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The spot market and implicit contracts with high-skilled wages

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ABSTRACT

This study investigates the relevance of the theories of implicit contracts and the spot market model with high-skilled wages. The data are linked employer-employee panel data from Finland over the period 1991-2004, including detailed information on individual, firm and establishment characteristics. We nest different wage-setting models into a wage regression and simultaneously control for individual and firm-specific unobserved heterogeneity in estimations as well as the cyclicality of the unemployment effects over time. The results suggest that the wages of the highly skilled are sensitive to the minimum unemployment rate of the tenure and decreasing unemployment in the spot market. We also find evidence of a positive wage effect of the initial unemployment rate. These findings at least indirectly imply the existence of implicit contracts with costless mobility for workers between firms.[1]

Keywords: implicit contracts, spot market model, high-skilled workers, cyclicality

JEL classification: J30

1. Introduction

Abraham and Haltiwanger (1995) state that the debate over the cyclicality of real wages has a long history filled with conflicting hypotheses and inconclusive empirical evidence. In the classical model, firms' labor demand curves are stable at cyclical frequencies and the relationship between real product prices and industry employment is countercyclical (Swanson, 2004). The technology-driven RBC models instead assume that the labor demand curve shifts substantially at cyclical frequencies and that the relationship between real product wages and employment is procyclical. Wage flexibility can actually be divided into two aspects (Faggio and Nickell, 2005). The first of these aspects is a responsiveness of wages to labor market conditions, and the second relates to the responsiveness of wages to idiosyncratic shocks within firms. These shocks occur to the firms' productivity or to the demand for their output. The wage curve (see Nijkamp and Poot, 2005 for a comprehensive survey) and implicit contracts literatures concentrate on the first aspect of the wage flexibility by unraveling the relationship between the labor market conditions and wages.

Worker mobility makes the difference between the theories explaining the link between wages and unemployment rates (see Malcomson 1999 for a review). *A spot market model* implies that the workers are mobile between firms but that the mobility is strongly related to the cycle. Therefore, the current degree of unemployment rates is crucial by negatively affecting skill-adjusted wages. Contract models assume that the history of labor market conditions experienced by workers affects their current wages. In the tightest form of the implicit contracts, in *a full-commitment risk-sharing model*, wages are determined by labor market tightness at the time the worker was hired, indicating costly mobility and binding contracts for the workers. *A risk-sharing implicit contract model with worker mobility* implies the tightest labor market condition since the worker was hired matters. The model assumes that wages are adjusted upwards when the unemployment rate decreases but are not adjusted downwards with higher unemployment rates, thus indicating costless mobility for the workers.

Beaudry and DiNardo (1991), followed by McDonald and Worswick (1999), Seltzer and Merrett (2000), Grant (2003) and Devereux and Hart (2007) discuss and test for the relevance of the spot market model as well as the implicit contract models. Beaudry and DiNardo develop a model and derive testable implications about wage determination. By using individual data from the Current Population Survey and the Panel Study of Income Dynamics they find that the implicit contract model with costless mobility more accurately describes the US labor market than do the other models. McDonald and Worswick base their analysis on the data from 11 cross-sections surveys from Canada and find consistent results with Beaudry and DiNardo in terms of the effect of the minimum unemployment rate. Seltzer and Merrett find, contrary to the implications of the tested contract models, a positive relationship between the current wage and the minimum unemployment rate since hired in Australia, and they find no significant correlation with the initial conditions. Their data consist of personnel records of a single firm.

Grant uses data from six cohorts of the National Longitudinal Surveys from the US that cover more than three decades. Grants' results support both the implicit contracts with costless mobility and the spot market, the latter having a stronger effect. He argues that wages probably follow a more general contracting model that predicts partial wage insurance against negative labor demand shocks connected to partial wage responsiveness to current labor market conditions. Devereux and Hart use New Earnings Survey Panel from the UK for the years 1976-2001 and find only support for the spot market wage setting. They also add the fourth aspect into the implicit contracts. Namely, if the contract is non-binding for the firm, it will cut the real wage in adverse conditions leading to the need to otherwise fire the worker, and it is the thinnest labor market condition that is responsive to wages.

Firm-specific factors are likely to have substantial wage effects. Baker *et al.* (1994) unravel the wage-setting policy of a firm. The observations of their study consist of management employees of a single US firm over a 20-year period. The study finds that differences in wages between cohorts entering the labor market in different economic conditions are permanent and that these differences cannot be explained by the observables in the composition of the cohorts. This finding is interpreted as evidence on the internal labor market in the sense that firms seem to be

shielding their employees from some of the market-induced variation in marginal products. Second, they also find that individual real wages are not rigid downwards, as usually expected. Third, Baker *et al.* observe substantial serial correlation in real wage increases for individuals meaning that an employee who does not get a nominal wage increase this year is two to three times as likely not to get a nominal wage increase the next year, either. The fourth finding of the study is that the individual variation in wage levels as well as in wage growth within each job level is substantial.

In this paper, we use rich linked employer-employee panel data from Finland to analyze the dependence of the wages of the highly educated on macroeconomic conditions in different phases of their careers as well as of the cycle over the period 1991-2004. Centralized wage bargaining with some room for flexibility plays an important role in Finland. Union membership (on average 75%) is so common that the agreements are generalized to also cover non-members. The room for individual-specific local flexibility in wage setting is likely to be larger for the highly educated than for the other worker groups (Heikkilä, 2004). Interestingly, Kilponen and Santavirta (2009) find implicit contracts for the blue-collar workers in Finland. They use linked worker-firm panel data with over 900,000 observations and find evidence of non-binding contracts but also find evidence of the spot market effect. Their findings also suggest that the wage elasticities become weaker with stronger import competition.

The period from 1991 to 2004 is interesting, as it covers a deep recession at the beginning of the 1990s, a recovery from it, a boom in the ICT sector led by Nokia, a crash after it and a period of regular macroeconomic conditions after the boom. The time period around the turn of the century is also interesting given that Finland joined the EU in 1995 and became a member of the European Exchange Rate Mechanism, ERM, in 1996. And, consequently, in 1999, Finland joined the Euro area as a member of the founding group of 11 countries. In addition, the expansion of the higher education is evident during the period: the number of post-graduate degrees in Finnish universities increased from 8,410 in 1991 to 12,588 in 2004, that is, by 50%. Due to rich data, we are able to control for both individual and firm-specific unobservable factors in wage setting.

The remainder of the paper is organized as follows. Section 2 presents the econometric framework of our study, and section 3 summarizes the data issues. In section 4, we present the results of our empirical analysis for whole period and also for different phases of the period. Section 5 concludes. The results indicate that the spot market matters for men for the whole period and for women after 1997. The initial unemployment rate of the tenure plays a role with male and female wages from 1998 to 2004, and the effect is positive. This result gives indirect support for the assumption of costless mobility for workers between firms.

2. Wage equation with two high dimensional fixed effects

This section presents a wage equation that tests for the dependence of individual wages on the regional unemployment rates at different phases of the ongoing contracts. A rich set of variables capture the wage effects of individual characteristics and firm as well as establishment-level factors. Our data are unbalanced panel data including 116,230 wage observations from 76,677 high-skilled males and 39,561 from females from 5 regions over a period of 14 years. The men are employed in 3,117 different firms and 4,368 establishments. The corresponding values for the women are 1,990 and 2,616, respectively.

The wage equation follows the idea of Beaudry and DiNardo (1991), followed by McDonald and Worswick (1999), Seltzer and Merrett (2000) and Grant (2003). Contrary to these studies, our specification includes firm-specific factors, thus linking employees and firms together over time. In addition to a rich set of observable factors, we also simultaneously control for time-invariant individual heterogeneity and firm heterogeneity. The wage equation with individual and firm fixed effects takes the following form:

$$(1) \quad \ln w_{ireft} = \alpha_i + \lambda_f + \beta_c u_{rt} + \beta_0 u_{rt_0} + \beta_{\min} \min(u_{rt_0}...u_{rt}) + \gamma X_{it} + \eta Z_{et} + \delta Y_{ft} + dt + dr + \varepsilon_{ireft},$$

where w_{ireft} is the monthly wage obtained by individual i working in region r, in establishment e, in firm f in year t. α_i denotes an individual-level fixed effect, λ_f a firm level fixed effect,

u_{rt} is the spot market unemployment rate in region r at time t, u_{rt_0} refers to the regional unemployment rate at the beginning of a tenure, and $\min(u_{rt_0}...u_{rt})$ is the minimum unemployment rate during the tenure. X is a vector of individual, Z a vector of establishment and Y a vector of firm characteristics. dt denotes the fixed effect for years, and dr denotes the fixed effects for regions. ε_{it} is a random error term. The wage equations are estimated separately for males and females.

The model includes two high-dimensional fixed effects. Basically, the estimation procedure is to include the firm effects into the model as dummies and to eliminate individual effects by the within transformation. In order to save memory, the step of creating the dummy variables is skipped by exploiting the information provided by the group identifiers to directly create the cross-product matrices needed for the least-squares normal equations (see Cornelissen, 2008). The pattern of worker mobility between firms is crucial in determining whether the firm effects can be identified. The firms with movers are divided in groups within which there is worker mobility but between which there is no mobility. Within each group, one effect is not identified. The effects for firms without mobility are not identified, as they are assumed to form single groups with only one firm per group.

Finally, in order to test whether the unemployment effects are constant over the entire research period, we estimate the wage equation (1) by augmenting it with interactions between the different unemployment rate measures and year dummies, thus yielding the following equation:

$$
\begin{aligned}
(2) \quad &\ln w_{ireft} = \alpha_i + \lambda_f + \beta_c u_{rt} + \beta_{ct} dt * u_{rt} + \beta_0 u_{rt_0} + \beta_{0t} dt * u_{rt_0} + \beta_{\min} \min(u_{rt_0}..u_{rt}) + \\
&\beta_{\min t} dt * \min(u_{rt_o}..u_{rt}) + \gamma X_{it} + \eta Z_{et} + \delta Y_{ft} + dt + dr + \varepsilon_{ireft}
\end{aligned}
$$

where $dt * u_{rt}$, $dt * u_{rt_0}$ and $dt * \min(u_{rt_0}...u_{rt})$ denote the interactions for the current regional unemployment rate, the regional unemployment rate prevailing at start of the tenure and the minimum regional unemployment rate during the tenure, respectively.

3. Employer-employee data over 1991-2004

Our data are linked employer-employee data for a period of 1991-2004. The data report a comprehensive set of information on both the firm and the establishment in which the individual works. The data includes a 33% random sample of a Finn population aged between 16 and 69 in 1990. In addition, from 1991 onwards a new 33% random sample of Finns aged 16 is added every year in the data set. The data are created by collecting information from individual micro panel data, private sector firm and consolidated company registers, industry and financial statements and the Social Insurance Institution statistics as well as R&D and ICT inquiries. The data contain firm- and establishment-affiliated characteristics only for the private sector firms; therefore, we concentrate on private sector employees in order to utilize the rich data set.[1]

We test the wage effects of labor market conditions for university graduates with post-graduate degrees (5A level in the ISCED classification). Furthermore, the analysis is confined to those who were full-time private sector wage earners at the end of year t. The dependent variable of our analysis is the log of monthly wage earnings. The data reports annual earnings augmented by information on working months. We deflate the wages to 2004 prices using the consumer price index. Due to the lack of information on part-time workers, we restrict our analysis to those females with earnings of more than 1,750 euros per month and males with earnings of more than 2,000 euros per month. These restrictions are based on the statistics of mean wages at the lowest quantile for the postgraduates' earnings distribution. Our final data set contains 14,231 males and 8,623 females, having together 76,677 and 39,561 observations over a period of 14 years. The low share of women is reasonable, given that almost half of the total female labor force is employed in the public sector.

The independent variables of interest are the regional unemployment rates that are used as proxies for labor market conditions affecting real wages. The unemployment rates are collected from five NUTS2 regions according to the Labour Force Survey of the Statistics Finland: Southern, Western, Eastern, Northern Finland and Åland. We use three unemployment measures

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[1] Regardless of this constraint our study provides an adequate picture of unemployment wage effect in Finland, as the public sector wages are more rigid, yielding only weak pro-cyclical movement in public sector real wages. (Quadrini and Trigari, 2007).

from different phases of the tenure: the unemployment rate at the beginning of the tenure, the minimum unemployment rate during the tenure and the spot market unemployment rate. We bring a comprehensive set of individual controls into the model, such as potential work experience, field of education, family-oriented factors and the labor market status of the employee at the end of year $t-1$.[2] The vectors of firm and establishment characteristics include variables that may reflect the average productivity and solidity of the firms, such as the share of foreign ownership, the industry, the establishment year and the size, which is measured as number of employees. The overall list of variables and their descriptions is given in Table A1 in Appendix.

Table 1 describes the mean values for the most important variables by sex. On average, the highly educated individuals in our sample are 36 years old and have around nine years of potential work experience. A higher proportion of men than women are married, a common finding in the literature; see, for example, Matsui (2004) and Pastor (2008). Over 95% of the individuals were wage earners also at time $t-1$, and 2-3% were unemployed or students. No more than 20% of firms are foreign-owned. Segregation by gender is evident: men tend to work in male-dominated firms, and women tend to work in female-dominated firms.

The average monthly wages are 4,848 Euros for men and 3,720 Euros for women. The average regional unemployment rates are at high levels due to a recession in Finland in the early 1990s, which had long-lasting impacts on the Finnish labor market. The means of the unemployment measures vary between 11% and 14%, taking the highest rates at the beginning of tenures for both sexes. There are, however, notable wage and unemployment variations over time. The average real wages for men and women and the aggregate spot market unemployment rate are depicted in Figure 1. The aggregate unemployment rate was 6% in 1991 and peaked to 17 % in 1993-1994. After the peak, the unemployment rate decreased steadily to 9% in 2004. The same trend also holds for the regional spot market unemployment rates; see Figure A1 in the Appendix.

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[2] The socioeconomic status is reported in 1990, 1993, 1995, 2000 and 2004, and the missing information was imputed. However, the use of socioeconomic status as a control did not affect our estimation results, and we dropped it from the earnings function.

Table 1. Sample characteristics by gender

Variables	Men		Women	
	Mean	s.t.d	Mean	s.t.d
Wage (€)	4,848	4,518	3,720	3,440
Initial unemployment rate (%)	14.0	5.0	13.4	4.7
Minimum unemployment rate (%)	11.6	3.8	11.4	3.6
Spot market unemployment rate (%)	12.6	3.7	12.2	3.5
Age	36.9	7.7	35.2	6.9
Potential work experience	9.5	7.5	8.1	6.3
Share of females in a firm (%)	35	19	49	22
Married, dummy	0.66		0.54	
Foreign owned firm, dummy	0.19		0.20	
Position at previous year				
Wage earner, dummy	0.970		0.950	
Self-employed, dummy	0.003		0.001	
Unemployed, dummy	0.013		0.020	
Student, dummy	0.007		0.014	
At home with children, dummy	0.000		0.009	
Some other position	0.007		0.006	
Number of observations	76,677		39,561	

Interestingly, the real wages were rather stable during the 1990s but showed strong changes from 1998 onwards. This period in the turn of the century is interesting from two points of view. First, Finland became a member of the Economic and Monetary Union, EMU, in 1999 and lost its independence in adjusting the effects of negative asymmetric shocks through exchange rates and monetary policy. Second, Finland faced a rapid increase in a new export-oriented high-tech sector led by Nokia from the mid-1990s onwards. Additionally the ICT-boom, a reduction after it and a recovery from the reduction affected the conditions of the Finnish economy.[3]

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[3] The ICT boom and the reduction after it affected more of the highly educated labour force in Finland. Therefore, the aggregate unemployment rate remained basically unaffected, see Figure 1. The change in GDP growth rate was evident. For example, the GDP growth rate was 5.1 % in 2000, 1.6 % in 2002 and 3.7 % in 2004.
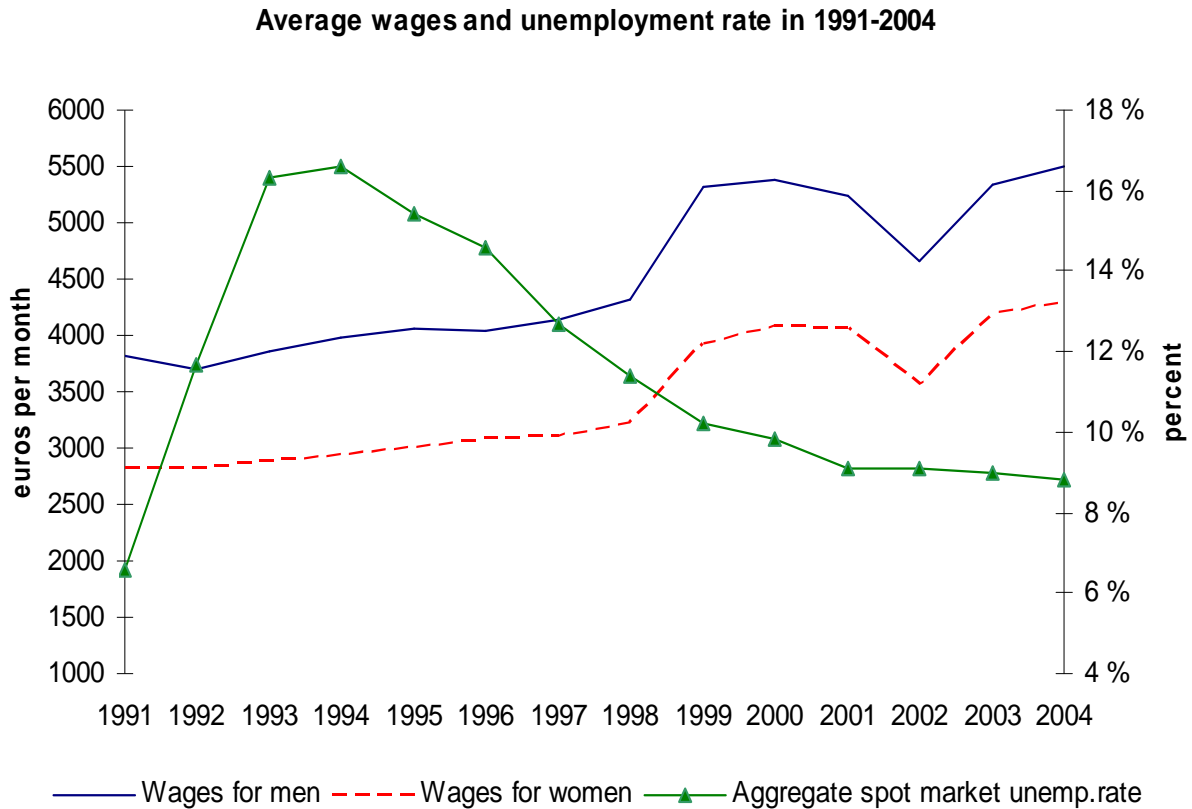
Average wages and unemployment rate in 1991-2004

Figure 1. Average real wages for males and females and aggregate unemployment rate in 1991-2004

According to theory, the wage flexibility becomes a substitute for the exchange rate and monetary policy in order to mitigate the negative effects of asymmetric shocks after joining the EMU (e.g., Hallett 2000). The recent findings from Maza (2006) and Babecky and Dybczak (2008) do not give support for this assumption. Maza uses nonparametric and semiparametric methods to analyze the wage flexibility in Spanish regions and finds that joining the Euro area has not led to the higher use of labor market wage flexibility as an adjustment instrument. Babecky and Dybczak find similar evidence by using a structural VAR approach to predict the real wage flexibility for new Euro area members by comparing the changes in wage flexibilities for 12 countries that were in the first wave to joining the Euro area in 1999 and 2001. Because the wage change trend in the 2000s is not a reason for the higher real-wage flexibility, also suggested by Böckerman *et al.* (2006), who point out that individual-level wage rigidity was at high levels in the late 1990s, the real-wage evolution may stem from other sources.

In particular, the share of foreign investments rose rapidly due to an increase in export-oriented high-tech industry and the membership of the EU from 1995, which removed a considerable amount of barriers to foreign investment in Finland. This trend has also led to a general shift in employment towards the highly educated labor force and increasing wages for the highly skilled, which supports the hypothesis of the skill-biased technical change. The skill-biased technical change suggests that the adoption of a new technical change leads to an increasing demand for highly skilled individuals, thus creating a wage premium relative to the unskilled individuals (see Chennels and van Reenen, 1999, for a survey). The role of technological change has become more important in recent years due to the ICT, the introduction of a new technological paradigm. Empirical evidence indicates higher wages for the more skilled workers (e.g., Acemoglu 2002). Our data also show that the number of extremely high-wage individuals rose in the turn of the century and decreased in 2001. At the same time, the number of upper-level employees doubled and decreased by 20% in 2001. This result suggests that the adjustment to new economic conditions does not operate through flexible wages but rather through structural changes in establishments and job descriptions of individuals. Our estimation results are unaffected by the extremely high wages, and we chose to keep them in the data set.

Foreign acquisitions are closely related to technical change. Huttunen (2007) reports empirical evidence on a positive high-skilled wage effect of the acquisitions in Finland. The result is in line with the findings from the UK (Conyon *et al.,* 2002). Also in our sample, average wages are evidently higher in foreign-owned than in domestic firms, the gap being around 17%. In order to take this gap into account, we control for foreign ownership in the wage equations.

4. Findings on the spot market effect and implicit contracts

First, we estimate wage equations by a conventional estimator with individual fixed effects.[4] Second, we control for the firm-specific fixed effects simultaneously with the individual effects. The results of the estimations are reported in Table 2 in Specification (1) (denoted by FE) and Specification (2) (denoted by Firm+FE). When the firm effects are added, explanatory power of the model for men increases from 0.33 to 0.44 and for women from 0.26 to 0.41. Overall, the estimates are well defined and take the expected signs across specifications and by gender. For example, the return to potential work experience is positive and statistically significant for both genders, being higher for men. And contrary to men, married women are not associated with higher earnings than their single colleagues. In accordance with previous evidence (e.g., Napari, 2008 from Finland), the presence of small children has a slight positive effect on males' earnings, while the effect is highly negative for women. The labor market status of the employee during the previous year also has an important role in wage determination. In turn, the establishment year of the firm and the size of the plant can be excluded from the model; see F-tests at the bottom of the Table 2.

With the wage effects of the unemployment rates, there are no considerable differences between male and female outcomes. All the unemployment rates matter for males in the fixed-effects model. Controlling for the unobserved firm heterogeneity makes the spot market unemployment rate insignificant for men, and, overall, the results become consistent with the results for women. The effect of the minimum unemployment rate is negative in accordance with the theory, but that of the initial unemployment rate is positive which is not expected by the theory. McDonald and Worswick (1999) find similar evidence and argue that rather than providing a test between different contracting models, nested specifications fit a more complex earnings profile over the business cycle than would be allowed by a single variable.

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[4] We also estimated earning equations by a random-effects model. The Hausman test, however, recommended the assumption of fixed panel effects, indicating that the individual effects are correlated with the explanatory variables, which is a usual case with the panel data. For this reason, we do not report the results on the multi-level specifications (Johnes, 2007), either.

Table 2. Results on the spot market, initial and minimum unemployment rate wage effects for men and women

ln(monthly wage)	Results for men				Results for women			
	FE		Firm+FE		FE		Firm+FE	
	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.
Unemployment rates								
Spot market	– 0.012*	0.004	– 0.007	0.004	– 0.004	0.006	– 0.001	0.007
Initial	0.006*	0.001	0.006*	0.001	0.006*	0.001	0.006*	0.001
Minimum	– 0.004*	0.001	– 0.003*	0.001	– 0.005*	0.001	– 0.005*	0.002
Experience	0.053*	0.003	0.045*	0.004	0.014*	0.005	0.029*	0.005
Experience squared	– 0.001*	0.000	– 0.001*	0.000	– 0.001*	0.000	– 0.001*	0.000
Married	0.011*	0.005	0.009	0.005	0.008	0.007	0.015	0.008
Cohabiting	– 0.005	0.005	– 0.009	0.005	0.012	0.007	0.023*	0.007
Children under 3 years	0.014*	0.004	0.005	0.004	– 0.136*	0.006	– 0.151*	0.006
Children between 4-6 years	0.017*	0.004	0.008	0.004	– 0.044*	0.006	– 0.054*	0.006
Position at previous year								
Self-employed	– 0.119*	0.023	– 0.123*	0.023	– 0.173*	0.050	– 0.148*	0.055
Unemployed	0.024*	0.010	0.038*	0.011	0.016	0.013	0.035*	0.013
Student	– 0.079*	0.014	– 0.080*	0.014	– 0.053*	0.015	– 0.061*	0.016
At home with children	na	na	na	na	0.024	0.018	0.033	0.018
Other position	– 0.154*	0.013	– 0.167*	0.013	– 0.047*	0.022	– 0.033	0.023
Foreign owned firm	0.040*	0.004	0.033*	0.006	0.016*	0.007	0.013	0.010
Share of women in firm	0.030*	0.013	0.023	0.026	0.010	0.018	– 0.018	0.037
NUTS2	– 0.004	0.015	– 0.031	0.019	0.007	0.027	0.002	0.035
NUTS3	0.047	0.027	0.021	0.032	0.063	0.047	0.088	0.056
NUTS4	0.071*	0.029	0.037	0.032	0.024	0.050	0.023	0.057
NUTS5	– 0.017	0.108	0.168	0.294	0.040	0.135	– 0.111	0.154
R^2	0.33		0.44		0.26		0.41	
No. of obs.	76,677				39,561			
Field of education	$F_{(6,62367)} = 8.30$*		$F_{(6,57942)} = 6.93$*		$F_{(7,30857)} = 1.45$		$F_{(6,27999)} = 3.02$*	
Establishment year	$F_{(6,62367)} = 1.29$		$F_{(6,57942)} = 0.56$		$F_{(6,30857)} = 1.22$		$F_{(6,27999)} = 0.41$	
Size of the firm	$F_{(5,62367)} = 2.95$*		$F_{(5,57942)} = 8.32$*		$F_{(5,30857)} = 2.57$*		$F_{(5,27999)} = 4.09$*	
Size of the plant	$F_{(4,62367)} = 0.69$		$F_{(4,57942)} = 0.22$		$F_{(4,30857)} = 0.60$		$F_{(4,27999)} = 1.08$	
Field of industry	$F_{(22,62367)} = 2.42$*		$F_{(22,57942)} = 2.63$*		$F_{(22,30857)} = 4.49$*		$F_{(22,27999)} = 2.67$*	

*Note:: *-sign denotes the statistical significance at least a 5-percent significance level. Na: no observations*

The results should be interpreted with caution. Namely, the aggregate unemployment rate decreased continuously after 1994, and the regional unemployment rates followed the trend after 1996 with some small variations (Figure 1 and Figure A1 in the Appendix), meaning that the difference between the minimum unemployment rate during the tenure and the spot market unemployment rate tend to diminish for many of the observations over time. In order to deal with the evident collinearity, we thus estimate the wage equations without simultaneously controlling for all of the unemployment measures. We follow Kilponen and Santavirta (2009) by first reporting the specifications that only control for the spot market unemployment rate, that is, the wage curves (Table 3, column 1 for men and 5 for women). Columns 2 and 6 report the specifications augmented by the unemployment rate at the beginning of the tenure. Finally, columns 3 and 7 present the results of the estimations after controlling for all the three unemployment rates also reported in Table 2 in Specification (2).

The results from the first estimations show that the effect of the current unemployment rate on real wages is negative across specifications and gender, but the coefficients fail to reach significance for women. Kilponen and Santavirta argue that when adding the unemployment rate at the start of the job tenure into the model, the wage effect of the current unemployment rate should become weaker. In our case, however, the effect of the current unemployment rate remains virtually unaffected. We also find a positive and statistically significant relationship between the initial unemployment rate and real wages both for men and women, its magnitude being 0.5%. When we add the minimum unemployment rate of the tenure into the model simultaneously with the other two unemployment rates, the effect of the current unemployment rate becomes statistically insignificant for men, as already reported above. The wage contribution of the initial unemployment rate increases from 0.5% to 0.6% both for men and women.

Table 3. The wage effects of the spot market, initial and minimum unemployment rates

Ln(monthly wage)	Results for men				Results for women			
Specification: Firm + FE								
Unemployment rates:								
Spot market	– 0.009*	-0.010*	-0.007	-	-0.005	-0.005	-0.001	-
Initial	-	0.005*	0.006*	0.006*	-	0.005*	0.006*	0.007*
Minimum	-	-	-0.003*	-0.004*	-	-	-0.005*	-0.005*
R^2	0.44	0.44	0.44	0.44	0.41	0.41	0.41	0.41
No. of obs.	76,677				39,561			

*Note: *-sign denotes the statistical significance at least a 5-percent significance level.*

To further test for the robustness of the results we also estimated the specification without the spot market unemployment rate retaining the initial and minimum unemployment rates in the model. The results from this examination are reported in Table 3 in column 4 for men and column 8 for women. The unemployment rate at the beginning of tenure remains positive and significant for both sexes with a wage effect of 0.6% for men and 0.7% for women. Also the minimum unemployment rate still takes a significant wage effect, -0.4% for men and -0.5% for women. The next section concentrates on the consecutive yearly variation in the unemployment rate wage effects, as it is possible that the coefficients take different estimates in different phases of the cycle.

## 4.1 Differential effects in the business cycle

In order to consider the variety of the research period of 1991-2004 and the possibility for the differential wage effects of current and past labor market conditions in different phases of the business cycle, we next add interaction terms of year dummies and unemployment measures into the model (Equation (2)). To avoid a problem of collinearity with the spot market and minimum unemployment rates, we estimate the specification with the initial unemployment rates but either without the minimum or spot market rates.

The cycle treats male and female workers somewhat in a similar manner with some deviations. When we allow the unemployment effects to vary in the cycle, the spot market effect is significant for males during the whole period, varying between -2.5% and -4.4%; see Figure 3 and Table A2 in Appendix. In the specification of adding the spot market unemployment in addition to the initial unemployment rate, the latter is significant over the whole period. The specification that controls for the minimum and the initial unemployment rates without the spot market effect yields negative coefficients for the minimum unemployment rate from 1999 to 2003; see Figure 2. The initial unemployment rate has positive wage effects over 1991-1994 and again from 1998 onwards.

For women (see Figures 4 and 5), the spot market unemployment rate significantly affects wages – contrary to the aggregate results – from 1999 to 2004, with the effect being near -3%. It also seems that the female wage formation is positively dependent on the initial unemployment rate from 1998 onwards. The minimum unemployment rate since hiring significantly contributes to female wages only for years 1999-2001 and again in 2004. The results hence suggest simultaneous wage effects of both the spot market unemployment (negative effects) and the initial conditions (positive effects) for both genders – over the whole period for men and after 1998 for women.[4]

Wages of the highly-skilled evidently became more flexible to labor market conditions from 1998 onwards. Since the unemployment rates were falling and wages increasing, the finding indicates a decrease in mobility costs for workers between firms and non-binding contracts for them. In order to keep the turnover costs low, firms were forced to raise wages. Similar flexibility did not hold during the recession and recovery from it. This development could be connected to the structural change in the labor market that followed the membership of the EU and deregulation of foreign investments which favored highly skilled labor force.

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[4] We also estimated a wage equation that simultaneously controls for all the unemployment rates over the business cycle. The results (Table A3 in appendix) support the implication of initial conditions for high-skilled wages for both sexes. Additionally, the spot market model matters for men in this examination, leaving the minimum unemployment rate insignificant. This is probably due to high correlation between spot market and minimum unemployment rates. Among women, the spot market unemployment rate is insignificant for most years.
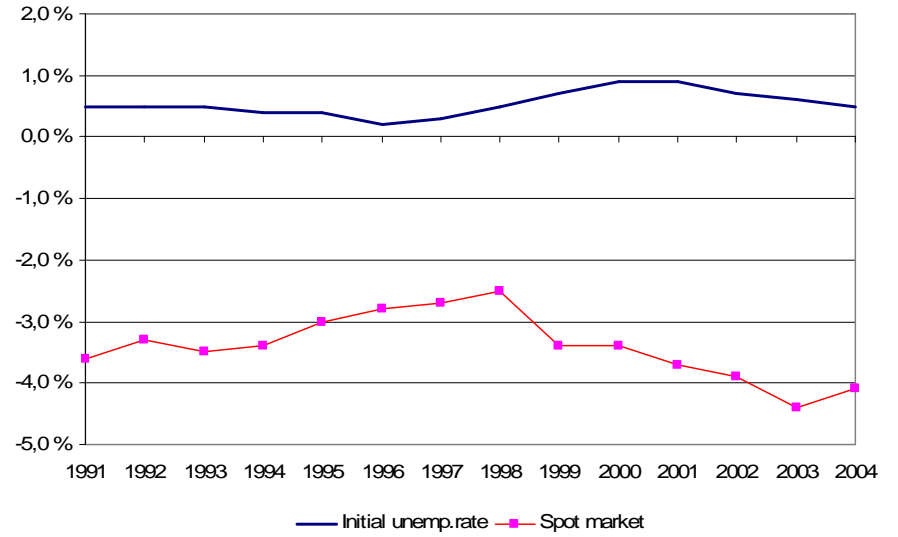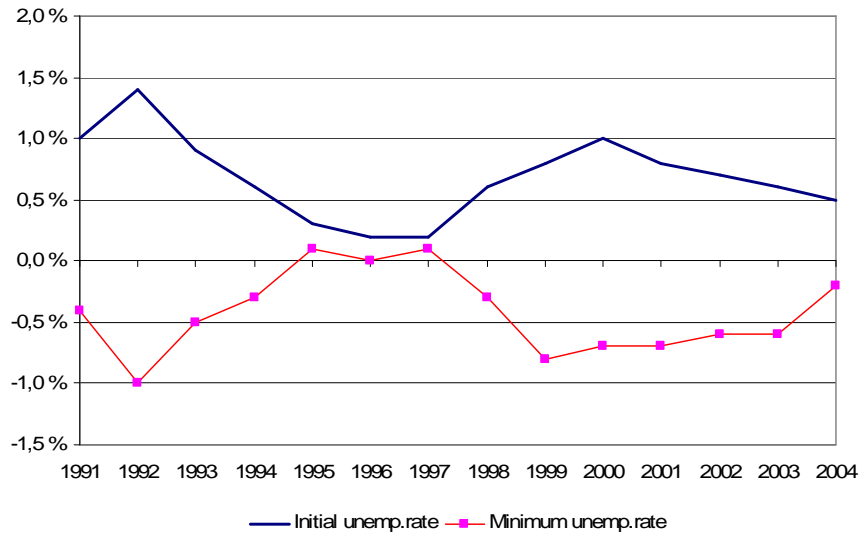
Figures 2-3. Unemployment rate wage effects for men
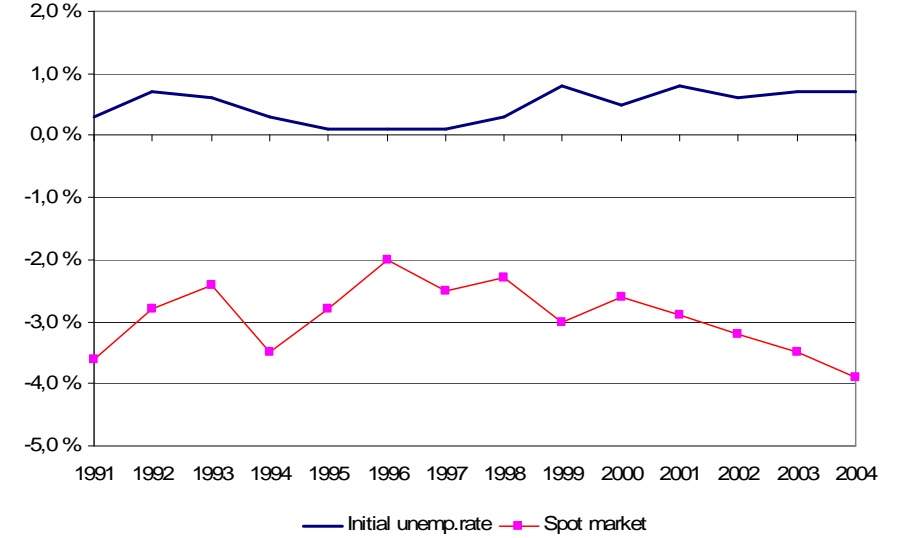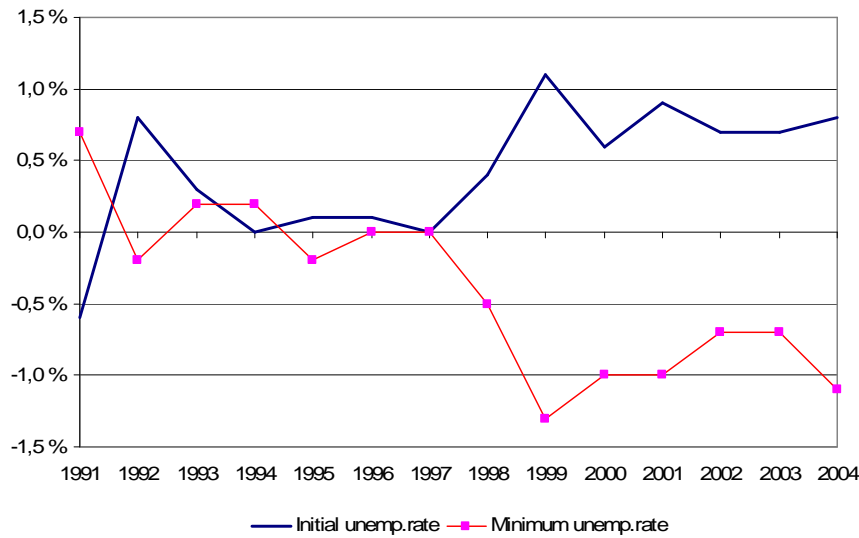
Figures 4-5. Unemployment wage effects for women

5. Conclusions

This paper adds to discussions and evidence presented by Beaudry and DiNardo (1991), McDonald and Worswick (1999), Seltzer and Merrett (2000), Grant (2003), and Devereux and Hart (2007) on spot market wage setting as well as on implicit contract models. We concentrate on the high-skilled labor market in Finland over the period 1991-2004. The period covers a major recession at the beginning of the 1990s as well as a recovery from it, a boom of the ICT sector led by Nokia as well as a crash after it, and a period of regular macroeconomic conditions following the boom. The turn of the millennium was particularly interesting, as Finland joined the Euro area in 1999, which followed its joining the EU in 1995 and the ERM in 1996. In addition, the expansion of higher education is evident during the period.

We find that the effect of the unemployment rate at the beginning of the tenure significantly contributes to wages of both highly skilled men and women. The sign of the effect is robustly positive, hence not providing any support for the implicit contracts with costly mobility for workers between firms. In addition, the wages are negatively affected by the spot market unemployment rates as well as the minimum unemployment rates of the tenure. Considering the macroeconomic conditions with falling unemployment over most of the research period, the results indicate that highly skilled workers were mobile across firms and that the mobility increased within the research period, which positively contributed to wages. In that sense, the results are in line with Beaudry and DiNardo.

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Appendix

Table A1. Variable description

Variable	Description
ln (wage)	Monthly earnings/euros (annual earnings/working months)
Unemployment rates	
Initial	Unemployment rate at start of job
Minimum	Minimum unemployment rate since start of job
Spot market	Spot market unemployment rate
Individual characteristics	
Experience	Potential work experience, calculated as age - age of graduation
Exper_squared	Potential work experience squared
Field of education	
Educational	Teacher education or educational science
Humanistic	Humanities or arts
Business	Social sciences or business
Natural science	Natural science
Technology	Technology
Agriculture	Agriculture or forestry
Health	Health or welfare
Services	Services
Notknown	Not known or unspecified
Married	Individual is married
Cohabiting	Individual is cohabiting
Children_under 3 years	Individual has child/children under 4 years of age
Children_between 4-7 years	Individual has child/children between 4 and 6 years of age
Status of employee before current job	
Wage earner	Individual was a wage earner before the current job
Self-employed	Individual was a self-employed before the current job
Unemployed	Individual was an unemployed before the current job
Student	Individual was a student before the current job
Home with children	Individual was at home with children before the current job
Other position	Individual was out of the labor force for other reason before current job
Firm-specific characteristics	
Establishment year	
Estab_76	Firm was established before 1976
Estab_80	Firm was established during 1977-1980
Estab_85	Firm was established during 1981-1985
Estab_90	Firm was established during 1986-1990
Estab_95	Firm was established during 1991-1995
Estab_98	Firm was established during 1996-1998
Estab_00	Firm was established during 1999-2000
Estab_04	Firm was established during 2001-2004
Size of the firm	Size of the firm measured as number of employees
Firmsize_4	Number of employees is less than 5
Firmsize_9	Number of employees is between 5 and 9
Firmsize_19	Number of employees is between 10 and 19
Firmsize_49	Number of employees is between 20 and 49
Firmsize_99	Number of employees is between 50 and 99

Firmsize_299	Number of employees is between 100 and 299
Firmsize_300-	Number of employees is more than 299
Foreign owned firm	Foreign ownership more than 50%
Share of women in firm	Share of women employees in the firm, %

Plant-specific characteristics

Size of the plant	Size of the plant measured as number of employees
Plantsize_4	Number of employees is less than 5
Plantsize_9	Number of employees is between 5 and 9
Plantsize_19	Number of employees is between 10 and 19
Plantsize_49	Number of employees is between 20 and 49
Plantsize_99	Number of employees is between 50 and 99
Plantsize_100-	Number of employees is more than 99
Field of industry	
Mining	Mining and quarrying
Grocery and tobacco	Manufacture of food products, beverages and tobacco
Textiles	Manufacture of textiles
Wearing and leather	Manufacture of wearing apparel; dressing and dyeing of fur and leather products
Wood and paper	Manufacture of wood and products of wood and cork, articles of straw and plaiting mater, pulp, paper and paper products
Publishing	Publishing, printing and reproduction of recorded media
Fuel and chemicals	Manufacture of coke, refined petroleum products and nuclear fuel and chemical products
Rubber and plastic	Manufacture of rubber and plastic products
Non-metallic	Manufacture of other non-metallic mineral products
Metals	Manufacture of basic metals
Fabricated metal	Manufacture of fabricated metal products
Machinery	Manufacture of machinery and equipment, office machinery and computers, electrical machinery and apparatus
Communication and other	Manufacture of radio, television and communication equipment and apparatus, instruments and watches and clocks
Transport equip	Manufacture of transport equipment
Furniture	Manufacture of furniture and recycling
Electricity, water and construction	Electricity, gas, steam and hot water supply; construction
Wholesale	Wholesale trade
Retail and restaurant	Retail trade; hotels and restaurants
Transport	Land, water and air transport
Telecommunication	Supporting and auxiliary transport activities; post and telecommunication
Finance	Financial intermediation
Real estate	Real estate and renting
Computer	Computer and related activities
Research	Research and development and other business activities

Regional characteristics

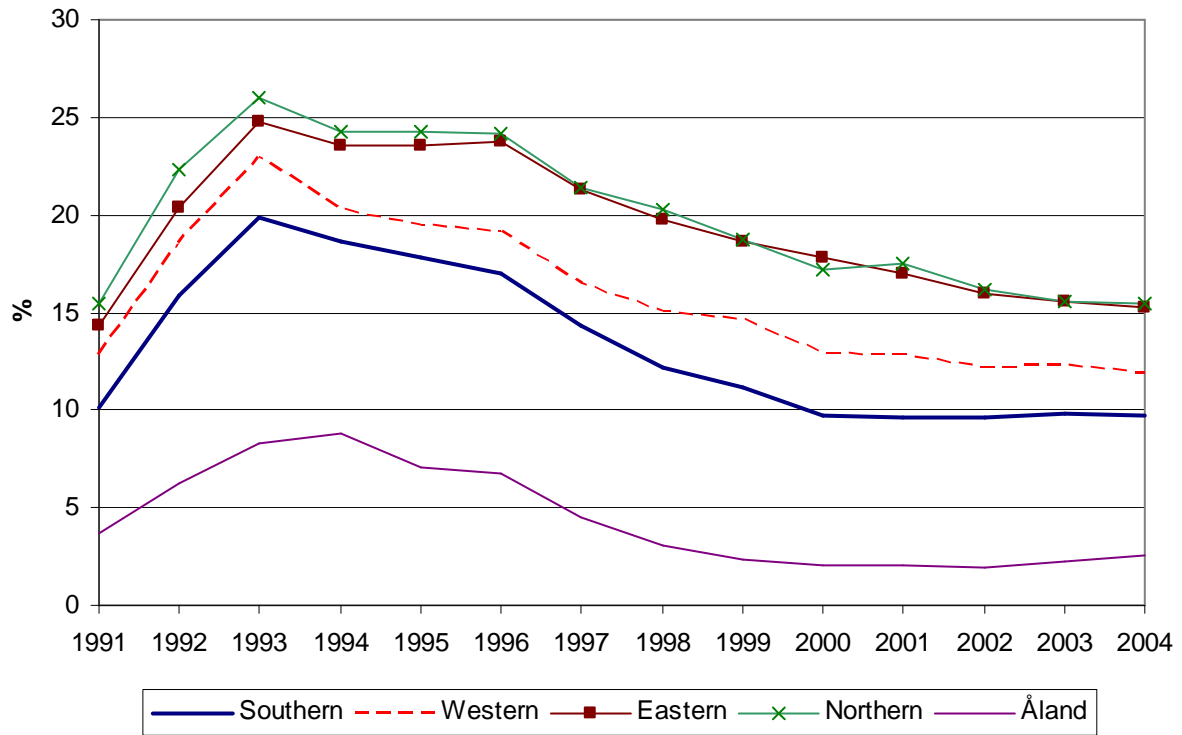|	
NUTS2-regions	
NUTS1	Southern Finland
NUTS2	Western Finland
NUTS3	Eastern Finland
NUTS4	Northern Finland
NUTS5	Åland

Figure A1. Regional unemployment rates over 1991-2004.

Table A2. FE+Firm results on unemployment wage effect for men and women

Ln(monthly wage)	Results for men				Results for women			
	Specification 1		Specification 2		Specification 1		Specification 2	
	Initial unemployment rate	Minimum unemployment rate.	Initial unemployment rate	Spot market unemployment rate	Initial unemployment rate	Minimum unemployment rate.	Initial unemployment rate	Spot market unemployment rate
1991	0.010*	– 0.004	0.007*	– 0.036*	– 0.006	0.007	0.003	– 0.036
1992	0.014*	– 0.010*	0.005*	– 0.033*	0.008	– 0.002	0.007*	– 0.028
1993	0.009*	– 0.005	0.005*	– 0.035*	0.003	0.002	0.006*	– 0.024
1994	0.006*	– 0.003	0.004*	– 0.034*	0.000	0.002	0.003	– 0.035
1995	0.003	0.000	0.004*	– 0.030*	0.001	– 0.001	0.001	– 0.028
1996	0.002	0.000	0.002*	– 0.028*	0.000	– 0.000	0.001	– 0.020
1997	0.002	0.001	0.003*	– 0.027*	– 0.000	– 0.000	0.001	– 0.025
1998	0.006*	– 0.003	0.005*	– 0.025*	0.004*	– 0.005	0.003*	– 0.023
1999	0.008*	– 0.008*	0.007*	– 0.034*	0.011*	– 0.013*	0.008*	– 0.030*
2000	0.010*	– 0.007*	0.009*	– 0.034*	0.006*	– 0.010*	0.005*	– 0.026*
2001	0.008*	– 0.007*	0.009*	– 0.037*	0.009*	– 0.010*	0.008*	– 0.029*
2002	0.007*	– 0.006*	0.007*	– 0.039*	0.007*	– 0.007	0.006*	– 0.032*
2003	0.006*	– 0.006*	0.006*	– 0.044*	0.007*	– 0.007	0.007*	– 0.035*
2004	0.005*	– 0.002	0.005*	– 0.041*	0.008*	– 0.011*	0.007*	– 0.039*
R^2	0.45		0.45		0.41		0.41	
No. of obs.	76,677				39,561			
Field of education	$F_{(6, 57917)} = 6.73$*		$F_{(6, 57917)} = 6.72$*		$F_{(7, 27974)} = 3.03$*		$F_{(6, 27974)} = 3.11$*	
Establishment year	$F_{(6, 57917)} = 0.56$		$F_{(6, 57917)} = 0.65$		$F_{(6, 27974)} = 0.40$		$F_{(6, 27974)} = 0.47$	
Size of the firm	$F_{(5, 57917)} = 8.32$*		$F_{(5, 57917)} = 8.18$*		$F_{(5, 27974)} = 4.20$*		$F_{(5, 27974)} = 4.10$*	
Size of the plant	$F_{(4, 57917)} = 0.23$		$F_{(4, 57917)} = 0.19$		$F_{(4, 27974)} = 1.08$		$F_{(4, 27974)} = 1.10$	
Field of industry	$F_{(22, 57917)} = 2.58$*		$F_{(22, 57917)} = 2.60$*		$F_{(22, 27974)} = 2.61$*		$F_{(22, 27974)} = 2.60$*	
NUTS-region	$F_{(3, 57917)} = 1.21$		$F_{(3, 57917)} = 5.78$*		$F_{(3, 27974)} = 1.40$		$F_{(3, 27974)} = 2.42$	

sign: statistically significant at least at a 5-percent significance level

Table A3. FE+Firm results on unemployment wage effects for men and women; all unemployment rates

Ln(monthly wage) Specification: Firm+FE	Results for men			Results for women		
	Spot market	Initial	Minimum	Spot market	Initial	Minimum
1991	− 0.036*	0.009	− 0.002	− 0.034	− 0.006	0.007
1992	− 0.031*	0.013*	− 0.009*	− 0.027	0.008	− 0.002
1993	− 0.034*	0.008*	− 0.003	− 0.023	0.002	0.002
1994	− 0.034*	0.005*	− 0.001	− 0.035	0.000	0.002
1995	− 0.031*	0.002	0.002	− 0.027	0.001	− 0.001
1996	− 0.029*	0.001	0.002	− 0.020	0.001	− 0.001
1997	− 0.027*	0.002	0.002	− 0.025	− 0.000	0.000
1998	− 0.032*	0.006*	− 0.005	− 0.019	0.005*	− 0.006
1999	− 0.032*	0.007*	− 0.003	− 0.019	0.011*	− 0.015*
2000	− 0.033*	0.009*	− 0.001	− 0.011	0.007*	− 0.018*
2001	− 0.043*	0.008*	0.008*	− 0.020	0.010*	− 0.010
2002	− 0.042*	0.006*	0.003	− 0.030	0.007*	− 0.003
2003	− 0.045*	0.005*	0.002	− 0.034*	0.007*	− 0.002
2004	− 0.045*	0.005*	0.005	− 0.032	0.008*	− 0.009
R^2	0.45			0.41		
No. of obs.	76,677			39,561		
Field of education	$F_{(6, 57903)} = 6.70*$			$F_{(6, 27960)} = 3.03$		
Establishment year	$F_{(6, 57903)} = 0.61$			$F_{(6, 27960)} = 0.43$		
Size of the firm	$F_{(5, 57903)} = 8.16*$			$F_{(5, 27960)} = 4.21*$		
Size of the plant	$F_{(4, 57903)} = 0.18$			$F_{(4, 27960)} = 1.03$		
Field of industry	$F_{(22, 57903)} = 2.59*$			$F_{(22, 27960)} = 2.56*$		
NUTS-region	$F_{(3, 57903)} = 5.82***$			$F_{(3, 27960)} = 2.24*$		

sign: statistically significant at least at a 5-percent significance level