4 present the data and empirical measures. Section 5 studies the empirical relationship between wages and fringe benefits, while the impacts of wages and fringe benefits on worker turnover are analysed in Section 6. Section 7 concludes the paper.

2. Fringe benefits as nonwage job amenities

Our study is not the first to consider fringe benefits as nonwage job amenities (see, e.g., Elliott, 1991). Several reasons exist for treating fringe benefits as nonwage elements.

Firstly, if diminishing sensitivity is a characteristic human nature (Kahneman and Tversky, 1979), we argue that by singling out the fringe benefit component, employees may experience the value as larger than a similar incremental in money wages. Secondly, endowment effects (Thaler, 1980; Kahneman et al., 1990) may make some employees more attached to fringe benefits than the equivalence in money. Thirdly, framing effects (Tversky and Kahneman, 1986; Kahneman et al., 1990) may affect employees evaluation of fringe benefits compared to money wages. The same is true for a social exchange interpretation of fringe benefits (as it is emphasised in sociology), for example, like the gift exchange of Akerlof (1982). Green et al. (1985) consider, for example, status as a nonwage characteristic, and several fringe benefits contribute to worker status (e.g., the company car, which often is of the more expensive kind). Fourthly, biases of judgements (Rabin, 1998) may make employees uncertain about the real value of the fringe benefits.

If employees for psychological reasons value fringe benefits in excess of what is reported to the tax authorities, this only enforce the motivation for treating fringe benefits as nonwage job amenities. Even if many fringe benefits have a clear monetary value, there are arguments for treating them as nonwage job amenities. Tax authorities attempt to value received fringe benefits for tax purposes (at least in the Nordic countries). Not all fringe benefits are taxable, and in countries with a progressive tax regime, nontaxable fringe benefits are clearly more valuable for high-wage workers than for low-wage workers (Long and Scott, 1982; Granquist, 1998). Many fringe benefits are exempted from payroll tax, and from establishments' point of view, economies of scale may make it profitable to offer goods for services provided by the employee, instead of money wages (Ehrenberg, 1971).

This complicated relationship between fringe benefits and wages is of course reflected in empirical difficulties regarding measurements (Smith and Ehrenberg, 1983). An implication of our discussion is that the actual amount of fringe benefits as registered by the tax authorities may not be sufficient to measure the true value of fringe benefits.

3. The data

The empirical analysis is based on a data set constructed from a large comprehensive linked employer–employee data set. This original data set comprises all employers and employees in Norway 1996−1997, i.e., more than 170,000 employers and 2,000,000 employees each year, as well as all individuals living in Norway during the same period (it is identical to Statistics Norway's data system Current System for Social Data—CSSD). It comprises information from several public administrative registers. An important feature in the data is that the individuals, as well as the establishments and firms, are identified by unique identifying codes (separate number series). In our data set, these original numbers have been replaced by encrypted numbers, but still, they uniquely identify each individual and each establishment.

Information covers individuals, i.e., individual characteristics such as gender, level of education, wages, fringe benefits (amount, as valued by tax authorities) and purely establishments/employer-specific characteristics such as sales, location, industry and sector. Barth and Dale-Olsen (1999) document a previous version of the data set. A more detailed description of the information on fringe benefits is provided in Appendix A.

In our analysis, we focus on full-time workers employed May 16th in private sector establishments, where at least one employee receives fringe benefits and where at least 50 valid wage observations across 2 years are observed. This data set is restricted to 1,007,224 observations (565,325 workers, 3578 employers). With respect to the employer–employee dimension, the data set is unbalanced (if balanced, every worker was employed by all employers at all times). Our restriction is motivated as follows.

Firstly, only private sector establishments can be considered truly profit maximising. Secondly, greater uncertainty exists regarding earnings for part-time workers.

Thirdly, in Barth and Dale-Olsen (1999), we showed that the labour supplies facing small establishments are unaffected by these establishments' wage policies. This reflects that a certain size is required to make a wage policy visible and credible. Also, both worker turnover rates and the estimated wage policy are calculated with large uncertainty (as well as with measurement errors and integer problems) for the very small establishments.

4. Decomposing wages and fringe benefits

In this section, we are to decompose wage and fringe benefit measures into their fixed worker and establishment effects. We are primarily interested in the latter. These decompositions are conducted *separately* for two wage measures and three fringe benefit

measures.[3] Except for the choice of dependent variable, the procedure is identical, so we describe the decomposition in detail for one measure only. Assume that log wages can be decomposed:

$$\ln\ w_{ift} = a + \boldsymbol{c}'\boldsymbol{X}_{ift} + \alpha_{wi} + \Delta_f + \omega_{ift}, \tag{1}$$

where subscript i, f and t denote worker, establishment and time, respectively. The vector $\boldsymbol{X}_{ift}$ describes the time-varying human capital variables years of seniority (and squares), years of potential experience (and squares) and a dummy for the year 1996. Δ_f expresses the fixed establishment effects, while α_{wi} expresses the workers' fixed effect. ω_{ift} is an error term with standard properties.

It is the presence of movers (employees that separate from one establishment and begin working in another) creating connected groups of workers and establishments that makes the identification of fixed worker and establishment effects possible (see Abowd et al., 2002 for details). We cannot conduct this decomposition in establishments where no worker turnover occurs or where the movements are nonconnected.

Due to the intrinsic unbalanced nature of the employee–employer relationship, our data are an unbalanced panel. Applying the standard text book approach to identify two-way fixed effects on huge balanced panels (within-individual and within-establishment transformations followed by an OLS regression of the transformed data) creates biased estimates. But a dummy approach is possible, even though this is close to the limits of what our software (SAS) can handle.[4] Define for each establishment a dummy $\boldsymbol{I}_{ift}$ taking the value of 1 (otherwise 0) for worker i employed by establishment f at time t. Our workers are employed by 3579 establishments; thus, we have 3578 dummies. Calculate the worker means of $\ln w_{ift}$ across the period of observation, $\overline{\ln w_{i\cdot}} = \frac{1}{T_i}\sum_1^{T_i} \ln w_{ift}$, and conduct the transformation: $\ln w^*_{ift} = \ln w_{ift} - \overline{\ln w_{i\cdot}}$. Similarly, transform $\boldsymbol{X}_{ift}$ and the 3578 establishment dummies $\boldsymbol{I}_{ift}$, i.e., $\boldsymbol{X}^*_{ift} = \boldsymbol{X}_{ift} - \overline{\boldsymbol{X}_{i\cdot}}$ and $\boldsymbol{X}^*_{ift} = \boldsymbol{I}_{ift} - \overline{\boldsymbol{I}_{i\cdot}}$. Finally, run the regression:

$$\ln w^*_{ift} = \boldsymbol{c}'\boldsymbol{X}^*_{ift} + \boldsymbol{b}_f'\boldsymbol{I}^*_{ift} + \varepsilon_{ift}. \tag{2}$$

$\boldsymbol{b}_f$ denotes the parameter vector associated with the transformed establishment dummies.

A more intuitive description of this procedure is that we simply conduct a within-worker regression controlling for years of seniority (and squared), years of potential experience squared, dummy for 1996 and 3578 dummies for the establishments.

The estimates of the parameter vector associated with the establishment dummies, $\hat{b}_f$, express the estimated fixed effects, but we normalise the fixed effects by measuring them

[3] By conducting these decompositions separately, we ignore the potential correlation that may exist between the error terms in the different decompositions. Even if the error terms are correlated, the parameter estimates are still consistent, and with 1 million observations, any loss of efficiency should not be a problem. Furthermore, taking account of the correlation between the five equations would increase the number of parameter by five times. With originally nearly 3500 parameters to estimate (which is close to the limit for our software), correcting for the potential correlation is at the moment computationally infeasible.

[4] Two other methods are also possible. The first method is to follow the approach described in Abowd et al. (1999) and Abowd and Kramarz (1999). This is based on statistical approximations to the estimation of fixed establishment and worker effects. The second method, described in Abowd et al. (2002), provides an exact solution to the estimation of fixed establishment and worker effects. Our method provides estimates comparable to the method of Abowd et al. (2002).

as deviations from the employment weighted means of the parameters: $\hat{\Delta}_f = \hat{b}_f - \sum_f \frac{n_f \hat{b}_f}{\sum_f n_f}$ where $\hat{\Delta}_f$ and n_f denote the normalised fixed effects and establishment f's number of employees, respectively. Due to lack of movers and nonconnected movement, the data set is reduced by 211 establishments. Thus, fixed establishment effects are only calculated for 3367 establishments.

We estimate separately two sets of fixed establishment effects related to wages and three sets of fixed establishment effects related to fringe benefits. The sets differ depending on what is used as the dependent variable in the decomposition of the fixed effects. The different fixed establishment effects are denoted as:

Δ_f^{wf}: dependent variable log(total daily wage including fringe benefits)
Δ_f^{w}: dependent variable log(daily wage)
Ψ_f^{f}: dependent variable log(daily fringe benefits+1)
Ψ_f^{pp}: dependent variable log(predicted probability of receiving fringe benefits of a value of 5000 NOK)
Ψ_f^{pl}: dependent variable I(receiving fringe benefits of a value>5000 NOK), where $I(\cdot)$ expresses the indicator function

When constructing Ψ_f^{f}, we assign yearly fringe benefits valued 1 NOK to all employees who do not report any reception of fringe benefits and calculate log daily fringe benefits. Then we conduct the analysis as if it was an ordinary continuous variable like the wage. This obviously neglects the censoring and may create measurement errors.

We have previously argued that even though fringe benefits have a clear monetary value, they have several characteristics implying a treatment as nonwage job amenities. Thus, probability measures, Ψ_f^{pp} and Ψ_f^{pl}, may provide a supplementary picture of worker evaluation of fringe benefits to that of the actual reported value of fringe benefits.

The first step of the construction of Ψ_f^{pp} is to estimate by probit regression the probability of receiving fringe benefits valued by the tax authorities to over 5000 NOK and then calculate the predicted probability. The model reported in Table A2 is used to predict the probability of receiving fringe benefits of a value of over 5000 NOK. Next, the decomposition described above is conducted using log of this predicted value as dependent variable, where Ψ_f^{pp} denotes the resulting fixed establishment effects.

When constructing Ψ_f^{pp}, the procedure may induce more variation in the predicted probability than there actually is in the actual receipt of fringe benefits.[5] Thus, the analysis is supplemented with the fixed effects from the linear probability model, Ψ_f^{pl}.[6]

[5] This was pointed out by one of the referees. He also suggested the application of the linear probability model.

[6] Running a fixed effect probit regression, directly, however, is probably not possible. Batalgi (1995, p.181) writes "...the fixed effects cannot be swept away and maximizing the likelihood over all the parameters including the fixed effects will in general lead to inconsistent estimates for large N and fixed T", but Greene (2001) argues that it is possible. If the problem exists in the probit case, then this problem also arises in the Tobit case, i.e., that Tobit analysis is difficult in a fixed effect approach. However, in the latest Handbook of Econometrics, Arellano and Honoré (2002) describe several approaches to control for fixed effects in Tobit analyses. Neither Greene nor Arellano and Honoré cover two-way fixed effects on *unbalanced* data.

Table 1
The relationship between establishment-specific wage and fringe benefits premiums

The establishments fixed effects	Mean	Std.	Correlation				
			Δ_f^{wf}	Δ_f^{w}	Ψ_f^{f}	Ψ_f^{pp}	Ψ_f^{pl}
All establishments (3367 establishments)							
Δ_f^{wf}	−0.0196	0.4163	1.000	0.9880***	0.2041***	0.0590***	0.0647***
Δ_f^{w}	−0.0200	0.4163	0.9880***	1.000	0.1921***	0.0537***	0.0305*
Ψ_f^{f}	−0.2464	2.2123	0.2041***	0.1921***	1.000	0.1437***	0.3531***
Ψ_f^{pp}	0.0863	1.4630	0.0590***	0.0537***	0.1437***	1.000	0.1786***
Ψ_f^{pl}	0.0005	0.1322	0.0647***	0.0305*	0.3531***	0.1786***	1.000

Mean, standard deviations and correlation.
Table elements express mean, standard deviation of establishment and worker fixed effects. Δ_f^{wf}, Δ_f^{w}, Ψ_f^{f}, Ψ_f^{pp} and Ψ_f^{pl} express the establishment-specific wage and fringe benefits fixed effects, respectively. Superscripts ^{wf}, ^{w}, ^{f}, ^{pp} and ^{pl} denote the dependent variable used in first-stage regressions when estimating the fixed effects. ^{wf}, ^{w} and ^{f} denote log(wages and fringe benefits), log(wages) and log(fringe benefits+1), while ^{pp} and ^{pl} denote log(probability of receiving fringe benefits>5000 NOK) and I(receiving fringe benefits>5000 NOK) (I expresses the indicator function which takes the value 1 if the worker receives fringe benefits of a reported value in excess of 5000 NOK. Tests for significance of correlation conducted. ***, ** and * denote 1%, 5% and 10% level of significance.

Finally, although not our primary target, it is possible to estimate the corresponding fixed worker effects [using the terminology of Eqs. (1) and (2)] by the expression:

$$\hat{\alpha}_{wi} = \overline{\ln w_{i\cdot}} - \hat{c}'\overline{X_{i\cdot}} - \hat{b}_f'\overline{I_{i\cdot}} - \left(\overline{\ln w\ldots} - \hat{c}'\overline{X\ldots} - \hat{b}_f'\overline{I\ldots}\right) \tag{3}$$

where $\overline{X\ldots}, \overline{I\ldots}$ and $\overline{\ln w\ldots}$ denote means across all observations. In Appendix A, we supplement (and enforce) our analyses by incorporating some of these estimated fixed worker effects (matching superscripts on fixed worker and establishment effects from same decomposition).

5. The empirical relationship between wages and fringe benefits

In this section, we examine our estimated fixed establishment wage and fringe benefits effects, from here on called wage and fringe benefits premiums. By studying the empirical relationship between the wage and fringe benefits premiums, we address the question about the existence of labour market frictions. Table 1 presents descriptive statistics for the establishments' wage and fringe benefits premiums.

The average values of $\hat{\Delta}_f^{wf}$ and $\hat{\Delta}_f^{w}$ are −0.020 (0.41) and −0.020 (0.42), respectively (standard deviations in parentheses), while the average values of $\hat{\Psi}_f^{f}$, $\hat{\Psi}_f^{pp}$ and $\hat{\Psi}_f^{pl}$ are −0.246 (2.21), 0.086 (1.46) and 0.001 (0.13), respectively (standard deviations in parentheses).

Table 1 shows that $\hat{\Delta}_f^{w}$ correlates positively with $\hat{\Psi}_f^{f}$, $\hat{\Psi}_f^{pp}$ and $\hat{\Psi}_f^{pl}$. The estimated Pearson correlation coefficients for the correlation ($\hat{\Delta}_f^{w}$, $\hat{\Psi}_f^{f}$), ($\hat{\Delta}_f^{w}$, $\hat{\Psi}_f^{pp}$) and ($\hat{\Delta}_f^{w}$, $\hat{\Psi}_f^{pl}$) are 0.192, 0.054 and 0.031, respectively.[7] Thus, it appears that high-wage firms offer

[7] The reported levels of significance are based on uncorrected standard errors. We acknowledge that it had been desirable to correct for the fact that the fixed effects are estimated. See footnote 10 for further discussion.

jobs with more fringe benefits, while low-wage firms offer jobs with little fringe benefits. This positive correlation between $\hat{\Delta}_f^w$ and the $\hat{\Psi}$'s is across establishments of different cost structure in providing fringe benefits and depicts the relation between wages and fringe benefits in optimum, i.e., the market solution. The positive correlation, however, does not indicate that there is a one-to-one relationship between these measures.

Furthermore, the positive correlations between wage and fringe benefits premiums are conditioned on worker heterogeneity; thus, it indicates the presence of labour market frictions. Therefore, our results lend support to hedonic wage models which incorporate labour market frictions.

Finally, in Table A4 in Appendix A, we present descriptive statistics of fixed worker wage and fringe benefits effects. As in Abowd et al. (2002), the correlations between the corresponding fixed worker and establishment effects are negative, but for fringe benefits, only weakly so.

6. The relation between wages, fringe benefits and worker turnover

We then proceed by examining how the wage and fringe benefits premiums affect the worker turnover. In the frictionless hedonic wage model, there is no worker turnover, but the model of Hwang et al. (1998) depicts a negative relationship between the steady-state separation rate, wages and nonwage job amenities. Thus, we need an empirical measure of the steady-state worker turnover rate.

Barth and Dale-Olsen (1999) measured the steady-state worker flow by excess turnover, a measure delineated from the *churning rate* of the establishment (Burgess et al., 2000, 2001). Following their work, we use this measure as our measure of the steady-state worker flow. For establishment, ETF_f excess turnover is defined as

$$ETF_f = \begin{cases} H_f, & H_f - S_f < 0, \\ S_f, & H_f - S_f \leq 0, \end{cases}$$

where H_f and S_f denote hires and separations, respectively. Excess turnover measures the worker flow in excess of what is needed to explain the observed changes in the establishment's number of employees. Dividing ETF_f and S_f by the establishment's average labour stock then measures the establishment's excess turnover rate (ETFR_f) and separation rate (SR_f). The mean excess turnover rate and separation rate are 0.1270 (0.0966) and 0.2075 (0.1835), respectively (standard deviation in parentheses).

Establishments paying higher premiums should, ceteris paribus, experience lower excess turnover rates. Studying wage premiums only, this has previously been established by Barth and Dale-Olsen (1999). The question now is how this relationship is depending on fringe benefits. Thus, we turn to the second empirical question in this paper, i.e., how does the policy regarding wages and fringe benefits affect the establishment's worker turnover?

Table 2
The relation between wage and fringe benefits premiums and worker turnover

Dependent variable: excess turnover rate					
	Model 1	Model 2	Model 3	Model 4	Model 5
Premium	−0.0003**	−0.0070**	−0.0054***	−0.0112***	−0.0217**
	(0.0001)	(0.0035)	(0.0007)	(0.0027)	(0.0157)
Type of premium used as explanatory variable	Δ_f^{wf}	Δ_f^{w}	Ψ_f^{f}	Ψ_f^{pp}	Ψ_f^{pl}
Control for: industry (two-digit) and county	Yes	Yes	Yes	Yes	Yes
R^2-adj.	0.6500	0.7193	0.6902	0.6870	0.7185
N	3367	3367	3367	3367	3367

FGLS regressions. Dependent variable: the establishment-specific excess turnover rate (ETR_f). Δ_f^{wf}, Δ_f^{w}, Ψ_f^{f}, Ψ_f^{pp} and Ψ_f^{pl} express the establishment-specific wage and fringe benefits premiums (fixed effects), respectively. Superscripts ^{wf}, ^{w}, ^{f}, ^{pp} and ^{pl} denote the dependent variable used in first-stage regressions when estimating the fixed effects. ^{wf}, ^{w} and ^{f} denote log(wages and fringe benefits), log(wages) and log(fringe benefits+1), while ^{pp} and ^{pl} denote log(probability of receiving fringe benefits>5000 NOK) and I(receiving fringe benefits>5000 NOK). $I(\cdot)$ expresses the indicator function which takes the value 1 if the worker receives fringe benefits of a reported value in excess of 5000 NOK. All regressions also include intercept, 56 dummies for two-digit NACE industry and 18 dummies for county. Standard errors not corrected for the use of estimated fixed effects. ***, ** and * denote 1%, 5% and 10% level of significance. Population: 3367 large private sector Norwegian establishments. Complete regression results available from the authors upon request.

We answer this by running FGLS regressions of excess turnover rate on the Δ's and Ψ's.[8] This analysis treats wages and fringe benefits as exogenous in determining worker turnover. The estimates of these regressions are presented in Tables 2 and 3.

We start out in Table 2 by just studying the separate impact of the different premiums on excess turnover. We conduct five FGLS regressions of excess turnover on the different premiums and controls for county (18 dummies) and industry (two-digit NACE, 56 dummies).

In all regressions, heteroscedastic error terms are identified. We correct for this by using FGLS. First, we run an auxiliary regression of log-squared residual from the OLS turnover regression on number of employees (and squared), age of establishment, dummies indicating +90%/−90% employment change and the fixed effect's standard deviation from the first-stage wage or fringe benefits equation.[9] The predicted residuals are then used to weight the observations in the turnover regression. However, we have not corrected the standard errors for the use of estimated fixed effects as covariates in the turnover regressions.[10]

[8] One could argue that excess turnover rate is censored (at zero), thus implying some sort of Tobit regression. However, since few observations are considered censored (less than 5%), the impact on the estimates of using Tobit regression instead of OLS is small. Also, problems related to heteroscedasticity are much easier dealt with using FGLS.

[9] All covariates affect the log-squared residual significantly.

[10] We acknowledge that this had been desirable. The fixed effects are calculated in several regressions each comprising 3500 covariates. The Murphy–Topel corrective procedure (Murphy and Topel, 1985) rests on matrix manipulations of first- and second-stage regressions' variance–covariance matrixes and score vectors. With nearly 3500 covariates in the first-step regressions, this is very software demanding. Additional complications arise since we use estimates from *several* first-step regressions, and that the first-step regressions are based on a population of workers, while second-stage regressions use observations of establishments. However, we do take account of the heteroscedasticity caused by the use of estimated fixed effects, and as will be seen, in the turnover regressions, the fixed effects are usually strongly significant.

Table 3
The impact of a joint wage and fringe benefits policy on worker turnover

Dependent variable: excess turnover rate (Models 1–5) and separation rate (Models 6–8)								
Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Δ_f^{wf}	−0.0034	−0.0068**	−0.0072**	−0.0033	−0.0036	−0.0052	−0.0064	0.0091
	(0.0034)	(0.0034)	(0.0034)	(0.0035)	(0.0034)	(0.0058)	(0.0058)	(0.0072)
Ψ_f^{f}	−0.0045***			−0.0044***	−0.0046***	−0.0052***	−0.0055***	−0.0081***
	(0.0007)			(0.0007)	(0.0007)	(0.0010)	(0.0010)	(0.0015)
Ψ_f^{pp}		−0.0104***		−0.0091***		−0.0171***		
		(0.0024)		(0.0024)		(0.0038)		
Ψ_f^{pl}			−0.0204*		0.0032		−0.0033	0.0294
			(0.0027)		(0.0114)		(0.0162)	(0.0237)
Control for: Industry, county	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2-adj	0.7252	0.7204	0.7191	0.7244	0.7260	0.7244	0.7214	0.5845
N	3367	3367	3367	3367	3367	1738	1738	3367

FGLS regressions. Dependent variable in Models 1–5 is the establishment-specific excess turnover rate (ETR_f), while dependent variable in Models 6–8 is the establishment-specific separation rate (SR_f). The explanatory variables Δ_f^{wf}, Δ_f^{w}, Ψ_f^{f}, Ψ_f^{pp} and Ψ_f^{pl} express the establishment-specific wage and fringe benefits premiums (fixed effects), respectively. Superscripts ^{wf}, ^{w}, ^{f}, ^{pp} and ^{pl} denote the dependent variable used in first-stage regressions when estimating the fixed effects. ^{wf}, ^{w} and ^{f} denote log(wages and fringe benefits), log(wages) and log(fringe benefits+1), while ^{pp} and ^{pl} denote log(probability of receiving fringe benefits>5000 NOK) and I(receiving fringe benefits>5000 NOK) (I expresses the indicator function which takes the value 1 if the worker receives fringe benefits of a reported value in excess of 5000 NOK). All regressions also include intercept, 55 dummies for two-digit NACE industry and 18 dummies for county. Standard errors not corrected for the use of estimated fixed effects. ***, ** and * denote 1%, 5% and 10% level of significance. Populations: Models 1–5 and Model 8—3367 large private sector Norwegian establishments; Models 6 and 7—1738 large private sector Norwegian establishments experiencing employment growth. Complete regression results available from the authors upon request.

Model 1 shows that evaluated at the mean excess turnover rate, a doubling of the wage premium including fringe benefits value ($\hat{\Delta}_f^{wf}$) reduces excess turnover rate by nearly 30% (the rate is reduced by 0.03, or equivalently, by 3 percentage points).[11] This is a confirmation of the results of Barth and Dale-Olsen (1999). The impact of $\hat{\Delta}_f^{w}$ (i.e., the wage premium without fringe benefits) on worker turnover rate reported in Model 2 is also negative and quite strong (nearly 25 times as strong as $\hat{\Delta}_f^{wf}$).

In Model 3, we turn to the fringe benefits. The impact of the premium related to the reported value of fringe benefits, $\hat{\Psi}_f^{f}$, on excess turnover is negative and strongly significant and, in strength, is quite similar to the impact of the wage premium without fringe benefits ($\hat{\Delta}_f^{w}$). Increasing fringe benefits by 1% reduces excess turnover by 0.5 percentage point. This is a surprisingly strong impact.

Two comments to this result should be noted. The average daily wage is 665 NOK, while the average daily fringe benefits is 0.6 NOK.[12] Since an employer achieves a desired reduction in excess turnover rate by the same percentage increase in wages or in fringe benefits, and since daily fringe benefits is roughly 1/1000th less, fringe benefits appear as "cheaper" instruments in achieving the desired labour supply. This is a too "hasty" interpretation since we do not know the actual costs of providing fringe benefits. However, we can infer that workers have stronger preferences for the reported values of fringe benefits than for the equivalence in money wages.

Next, in Model 4, we focus on the premium related to log(predicted probability of receiving fringe benefits of a value of over 5000 NOK), $\hat{\Psi}_f^{pp}$. Also, $\hat{\Psi}_f^{pp}$ has a negative impact on excess worker turnover. By increasing the predicted probability for workers receiving fringe benefits of over 5000 NOK by 1%, the excess turnover rate decreases by 1 percentage point. This is also a strong impact since this figure implies that by increasing the probability of receiving fringe benefits by 1 percentage point, the excess turnover rate is reduced by 28 percentage points, i.e., a reduction of more than twice the observed average excess turnover rate.

Finally, in Model 5, we turn to the fixed effect estimated directly from the linear probability model. Its negative impact on worker turnover rate is 50 times weaker than the previous probability premium, but is still significant at a 5% level of significance. By increasing the probability for workers receiving fringe benefits of over 5000 NOK by 1%, the excess turnover rate decreases by 0.02 percentage point.

In Table 3, we turn to our last topic, i.e., the joint impact of wages and fringe benefits premiums on excess worker turnover. We run five FGLS regressions of excess worker turnover on the wage and fringe benefits premiums and controls for county and industry.[13]

[11] Four of the premiums are measured on log form. Thus, for premiums related to an amount (e.g., wages), an increase of 1 implies an increase of 100%. For the fringe benefit premium that is calculated from the predicted probability, i.e., a rate, an increase of 1% implies increasing the average probability from 0.042 to 0.0424. For the fringe benefit premium calculated using the linear probability model, an increase of 1 implies an increase of 100 percentage points.

[12] Parts of this low average value are explained by the fact that many workers do not receive fringe benefits at all (in the analysis, they have been assigned a yearly fringe benefit value of 1 NOK). However, no workers who receive fringe benefits receive fringe benefits on par with the ordinary wage.

[13] We correct for heteroscedasticity by using the FGLS approach as described for Table 2.

We argue that fringe benefits have a value for the workers in excess of the pecuniary value and can be considered as nonwage job amenities. If this assertion is correct, then one may treat money wages and fringe benefits separately. The hedonic wage models imply that workers should prefer higher Δ's (higher wages) for given probability levels of fringe benefits and higher Ψ's (more likely to receive fringe benefits) for given wages. Thus, establishments offering higher Δ's for a given probability level of receiving fringe benefits should experience lower excess worker turnover rate than other establishments. Similarly, establishments offering higher Ψ's for a given level of wages should experience lower excess worker turnover rate than other establishments.

In Model 1, we include the premium related to the total value of compensation (wages and fringe benefits), $\hat{\Delta}_f^{\mathrm{wf}}$, and the fringe benefits premium, $\hat{\Psi}_f^{\mathrm{f}}$. If worker evaluation of fringe benefits is correctly expressed by the reported money value, then the fringe benefits premium should not have any extra explanatory power. We see the contrary, $\hat{\Psi}_f^{\mathrm{f}}$, has a strongly significant negative impact on the excess turnover rate of the establishment, and the inclusion actually leaves $\hat{\Delta}_f^{\mathrm{wf}}$ no longer significant (though the point estimate is still negative as expected). Thus, for given total reported value of wages and fringe benefits, more fringe benefits strongly reduce worker turnover.

In Model 2, we focus on $\hat{\Delta}_f^{\mathrm{wf}}$ and $\hat{\Psi}_f^{\mathrm{pp}}$. Controlling for the fact that workers in some establishments are more likely to receive fringe benefits valued to over 5000 NOK, we see that by paying higher total value of compensation premium, the excess turnover rate is significantly reduced. Moreover, given this total value of compensation premium, establishments where workers are more likely to receive fringe benefits valued to over 5000 NOK experience lower excess turnover rate. Model 3 reveals a similar story as the one told by Model 2, except that the results related to $\hat{\Psi}_f^{\mathrm{pl}}$ (the fixed effect from the linear probability model) are weaker.

In Model 4, we include all three premiums: $\hat{\Delta}_f^{\mathrm{wf}}$, $\hat{\Psi}_f^{\mathrm{f}}$ and $\hat{\Psi}_f^{\mathrm{pp}}$. All three premiums have a negative impact on the excess turnover rate, but only the fringe benefit premiums are significant. That negative impacts (point estimates) are identified for the premiums based on the reported amount of what the workers actually receive ($\hat{\Delta}_f^{\mathrm{wf}}$ and $\hat{\Psi}_f^{\mathrm{f}}$) are not so surprising. However, even given the level of these premiums, establishments where sizably fringe benefits are *likely* to be given experience lower excess worker turnover.

In Model 5, we repeat the analysis of Model 4, but include $\hat{\Psi}_f^{\mathrm{pl}}$ instead of $\hat{\Psi}_f^{\mathrm{pp}}$. The premiums based on what the workers actually receive ($\hat{\Delta}_f^{\mathrm{wf}}$ and $\hat{\Psi}_f^{\mathrm{f}}$) reduce worker turnover, but only the fringe benefit premium is strongly significant. The premium from the linear probability model, $\hat{\Psi}_f^{\mathrm{pl}}$, is positive but not significant.

Some readers might worry that the excess worker turnover rate is not an appropriate measure for the steady-state separation rate. Thus, in the final three models, Models 6–8, we supplement our analysis by studying how the actual separation rate is affected by fringe benefits. The problem is of course that our data do not differentiate between different kinds of separations, i.e., quits and layoffs. It is unlikely that separations in establishments strongly downsizing are related to these establishments' wage policies. Thus, in Models 6 and 7, we focus on establishments

experiencing positive employment growth (where separations are less likely to be caused by establishments laying off workers), but supplement the analysis for consistency by Model 8 where the regression is based on observations of all the establishments. The results are quite similar to results for excess turnover. All three models show that by offering more fringe benefits, establishments achieve significantly reduced separation rates.

Finally, to further substantiate our findings, in Table A5 in Appendix A, we present results from excess turnover and separation regressions where we as controls have included the establishment-specific average of the estimated fixed worker effects.[14] Controlling for fixed worker effects strongly enforces our previous results.

Thus, our basic conclusion from these regressions in the present section is that wages and fringe benefits affect worker turnover. Higher wages or more fringe benefits significantly reduce the worker turnover rate of establishments. However, fringe benefits have a stronger impact on excess turnover than what the reported value indicates. This may be interpreted as fringe benefits have an additional value to workers in excess of reported money value.

7. Conclusions and caveats

We have presented an empirical analysis of wages, fringe benefits and worker turnover. Empirical analyses of fringe benefits in general are few, and thus we supplement a thin literature. We identify, on average, a positive correlation between wage premiums and fringe benefit premiums. This result indicates the presence of labour market frictions and is thus supportive of friction models á la Hwang et al. (1998). Workers have clear preferences for higher wages and more fringe benefits. Establishments offering higher wages experience reduction in worker turnover rates. Similarly, more fringe benefits, evaluated at the mean, also decrease the worker turnover rates. We also find evidence of stronger worker preferences for fringe benefits than indicated by the reported values.

Some weaknesses remain for future research to correct. Firstly, although our establishments employ a quarter of the total Norwegian labour force, our analyses have been restricted to large private sector establishments only. This may create some selection issues. However, our requirements are only that in each establishment, we should observe at least 50 valid wage observations across 2 years and that at least one employee receives fringe benefits. Furthermore, an establishment needs a certain size for it to have a credible payment policy. Secondly, since the reported amounts of fringe benefits are censored, we do have problems providing nonbiased estimates of the fixed effect. To assign fringe benefits of a value of 1 NOK to all nonreceivers of fringe benefits is unsatisfactory.

[14] Although one may argue that they are more affected by endogeneity and selection issues and interpretational problems, these regressions are of interest (as pointed out by one of the referees). Therefore, we regard them as supplementary evidence and present the results in Appendix A.

Thirdly, we have not corrected the standard errors for the use of estimated fixed effects as covariates in the turnover regressions.

In spite of some weaknesses, we are of the opinion that our study provides valuable insight into employers' behaviour for managing labour.

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Appendix A. About Fringe Benefits

Fringe benefits are known from the wage information on wages reported by employers to the tax authorities. Our information consists of the amount (in NOK) of fringe benefits received by the worker. The amount is determined by rates determined by the tax authorities. Fringe benefits cover taxable fringe benefits. Considered as fringe benefits are (not a comprehensive listing): benefits of lower interest rate from employer-provided loans, free or subsidised: telephone/cellphone, newspaper, work clothing, public holidays, gifts, food (lunch/dinner), free children care, free accident insurance, retirement insurance, gain from buying stocks at lower prices than market value, free housing, free membership in private medical service, paid parking space and benefits from borrowing computer equipment from employer. Many of these fringe benefits have a clear monetary value; thus, one may argue that they should be treated as part of the wage. We consider them as nonwage job amenities (see our discussion in Section 2 and since they are not free for the employee to use for consumption of goods).

Table A1
Descriptive statistics

Variable	Mean	Standard deviation
Employee wage and fringe benefits fixed effects regressions		
Year 1996	0.4937	0.4999
Seniority	5.3142	6.3742
Seniority^2	68.8714	140.8330
Experience^2	885.3297	743.6193
Log(daily wages+daily fringe benefits)	6.5122	0.6538
Log(daily wages)	6.4992	0.6550
Log(daily fringe benefits+1)	−0.3973	3.3184
Log(predicted probability of receiving fringe benefits >NOK 5000)	−3.1608	1.8239
I(receive fringe benefits >NOK 5000)	0.1152	0.3193
N(years)/N(workers)/N(establishments)/N(observations)	2/565,325/3578/1,007,224	
Establishment-level regressions		
Excess turnover rate	0.1270	0.0966
Quit rate	0.2075	0.1835
Δ_f^{wf}	−0.0196	0.4163
Δ_f^{w}	−0.0200	0.4163
Ψ_f^{f}	−0.2464	2.2123
Ψ_f^{pp}	0.0863	1.4630
Ψ_f^{pl}	0.0005	0.1322
α_f^{wf}	−0.005	1.417
α_f^{w}	−0.005	1.408
α_f^{f}	−0.001	3.891
α_f^{pp}	−0.011	2.762
N(industries)/N(counties)/N(establishments)	57/19/3367	

See Tables 2, 3 and A5 for notation. Population: Full-time workers in private sector establishments with more than 50 wage observations.

Table A2
The probability of receiving fringe benefits in excess of NOK 5000, 1996−1997

TableVariables	Estimates (standard error)
Woman	0.0433 (0.0333)
Education	0.1959*** (0.0026)
Education^2	−0.0031*** (0.0003)
Woman×education	−0.0552*** (0.0063)
Woman×education^2	0.0069*** (0.0007)
Experience	0.1033*** (0.0010)
Experience^2	−0.0013*** (0.0000)
Woman×experience	−0.0284*** (0.0023)
Woman×experience^2	0.0002*** (0.0000)
Seniority	0.0202*** (0.0009)
Seniority^2	−0.0008*** (0.0000)
Woman×seniority	0.0287*** (0.0023)
Woman×seniority^2	−0.0008*** (0.0001)

(continued on next page)

Table A2 (*continued*)

TableVariables	Estimates (standard error)
Dummies for field of education	
Humanities and aesthetics	−0.2587*** (0.0131)
Teaching	−0.3256*** (0.0191)
Adm., econ., social science, law	−0.0115* (0.0066)
Industry, craft, natural science, tech.	−0.2298*** (0.0063)
Transport	−0.3513*** (0.0122)
Health service	−0.2284*** (0.0240)
Agriculture, forestry, fisheries	−0.2444*** (0.0200)
Provision of services and defence	−0.1124*** (0.0117)
Establishment characteristics	
Humanities and aesthetics^{m}	−1.8889*** (0.0785)
Teaching^{m}	−3.5364*** (0.1226)
Adm., econ., social science, law^{m}	−0.1112*** (0.0407)
Ind., craft, natural science, tech.^{m}	−1.0283*** (0.0335)
Transport^{m}	−2.1801*** (0.0507)
Health service^{m}	−1.7970*** (0.0820)
Agriculture, forestry, fisheries^{m}	−4.2150*** (0.0976)
Provision of services and defence^{m}	−0.3084*** (0.0803)
Education^{m}	0.2174*** (0.0034)
Woman^{m}	−0.1392*** (0.0234)
Number of employees	−0.0003*** (0.0000)
Number of employees^{2}	0.0000*** (0.0000)
Woman×number of employees	0.0003*** (0.0000)
Woman×number of employees^{2}	−0.0000*** (0.0000)
Number of year dummies	1
Number of industry dummies	57
Log likelihood	−268604.23
N	1,077,224

Probit estimation. Dependent variable is a dummy for receiving fringe benefits in excess of NOK 5000 during the employment spell in a given year. Of 1,007,224 observations, 116,043 observations are of employees receiving fringe benefits in excess of NOK 5000. All regressions include intercept and year dummy. Education is measured in years of education in excess of 9 years of compulsory schooling. Experience denotes Mincer experience and is measured in years. Seniority is measured in years. ^{m} denotes establishment-specific means. Fifty-six dummies for two-digit NACE industry are included. ***, ** and * denote 1%, 5% and 10% level of significance.

Table A3
Construction of wage and fringe benefits premiums

	Wages+ fringe^{k}	Fringe benefits^{k}	Wages^{k}	Pr(fringe benefits)^{k}	*I*(fringe benefits)^{k}
Year 1996^{k}	−0.1631***	−0.6101***	−0.1621***	−0.4259***	−0.0254***
	(0.0015)	(0.0064)	(0.0015)	(0.0006)	(0.0007)
Experience^{2k}	−0.0016***	−0.0036***	−0.0016***	−0.0030***	−0.0001***
	(0.0000)	(0.0001)	(0.0000)	(0.0001)	(0.0000)
Seniority^{k}	0.0060***	−0.0011	0.0062***	0.0644***	0.0014***
	(0.0005)	(0.0022)	(0.0005)	(0.0002)	(0.0002)

Table A3 (*continued*)

	Wages+ fringe^{k}	Fringe benefits^{k}	Wages^{k}	Pr(fringe benefits)^{k}	*I*(fringe benefits)^{k}
Seniority^{2k}	−0.0005***	−0.0001	−0.0006***	−0.0028***	−0.0001***
	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0000)
Number of establishment dummies	3577	3577	3577	3577	3577
R^2-adj.	0.0905	0.1865	0.0905	0.8731	0.0423
N	1,007,224	1,007,224	1,007,224	1,007,224	1,007,224

OLS regressions. Full-time workers in private sector establishments with more than 50 wage observations, 1996−97.

Dependent variables are log(wage+fringe benefits)^{k}, log(wage)^{k}, log(fringe benefits+1)^{k}, log(predicted probability of receiving fringe benefits>NOK 5000)^{k} or *I*(receive fringe benefits>NOK 5000)^{k} denoted wages+fringe^{k}, wages^{k}, fringe benefits^{k}, Pr(fringe benefits)^{k}, *I*(fringe benefits)^{k}, respectively. $I(\cdot)$ expresses the indicator function which takes the value 1 if the worker receives fringe benefits of a reported value in excess of 5000 NOK. Superscript ^{k} denotes that the variables are subtracted from their worker means. Standard errors in parentheses. *** denotes a 1% level of significance.

Table A4

The correlation between establishment-specific wage and fringe benefits premiums and worker-specific fixed effects

The workers' fixed effects	Mean	Std.	Correlation						
			α_f^{wf}	α_f^{w}	α_f^{f}	α_f^{pp}	Δ_f^{wf}	Ψ_f^{f}	Ψ_f^{pp}
All establishments and their employees (3367 establishments, 975,277 employees)									
α_i^{wf}	−0.005	1.417	1.000	0.998***	0.792***	0.888***	−0.119***	0.081***	0.029***
α_i^{w}	−0.005	1.408	0.998***	1.000	0.783***	0.883***	−0.119***	0.079***	0.026***
α_i^{f}	−0.001	3.891	0.792***	0.783***	1.000	0.779***	0.031***	−0.006***	0.061***
α_i^{pp}	−0.011	2.762	0.888***	0.883***	0.779***	1.000	0.063***	0.090	−0.039***

α_i^{wf}, α_i^{w}, α_i^{f} and α_i^{pp} denote the workers' fixed effects. Δ_f^{wf}, Ψ_f^{f} and Ψ_f^{pp} express the establishment-specific wage and fringe benefits premiums. Superscripts ^{wf}, ^{w}, ^{f} and ^{pp} denote the dependent variable used in first-stage regressions when estimating the fixed effects. ^{wf}, ^{w} and ^{f} denote log(wages and fringe benefits), log(wages) and log(fringe benefits+1), respectively, while ^{pp} denote log(probability of receiving fringe benefits>5000 NOK). The two first columns of figures express mean and standard deviation of the workers' fixed effects. The next seven columns express Pearson's correlation between the workers' fixed effects and the establishments' wage and fringe benefits premiums. Tests for significance of correlation conducted. *** denotes 1% level of significance.

Table A5

Worker turnover, wage and fringe benefits policies and worker effects

Variable	Model 1	Model 2	Model 3	Model 4
Δ_f^{wf}	−0.0524*** (0.0043)	−0.0427*** (0.0071)	−0.0592*** (0.0072)	−0.0748*** (0.0110)
Ψ_f^{f}	−0.0029*** (0.0007)	−0.0027*** (0.0007)	−0.0032*** (0.0009)	−0.0028*** (0.0009)
Ψ_f^{pp}		−0.0075*** (0.0022)		−0.0130*** (0.0035)

(continued on next page)

Table A5 (*continued*)

Variable	Model 1	Model 2	Model 3	Model 4
α_f^{wf}	−0.0589*** (0.0036)	−0.0490*** (0.0073)	−0.0610*** (0.0055)	−0.0805*** (0.0112)
α_f^{f}	−0.0041*** (0.0009)	−0.0039*** (0.0009)	−0.0035** (0.0014)	−0.0030** (0.0014)
α_f^{pp}		−0.0055 (0.0034)		0.0107** (0.0054)
Control for: Industry, county	Yes	Yes	Yes	Yes
R^2-adj	0.7678	0.7667	0.7609	0.7638
N	3367	3367	1738	1738

Dependent variable: excess turnover rate (Models 1 and 2) and separation rate (Models 3 and 4).
FGLS regressions. Dependent variable in Models 1 and 2 is the establishment-specific excess turnover rate (ETR_f), while dependent variable in Models 3 and 4 is the establishment-specific separation rate (SR_f). Δ_f^{wf}, Ψ_f^{f} and Ψ_f^{pp} express the establishment-specific wage and fringe benefits premiums, respectively, while α_f^{wf}, α_f^{f} and α_f^{pp} denote the establishment-specific average of the corresponding workers' fixed effects, respectively. Superscripts ^{wf}, ^{f} and ^{pp} denote the dependent variable used in first-stage regressions when estimating the fixed effects. ^{wf} and ^{f} denote log(wages and fringe benefits) and log(fringe benefits+1), respectively, while ^{pp} denote log(probability of receiving fringe benefits>5000 NOK). All regressions also include intercept, 55 dummies for two-digit NACE industry and 18 dummies for county. Standard errors not corrected for the use of estimated fixed effects. ***, ** and * denote 1%, 5% and 10% level of significance. Populations: Models 1 and 2—3367 large private sector Norwegian establishments; Models 3 and 4—1738 large private sector Norwegian establishments experiencing employment growth.

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