VATT-KESKUSTELUALOITTEITA
VATT-DISCUSSION PAPERS

68

INDUSTRY WAGE DIFFERENTIALS IN FINLAND, 1989

Pekka Tossavainen

Valtion taloudellinen tutkimuskeskus
Government Institute for Economic Research
Helsinki 1994

* The author thanks Tor Eriksson of the Turku Business School of Economics for his helpful suggestions and comments and Andrew Lightfoot for correcting the language of the paper. The comments of Pasi Holm, Seppo Leppänen and Antti Romppanen of the Goverment Institute for Economic Research and Jari Vainionmäki of the University of Tampere are also acknowledged. The author alone is responsible for any remaining errors or shortcomings.

Pekka Tossavainen: Government Institute for Economic Research, Helsinki.

ISBN 951-561-094-X

ISSN 0788-5016

Valtion taloudellinen tutkimuskeskus

Government Insitute for Economic Research

Hämeentie 3, 00530 Helsinki, Finland

Painatuskeskus Pikapaino Opastinsilta

Helsinki 1994

PEKKA TOSSAVAINEN: INDUSTRY WAGE DIFFERENTIALS IN FINLAND, 1989, Helsinki: VATT, Valtion taloudellinen tutkimuskeskus, Government Insitute for Economic Research, 1994, (C, ISSN 0788-5016, No. 68). ISBN 951-561-094-X.

ABSTRACT: The approach implemented in this paper, to estimating earnings equations with controls for human capital and other characteristics tackles the question of why wages do not clear the labour market. Moreover, this area of research is essential in the discussion on promoting labour market flexibility and for understanding the persistence of unemplyment. Earning equations extended with industry dummies are estimated using Labour Survey cross-sectional data for 1989, which gives a good opportunity to analyse the impact of little explored variables, such the indicator for the use of computers and variables based on efficiency wage considerations. We found that the use of computers in work increases individuals' earnings significantly, and that despite the controls for all relevant characteristics there remain large and significant industry wage differentials.

KEY WORDS: Wage differentials, computers, efficiency wages.

PEKKA TOSSAVAINEN: INDUSTRY WAGE DIFFERENTIALS IN FINLAND, 1989. Helsinki: VATT, Valtion taloudellinen tutkimuskeskus, Government Insitute for Economic Research, 1994, (C, ISSN 0788-5016, No. 68). ISBN 951-561-094-X.

TIIVISTELMÄ: Toimialoittaisten palkkaerojen tutkimus on keskeistä työmarkkinoiden toiminnan tarkastelussa. Palkkayhtälöt täydennettynä toimialaa kuvaavilla indikaattoreilla estimoidaan Työvoimatutkimuksen vuosihaastattelua (nk. lisäosa) 1989 käyttäen. Aineisto mahdollistaa vähän tutkittujen selittäjien, kuten ATK-laitteen käyttöä töissä kuvaavan muuttajan sekä tehokkuuspalkkamalleihin pohjautuvien muuttujien tarkastelun. ATK-laitetta käyttävät työntekijät saavat korkeampaa palkkaa verrattuna ei-käyttäjiin. Lisäksi merkitseviä toimialoittaisia palkkaeroja esiintyy huolimatta relevanttien selittäjien kontrolloimisesta.

ASIASANAT: palkkaerot, ATK, tehokkuuspalkat

Contents

1. INTRODUCTION

Studies of industry wage differentials made using Finnish data [(Vainiomäki and Laaksonen 1992), (Asplund 1993, 1994), (Maliranta 1993) and (Eriksson 1994)] have shown that large and significant industry wage differentials remain even after controlling for personal and job characteristics. Since these differentials cannot be totally explained by differences in labour quality and work conditions, other complementary explanations are needed[1]. This study provides an examination of the effect of complementary, little explored variables, such as the use of computers in work and variables based on efficiency wage considerations.

Recent contributions to research into wage differentials owe much to Mincer (1974), whose basic specification of the human capital earnings function is widely referred to as a standard approach:

(1) $$\ln W_i = X_i\beta + \varepsilon_i,$$

where the natural logarithm of individual earnings $\ln W_i$ is regressed on a vector X_i of personal, job and other characteristics[2], β is a vector of parameters to be estimated and ε_i is an error term.

In this paper earnings functions relating to the private sector in Finland are estimated using ordinary least squares (OLS) techniques. We follow the frequently implemented strategy of estimating a standard function extended with industry dummies:

(2) $$\ln W_{ij} = I_j\alpha + X_i\beta + \varepsilon_{ij},$$

where $\ln W_{ij}$ is the log of earnings for individual i in industry j, I_j is a vector of industry dummies and α is a parameter vector to be estimated.

The attraction of this method is that the vector X_i can be further extended with indicators based on modern explanations of wage formation, such as efficiency wage and insider-outsider models. In particular, our data provides an opportunity to analyse the effect of a little explored variable, the indicator for the use of computers. It is claimed that rapid,

---

1 The finding that wages are responsive to industry-specific factors has been reported in studies by Krueger and Summers (1988) and Gittleman and Wolff (1993). According to Gittleman and Wolff (1993) industry wage differences are positively related to an industry's productivity growth, output growth, capital intensity and export orientation. The correlations between industry wage premiums and a number of industry characteristics are also examined in studies by Vainionmäki and Laaksonen (1992) and Asplund (1993). In their findings, the proportion of males, industry-specific productivity measures and workers' average years of schooling are positively correlated with the premiums.

2 Usually, personal and job characteristics measure workers' ability inadequately. This implies that large industry wage differences may remain even after controlling for all the variables as affectively as possible. Sorting high-ability workers into high-wage industries causes correlations between error term and industry indicators and the estimated industry effects are biased because a variable has been omitted in the equation. In view of our cross-sectional data it is not possible to distinguish unobserved ability and efficiency wage interpretations as it is in the case of panel data [see fixed-effect method estimations in Vainiomäki and Laaksonen (1992)].

skill-based technological change which has caused changes in the relative productivity of various types of workers may explain the changes in the wage structure in the 1980s (Krueger 1993). Thus, new computer techology may be a potential determinant of individuals' earnings. In addition, the 'standard' labour and job quality indicators are examined in this paper.

However, it is well known that no matter how effective the controls for these explanations are, unmeasured labour quality differences remain, such as unobserved ability and motivation, and these have an impact on wages. It is clear that these unmeasured factors vary across industries and that a proportion of them will be picked up by the industry controls rather than by all the measurable controls available in the data sets.

Reseach into industry wage differentials tackles the question of why wages do not seem to clear the labour market. Moreover, addressing this question is vital for the discussion on promoting labour market flexibility and understanding the persistence of unemplyment.

This study is organized as follows. Section 2 describes the Finnish wage structure and makes some comparisons with other countries. Section 3 introduces the data and defines the variables used. The estimated equation is presented in section 4. The empirical results are commented in section 5. Section 6 concludes the paper.

2. WAGE STRUCTURE IN FINLAND AND IN THE OECD COUNTRIES

The coefficient of variation of average wages in private sector 27 industries based on National Accounts (Figure 1) shows that aggregate wage dispersion in Finland declined during the 1970s. This development was halted as from the early eighties.[3] Yet by international standards wage dispersion in Finland has been at an average level (Table 1).

The emergence of increasing inequality is more pronounced in other western countries [(Davis 1992), (Gittleman and Wolff 1993) and (OECD 1993)]. The degree of wage dispersion is very different between countries, but developments over time in relative wages have been parallel across countries. The previous trend of compression was reversed and dispersion increased towards the end of the1980s.

The data presented in Table 1 suggests that in the mid 1980s industry wage dispersion was largest in Japan but also relatively large in north America, the United Kingdom and Austria. It was smaller in most EC countries and particularly small in Sweden and

---

[3] An examination based on Confederation of Finnish Industry and Employers (TT) data shows only marginal shifts in relative wages in manufacturing industries over the period 1980-92 (Asplund 1993).

Denmark. In Finland wage dispersion has been larger than in the other Nordic countries[4].

Numerous explanations may be advanced to account for the developments of the late 1970s and early 1980s. Most western countries experienced a narrowing of gender pay differences, legislated wage equalisation and reduced discrimination. In the Nordic countries centralized and solidaristic wage-setting may have had the effect of reducing wage dispersion in the first half of the 1980s. In many western countries the emergence of increased inequality in wages towards the end of the 1980s may be due to the expansion of the female labour supply.

In the context of the functioning of the labour market it is interesting to note the following facts. Firstly, studies of different countries have documented large inter-industry wage differentials which have shown remarkable stability over time [(Gittleman and Wolff 1993) and (Vainiomäki and Laaksonen 1992)]. In the USA, for example, where the labour market captures many features of the theoretical competitive labour market, wage dispersion is much greater than in Sweden and Finland [(Edin and Zetterberg 1992) and (Eriksson 1991)].

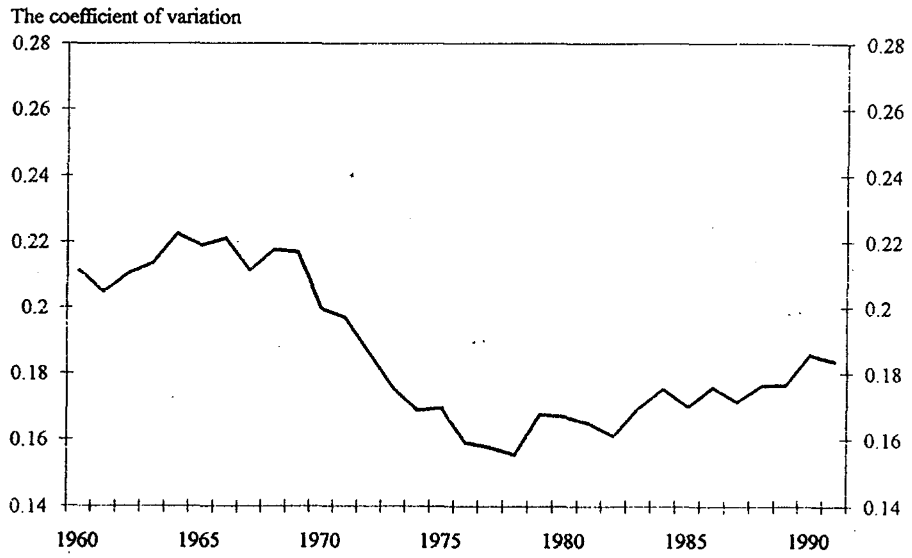
Thus, wage differentials cannot be seen simply as required price signals for labour mobility. Secondly, since different countries seem to have quite similar industry wage structures, existing wage differenitals cannot be due solely to differences in wage bargaining systems. These findings conflict against the competitive labour market view.[5]

---

[4] Besides the changes in wage dispersion across industries, the wage structure has also changed in Finland within industries as well as within different characteristics groups (Eriksson and Jäntti 1993). The increase in overall wage dispersion is due to a rise in inequality within age, gender and education groups and industry sectors. In fact, inequality between groups declined between 1985 and 1990 as overall inequality increased.

[5] The neoclassical human capital view is based on the idea that persons with identical human resources are assumed to be equally paid, and that wage differentials may represent compensating wage premiums for differing job characteristics and work environments. In the long run labour mobility should clear wage differentials.

Figure 1. ***The coefficient of variation of average wages in private sector 27 industries 1960-1991***



Source: National Accounts

Table 1. Wage dispersion across manufacturing industries in OECD countries 1973-1985

	Coefficient of variation 1973	Coefficient of variation 1985	Change 1973-1985
USA	21.6	22.5	0.9
Japan	28.8	33.1	4.3
Germany	14.5	13.7	-0.8
France	15.6	13.8	-1.8
UK	21.6	18.3	-3.3
Austria	23.2	21.7	-1.5
Belgium	23.1	16.5	-6.6
Denmark	12.6	9.8	-2.8
Finland	16.2	14.5	-1.7
Netherlands	10.0	11.0	1.0
Norway	12.2	14.2	2.0
Sweden	9.3	8.8	-0.5

Source: OECD (1993): High and Persistent Unemployment: Assessment of the Problem and its Causes.

3. THE DATA

3.1 Data source and the sample

Extended versions of the standard human capital functions are estimated using cross-sectional micro data from the Finnish Labour Force Survey for 1989. Earnings information is from tax registers. The actual data is restricted to wage earners in the private sector aged 15 to 64, making a total of 2949 observations. The persons involved were employed in full-time or part-time jobs during the year.

The sample includes some errors. The main problems centre on contradictions between earnings and hours or months worked, response errors with part-time or temporary workers, i.e. problems with the data are related mainly to so-called atypical work. As a result, some clearly problematic elements have been excluded from the sample.

3.2 Variables, their measurement and transformations

This sub-section defines the variables used in our analyses. The definitions of the variables used in the estimations are given in Table A.1 of Data appendix A. As an illustration sample means and standard deviations by variables are presented in Table A.2 of Data appendix A. Table A.3 of Data appendix A.3 shows number of observations, mean wages, standard deviations of mean wages and raw differences from average wages by industry. The signs of the percentage differences from the average wage level are similar to the differences estimated from the National Accounts and in other studies [see Eriksson (1991)].

Earnings

The dependent variable in the cross-sectional models is the log of earnings before taxes, where earnings are of the 'per month' type (LOGWAGE)[6]. The earnings information is in line with the concept of 'wage income from main occupation' applied in taxation. Annual earnings are transformed into monthly wages using information on months employed in full-time and part-time work. This transformation takes due account of unemployment spells, flows into and out of the labour market, i.e. entrants, job-leavers and persons with some unemployment spells during the year are also included. Fringe benefits are not taken into account.

---

6 The dependent variable in this study differs from that used in the studies by Asplund (1993) and Maliranta (1993), where the dependent variable is average hourly earnings.

Industry classification

Industry dummies are formed on the basis of the 1988 Finnish Standard Industry Classification (SIC) (two- and three-digit level). The main principles and definitions of the SIC follow the recommendations in the ISIC.

The final number of industry classes used is 30. It should be noted that the number of observations in some classes is very small (see Table A.2 in Data appendix A), which of course weakens the reliability of the estimates. In this study, fabricated metal products, machinery, etc. (IND24) is taken as the reference group in the estimations.

3.2.1 Standard explanations

Marital status and gender

Factors such as gender, marital status or area of residence are important determinants of earnings. Usually men have higher earnings than women. The indicator (SEX) attempts to capture this existing sex discrimination in the labour market. A positive 'marriage premium' is widely reported in several studies and therefore an indicator for being married (MARRIED) is also introduced.

Formal education

Six education dummies are distinguished in the estimations. Primary school education (EDUC1), which comprises all individuals with basic education only, is treated as the base category, i.e. the intercept term will reflect the intercept for this category. The differential intercepts of other education levels provide a direct estimate of the average level of the internal rate of return on education.

(EDUC3) and (EDUC4) stand respectively for individuals who have completed lower-level (educational level 3) and upper-level (educational level 4) upper secondary education. The four levels of higher education are represented by three dummy variables: (EDUC5) (educational level 5), (EDUC67) (educational levels 6 and 7) and (EDUC8) (educational level 8). More information on the classification of formal education is provided in Data appendix A.

Work experience and seniority

The data comprises self-reported information on individuals' total labour market work experience in years (EXP) and years with the current employer (SENIOR), i.e. seniority. The coefficient of work experience (EXP) is interpreted as a return on investment in general human capital, while the coefficient of years worked with the same employer (SENIOR) provides an estimate of earnings growth due to individual investment in specific human capital. The quadratic work experience term (EXP2) is included to capture the concavity of experience-earnings profiles.

Area of residence

Area of residence is used as a classified variable. The indicator (SOUTH) comprises persons living in the provinces of Uusimaa, Turku and Pori, Häme and Kymi and the indicator (NORTH) comprises persons living in the provinces of Oulu and Lapland. In the regional variables the middle part of Finland and Åland (MIDDLE) are treated as the base group.

Unionized employees

The Nordic labour markets are examples of institutionalized labour markets, where wages are negotiated between central bargainers and where the level of unionization is high. The variable (UNION) attempts to capture the utility obtained from unionization.

Training sponsored by employer

The survey contains self-reported information on on-the-job training (TRAIN) sponsored by the employer during the year and this refers to any training partly or wholly sponsored by the employer. The coefficient of this indicator is interpreted as a return on investment in firm-specific skills. On the other hand, it may also reflect insider position of workers.

Part-time work

The effect of part-time work on individuals' earnings is examined with the indicator (PART). The proportion of part-time workers in the sample is 7 %. 2.6 % of employees reported working part-time for 12 months in the year.

Occupational status

Five different occupation levels are defined in the data and the indicators for them are: senior officials and upper management (OCC31), senior officials and employees in research and planning, senior officials and employees in education and training, and other senior officials and employees (OCC32), supervisors (OCC41), industrial workers (OCC52), and workers in agriculture, forestry and commercial fishing, other production workers, and distribution and service workers (OCC51). The occupation group other lower-level officials (OCC1) is treated as the base category. More information on occupational status is provided in Data appendix A.

3.2.2 The use of computers, shift work, insider position and efficiency wages

The use of computers in work

The variables described above are standard variables in several studies based on the human capital theory. In addition to these widely used variables the sample gives an opportunity to analyse the impact of other job characteristics variables, like the indicator (COMPUT), which tells whether users of computers are better paid.

Shift work

The data provides information on different working times. Since shift work is likely to be an important determinant of earnings, especially in manufacturing industry, indicators for two-shift work (2SHIFT) and three-shift work (3SHIFT) are also included. These indicators also reflect how work is organized, and therefore may capture the same information than variables based on efficiency wage considerations.

Permanent job (insiders)

According to insider-outsider models[7], workers with a permanent job (INSIDER) have higher earnings than workers with 'atypical' work. The positive return on a permanent job may also capture a return on specific training and learning-by-doing and can also be interpreted as a return on seniority.

Efficiency wage considerations: flexible working hours and employees who can negotiate their working hours

Explanations of efficiency wage models[8] rest on the assumption that employers paying wages above the market-clearing level to attract highly productive, motivated workers and that employers are unable to monitor worker performance perfectly, for example because of differences in production technology or in the organization of work. If workers have flexible working hours (EFWAGE1) and are in a position to negotiate their working time (EFWAGE2), they are assumed to have higher earnings.

---

7 **Insider-outsider models** (Carruth and Oswald 1987) assume that once all members of a labour group have jobs, that particular group (insiders) attaches no importance to employment and hence becomes concerned solely with raising its own members' wages.

8 Surveys of different **efficiency wage models** are provided by Akerlof and Yellen (1986) and Katz (1986).

4. ESTIMATED EQUATION

The equation to be estimated is augmented with industry indicators and a broad variety of personal, job and other characteristics:

$$(3) \qquad \ln W_{ij} = \alpha^0 + \alpha^1 I_j + \alpha^2 X_i + \alpha^3 T_i + \alpha^4 P_i + \alpha^5 O_i + \alpha^6 C_i + \alpha^7 E_i$$
$$+ \alpha^8 IA1_i + \alpha^9 IA2_i + \alpha^{10} IA3_i + \alpha^{11} IA4_i + \alpha^{12} IA5_i + \varepsilon_{ij},$$

where $\ln W_{ij}$ is the natural logarithm of earnings for individual i in industry j, $\alpha^0 ... \alpha^{12}$ are vectors of the parameters to be estimated and ε_{ij} is an error term. The vectors of the explanatory variables included are as follows. I_j is a vector of industry indicators (IND1-IND95), X_i is a vector of characteristics comprising indicators for being married (MARRIED), gender (SEX), formal education (EDUC3-EDUC8), work experience (EXP), the square of work experience (EXP2), seniority (SENIOR), area of residence, either northern Finland (NORTH) or southern Finland (SOUTH), and unionization (UNION).

T_i is a vector of the indicator for firm-specific training (TRAIN) and P_i for part-time work (PART). O_i denotes a vector of occupation characteristics (OCC31-OCC52). C_i is a vector of the indicator for the use of computers in work (COMPUT). Vector E_i contains indicators for two-shift work (2SHIFT), three-shift work (3SHIFT), insider position (INSIDER), flexible working hours (EFWAGE1) and employees who are able to negotiate their working hours (EFWAGE2).

Vector $IA1_i$ stands for the interaction effects of occupation category and the efficiency wage consideration of flexible working hours (OCC31-OCC52)*(EFWAGE1). Vector $IA2_i$ denotes the interaction effects of occupation and unionization (OCC31-OCC52)*(UNION).

Vector $IA3_i$ contains the interaction effects of an insider position and work experience (INSIDER)*(EXP) and an insider position and unionization (INSIDER)*(UNION). The interaction effects of occupation and an insider position (OCC31-OCC52)*(INSIDER) are denoted by vector $IA4_i$, and the interaction effects of the selected variables included are denoted by vector $IA5_i$.

The strategy implemented in this study, which has recently been adopted in studies by Asplund (1993, 1994) and Maliranta (1993), is to first estimate equation (3) with controls for industry effects only, and then to add, in stages, more controlling variables into the equation. The different stages of estimation are denoted by a restricting equation (3).

5. EMPIRICAL RESULTS

The estimation results obtained with different versions of the earnings equation are commented in this section. The estimation results are given in Table B.1 of Appendix B. Note that in Table B.1 we report the estimation results of four selected models only, namely models 1, 2, 3 and 4. However, some results of numerous estimations are commented in the text. Model 1 stands for industry effects only. Model 2 is extended with standard explanations, and in model 3 the little explored variables are added into the analysis, i.e. the model captures the effects of all the explanations. Model 4 represents the final model extended with all control variables and selected interaction indicators. The results of the other estimated models, which are commented in text, are available upon request.

Since heteroskedasticity is a common problem in cross-sectional data we examined the estimated residual squares and tested heteroskedasticity explicitly by the Goldfeld-Quandt test and found that heteroskedasticity is not very likely in our models.

The omitted industry category IND24 (fabricated metal products, machinery etc.) is treated as the base category in the estimations which follow and therefore is treated as zero in terms of industry effects. The coefficients of the other industry indicators show how employees' earnings in each industry differ from the base category. In other words, the estimated parameters α^1 of industry dummies can be interpreted as the utility of an individual for being in a particular industry, as compared to a randomly selected individual.

5.1 Industry-related wage differentials

The first equation to be estimated is augmented with industry indicators (IND1-IND95) only, i.e. equation (3) is estimated with the restriction $\alpha^2 = ... = \alpha^{12} = 0$ (see model 1 in Table B.1 of Appendix B). The estimation results of model 1 are also commented in sub-sections 5.4 and 5.6.

After controlling for industry indicators, the high-wage industries in the sample are paper products (IND151), basic metal industries (IND231) and communications (IND57), whereas the low-wage industries after controls are textile etc. industries (IND12), retail sale (IND431), real estate and rental services (IND65), and personal and household services (IND95).

Despite a few exceptions - which may be partly due to a different base category and industry classification- such as wholesale trade, these results are consistent with Asplund's (1994) results obtained with 1987 Labour Survey data. Thus industry-related wage differentials have not changed markedly during the period 1987-1989 (see also the uncontrolled wage premiums in Figure 2).

5.2 Standard explanations

The next stage in our analysis was to introduce vector X_i of characteristics (MARRIED), (SEX), (EDUC3-EDUC8), (EXP), (EXP2), (SENIOR), (SOUTH), (NORTH) and (UNI-ON) into equation (3) with the restriction $\alpha^3 = ... = \alpha^{12} = 0$. The signs of the estimated values of α^2 were as expected and clearly significant[9]. The estimation results suggested that inclusion of these variables strongly decreases the values of α^1 in most industries, particularly in food, beverages etc. (IND11), restaurants and hotels (IND47), real estate and rental services (IND65), medical etc. services (IND87) and in personal and household services (IND95).

The impact of employer-sponsored training (TRAIN) on wage determination was examined individually by introducing vector T_i into equation (3) with the restriction $\alpha^4 = ... = \alpha^{12} = 0$. The highly significant estimated value of α^3 revealed a strong positive impact on earnings. The inclusion of this indicator for investment in firm-specific skills decreased the estimated α^1 values of industry indicators most clearly in petroleum refineries, coal and nuclear energy (IND19), communications (IND57), financial institutions (IND61) and recreational and cultural services (IND91).

The impact of part-time work was examined individually by introducing vector P_i into equation (3) with the restriction $\alpha^5 = ... = \alpha^{12} = 0$. The estimation results suggested that part-time work has a negative but insignificant impact on earnings. Next we introduced vector O_i of occupation characteristics (OCC31-OCC52) into the equation with the restriction $\alpha^6 = ... = \alpha^{12} = 0$ (see model 2 in Table B.1 of Appendix B).[10] The estimated α^5s are significant, except for the estimated parameter of the occupation group manufacturing workers (OCC52). Controlling for occupation increased the explained sum of squares by over 3 % and decreased the estimated α_1 values of industry indicators most clearly in agriculture, forestry etc. (IND1) and in real estate and rental services (IND65).

Model 2 in table B.1 represents the model extended with standard explanations and some of the estimated parameter values are commented on briefly as follows. In this regression the wage premium obtained for being married, the 'marriage premium' (MARRIED) is nearly 4 %. Gender (SEX) had a particularly strong impact on earnings; the results suggest that men earn in excess of some 26 % more per month than women. The level of monthly earnings is expected to be some 46 % higher for those with higher education (EDUC67) than for those with basic education only. Unionization (UNION) has a clearly significant impact on earnings; unionized workers earn over 6 % more than non-unionized workers.

In terms of R^2 the inclusion of the standard characteristics variables (MARRIED), (SEX), (EDUC3-EDUC8), (EXP), (EXP2), (SENIOR), (NORTH), (SOUTH), (UNI-ON), (TRAIN), (PART) and (OCC31-OCC52) into the model augmented with industry

---

9 One exception was the indicator for northern Finland (NORTH).

10 The introduction of occupation variables (OCC31-OCC52) as job characteristics variables may be critical, since occupations are usually correlated with the level of education.

indicators only, i.e. into model 1, increases the explained sum of squares by over 30 percentage points, thus they are important determinants of earnings.

5.3 The use of computers, shift work, permanent job and efficiency wages

In this study the impact of little explored variables of wage determination are of particular interest. The next stage of the analysis was to attempt to capture the impact of the use of computers in work (COMPUT), shift work (2SHIFT, 3SHIFT), permanent job (INSIDER) and efficiency wage considerations (EFWAGE1, EFWAGE2) on wage determination.[11]

The impact of the use of computers on earnings was examined individually with the restriction $\alpha^7 = ... = \alpha^{12} = 0$, i.e. vector C_i of the indicator (COMPUT) was incorporated into equation (3). The estimated parameter α^6 suggested that the use of computers increases earnings by over 8 %. In comparison, evidence from US microdata shows that employees who use computers in their work earn 10 to 15 % higher wages (Krueger 1993).

The equalizing impact of the computer variable on industry wage differentials was relatively weak; one exception was finance and insurance (IND61), where the significant estimated parameter value decreased markedly. This is not a suprising result since the use of computers in work is particularly pronounced in finance and insurance.

Next vector E_i composed of the indicators for two-shift work (2SHIFT), three-shift work (3SHIFT), insider position (INSIDER), flexible working hours (EFWAGE1) and employees able to to negotiate their working hours (EFWAGE2) was introduced into the equation, i.e. the restiriction of equation (3) is $\alpha^8 = ... = \alpha^{12} = 0$ (model 3 in Table B.1).

According to Maliranta (1993), shift work is an important determinant of earnings in the manufacture of pulp, paper and paper products. We found the same impact, implying that the estimated parameter value of the paper products industry indicator declined markedly. The finding that three-shift work has a stronger impact on earnings than two-shift work is also consistent with Maliranta (1993).

Model 3 in table B.1 shows that the utility derived from the use of computers in work (COMPUT) in this fully extended model is 7 %. The results further suggest that permanent job (INSIDER) has a strong impact on earnings. Workers who reported having a permanent job have earnings over 9 % higher than workers with an 'atypical' job.

Flexible working hours (EFWAGE1) also increase individuals' earnings; a positive impact in excess of 3 % on earnings gives support to efficiency wage hypotheses: if an employer is unable to monitor worker performance perfectly because of flexible working hours, then the employee is better paid. In contrast, the second efficiency wage hypothesis, negotiation of working time (EFWAGE2), has no significant impact on earnings.

---

[11] Shift work was previously examined in Maliranta (1993) and temporary job in Asplund (1993).

To what extent are industry wage differentials accounted for by these explanations? Inclusion of these indicators into model 2 increases the explained sum of squares only slightly. The drop in the standard deviation (SEE) in model 3 is also very modest compared to the drop caused by the inclusion of the standard explanations into model 1.

The overall finding is that controlling for labour and job characteristics and our little explored variables decreases wage differentials. The trend of decreasing wage differentials is also found in the studies by Asplund (1993, 1994) and Maliranta (1993). In our study the equalizing impact of all control variables is substantial in chemical products (IND18), petroleum refineries (IND19)[12], basic metal industries (IND231), restaurants and hotels (IND47), real estate and rental services (IND65) and in medical, dental etc. services (IND87).

5.4 A comparison of non-controlled and controlled industry wage premiums

As an overview of the wage structure, the non-controlled and controlled wage premiums are presented in Figure 2. The premiums are employment-weighted wage differentials calculated from the parameter values of industry dummies. The "non-controlled" premiums are calculated using the estimation results of the model extended with industry dummies only, meaning model 1. The "controlled" premiums are calculated using the results of model 3.

One of the ideas behind the competitive labour market is that in the long run labour mobility will clear the market. Assuming that labour market was in equilibrium in 1989, controlled wage premiums in Figure 2 should totally vanish after controls.[13] The calculated premiums and the estimation results suggest that despite controlling for personnel and job characteristics and our 'new' explanations, there remain large and statistically significant wage premiums. In recreational and cultural services (IND91) for example, the premium remains constant after control. These findings, together with other Finnish results obtained from Labour Survey cross-sectional data for 1987, (Asplund 1993, 1994), contradict the competitive labour market view.[14]

The lack of a time dimension in the cross-sectional data sets makes it impossible to tackle the issue of the functioning of the labour market more precisely. In the study by Vainiomäki and Laaksonen (1993) essential longitudinal information is obtained from Population Census panel data. In their study industry wage differentials were found to be persistent over years, which makes it difficult to explain wage differentials solely on the basis of labour-market-clearing considerations.

---

[12] Note: eight observations only.

[13] With an unemployment rate of 3.4%, the situation in the Finnish labour market in 1989 could be described as an excess demand for labour.

[14] In the study by Asplund (1993) paper, printing and basic metal industries, finance and insurance were high-wage industries after controls, whereas textile and wood (wood products and furniture) industries, retail trade and sanitary services were low-wage industries after controls.

5.5 Interaction effects of selected variables

Table A.4 of Data appendix A presents the proportions of the 'new' controls and the control for unionization by different occupation groups. It suggests that a high proportion of white-collar employees use computers in their work, while the use of computers is less common among blue-collar workers. Secondly, almost all holders of senior positions [senior officials and upper management (OCC31)] have a permanent job and also have the clear advantage of flexible working hours.

Whether these findings show that senior persons have a stronger attachment to their firms due to investments in firm-spesific skills in the form of the use of computers and whether they benefit from these investments is an interesting question. The findings also suggest that insider-outsider models and efficiency wage models may be potential determinants of the earnings of upper management.

We tried to answer these questions by forming a number of interaction dummies. The indicators formed were incorporated into model 3. The interaction effect between occupation and the use of computers (OCC31-OCC52)*(COMPUT) revealed an insignificant impact on earnings[15]. We also examined the impact of the indicator (COMPUT)*(TRAIN), but the effect of this indicator on earnings was insignificant.

The estimation results of significant interaction effects are commented on as follows. The interactions of (OCC31-OCC52)*(EFWAGE1) were examined by introducing vector $IA1_i$ into equation (3) with the restriction $\alpha^9 = ... = \alpha^{12} = 0$. (OCC32)*(EFWAGE1) revealed an 11 % impact on earnings, indicating that the positive impact of flexible working hours on earnings is reinforced by the effect of the occupational group of other senior official and employees in research and planning etc.

With the restriction in equation (3) that $\alpha^8 = \alpha^{10} = \alpha^{11} = \alpha^{12} = 0$ vector $IA2_i$ composed of interaction indicators (OCC31-OCC52)*(UNION) was incorporated into the analyses. The parameter of (OCC52)*(UNION) revealed an impact of over 8 % on earnings, implying that manufacturing workers obtain utility from unionization.

Vector $IA3_i$ composed of indicators (INSIDER)*(EXP) and (INSIDER)*(UNION) was introduced into equation (3) with the restriction $\alpha^8 = \alpha^9 = \alpha^{11} = \alpha^{12} = 0$. The interaction of insider position and work experience (INSIDER)*(EXP) revealed a weak positive impact on earnings, thus the multiplicative effect of these variables will only slightly reinforce the individual effects of these variables. Suprisingly, the estimated parameter of (INSIDER)*(UNION) revealed a negative impact on earnings, indicating that the interaction of insider position (permanent job) and unionization attenuate the individual effects of these variables.[16]

---

[15] It should be mentioned that in the case of upper management (OCC31) the negative interaction effect was almost significant at 5% level.

[16] This is contrast to a priori expectations obtained from union and insider-outsider models. A plausible explanation for this finding may be that the assumed positive multiplicative interaction impact between insider position and unionization is valid only in the case of low-paid blue-collar workers (occupation groups (OCC51) and (OCC52)).

Vector $IA4_i$ composed of interaction indicators (OCC31-OCC52)*(INSIDER) was introduced into equation (3) with the restriction $\alpha^8 = \alpha^9 = \alpha^{10} = \alpha^{12} = 0$. Estimated parameter α^{12} of indicator (OCC52)*(INSIDER) showed that manufacturing workers derive utility from their insider position.

Model 4 in Table B.1 in Appendix B represents our final model augmented with all the control variables and with selected significant interaction indicators, i.e. equation (3) is estimated with the restriction $\alpha^8 = \alpha^9 = \alpha^{10} = \alpha^{11} = 0$. The estimation results of model 4 show that in terms of R^2 nearly 45 % of earnings differentials can be explained by the variables used in the estimations. The standard deviation (SEE) also dropped further after the inclusion of the interaction indicators.

The results of interaction effects give the impression that the potential of models based on the 'non-market-clearing' tradition, such as efficiency wage and insider-outsider models, should be examined between different occupational groups. The results also reflect the difference between white- and blue-collar employees in negotiations on wages and working hours. Particularly in the case of senior officials and management flexible and firm-level labour contracts are widely used.

5.6 The importance of industry effects

Besides the question of the role of the little explored variables, the study also focuses on the importance of industry indicators in explaining individual earnings. In Table B.1 we report the results of a general F-test (see Appendix C) using the information of restricted and unrestircted models (measure F_2). The results suggest that the F_2 values obtained were all significant at the 1 % level and thus we may reject the hypothesis that wage differences do not depend on industry dummies.

According to studies made on Finnish data [(Asplund 1994), (Vainiomäki and Laaksonen 1992) and (Maliranta 1993)] measured personal and job characteristics account for the majority of explained industry wage differentials. The relative importance of industry affiliation in explaining the variation in earnings between Finnish industries is quite small. Similar findings have been obtained for the other Nordic countries too (Edin and Zetterberg 1992).[17]

Our results are consistent with these other studies. As an indication of the role of industry dummies in explaining earnings, the explained sum of squares increased by 2.7 percentage points once the vector of industry controls was added to an equation already controlled for vector representing marital status, gender, formal education, work experience, seniority, area of residence and unionization. In comparison, the inclusion of

---

[17] In comparison, in the USA industry effects seems to have a much greater role in explaining earnings determination than worker and job characteristics (Krueger and Summers 1988).

employee-sponsored training, part-time work and occupation increased R^2 by 4.6 percentage points.

Our rough comparisons also suggest that R^2 increased by nearly 2.4 percentage points once industry controls were added to an equation already controlled for all the other control variables but excluding the new variables (COMPUT), (2SHIFT), (3SHIFT), (INSIDER), (EFWAGE1) and (EFWAGE2). In comparison, the inclusion of the 'new' variables with the exclusion of industry dummies increased R^2 by 1.42 percentage points.

6. CONCLUDING REMARKS

In literature the competive view of the labour market is seen as inadequate in explaining industry wage differentials. The approach implemented in this paper, to estimate earnings equations with controls for complementary little explored or 'non-competitive' explanations of wage determination, tackles the question.

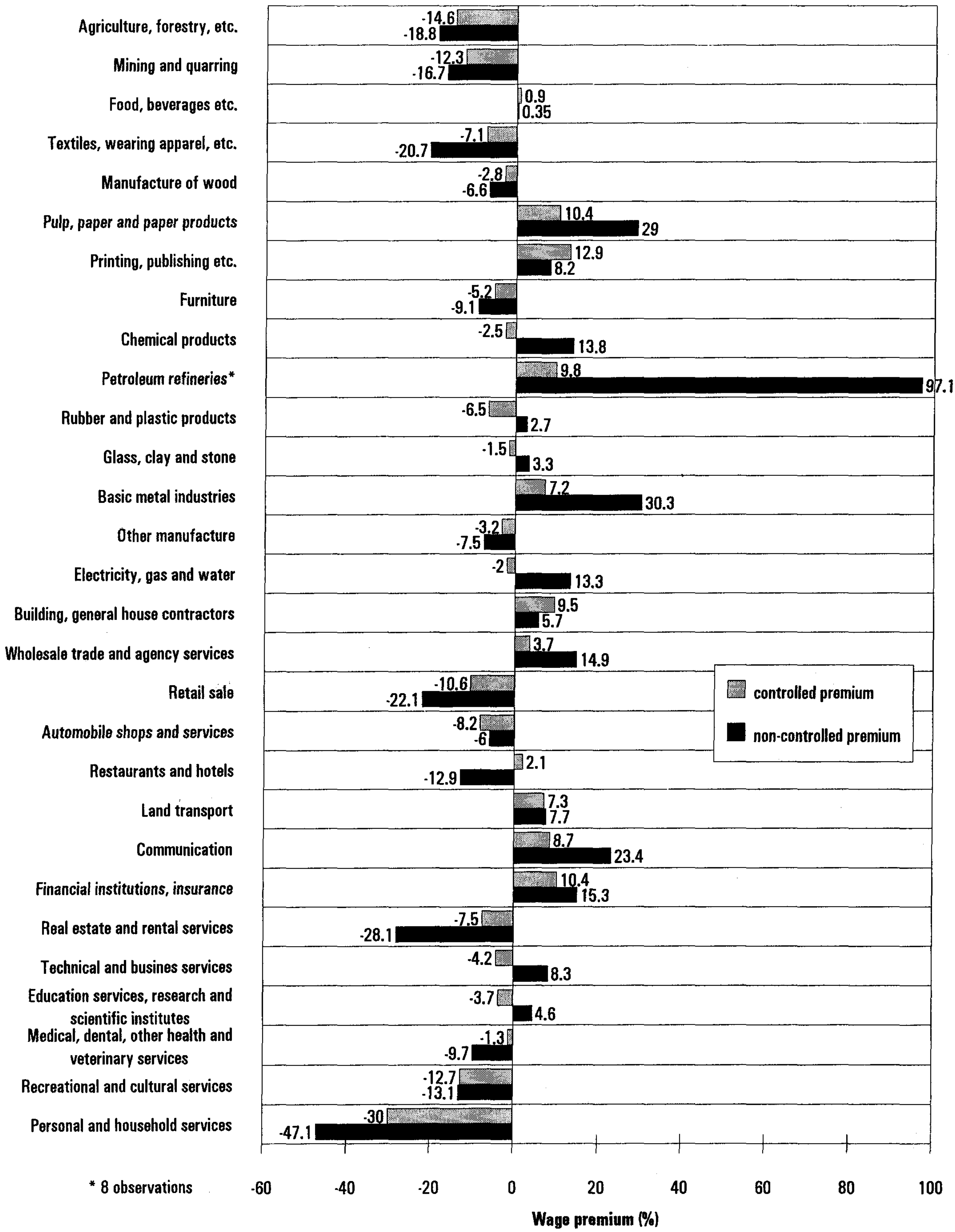
The general observation from estimations is that standard personal and job characteristics account for the majority of the explained industry wage differentials. Furthermore, standard explanations are more important determinants of wages than industry affiliation. These finding are consistent with the results of other studies made on Finnish data.

The results further suggest that 'new' complementary explanations have a role in explaining industry wage differentials. The use of computers in work, permanent job and flexible working hours increase individuals' earnings significantly. A detailed examination of the impact of computer technology on individuals' earnings could be an interesting area for future studies. More specifically, educationally and occupationally related computer use is a case of point.

However, the role of the new explanations in explaning wage differentials should not be overestimated. Comparisons of different models suggest that industry indicators account for wage differentials proportionately more than our new explanations. Besides, it is obvious that some unknown proportion of unmeasured labour quality differences will be picked up by the industry controls rather than all the other measurable controls available in our data set.

More complementary explanations are required to account for industry wage differentials. An indication of this need is the remaining large and significant industry wage premiums after controls for various indicators of wage determination in our data. A remedy to this problem could be found in the demand side of the labour market; detailed micro information on questions such as how work is organized, the size of a firm, the degree of a firm's export-orientation or the proportion of female employees, are required. So far, available data sets are not adequate to meet these requirements.

Figure 2. ***Wage premiums across industries 1989. The premiums are employment-weighted wage differences obtained from coefficient values of industry dummies. The controlled premiums are calculated from model 3 and the non-controlled premiums from model 1.***



References

Akerlof, G. and Yellen, J. (1986): Efficiency Wage Models of the Labour Market, Cambridge UP.

Asplund, R. (1993): Essays on Human Capital and Earnings in Finland, The Reseach Institute of the Finnish Economy, Series A 18, Helsinki.

Asplund, R. (1994): Human Capital and Industry Wage Differentials in Finland, Proceedings of the Symposium on Unemployment, VATT publications 14, Government Institute for Economic Reseach, Helsinki.

Carruth, A. A. ja Oswald, A. J. (1987): On Union Preferences and Labour Market Models: Insiders and Outsiders, The Economic Journal, June 1987.

Davis, S. (1992): Cross-Country Patterns of Change in Relative Wages, NBER Macroeconomics Annual 1992.

Edin ja Zetterberg (1992): Inter-Industry Wage Differentials: Evidence from Sweden and a Comparison with the United States, American Economic Review.

Eriksson (1991): Työmarkkinoiden toiminta, Kansantaloudellinen aikakausikirja 3/1991.

Eriksson, T. and Jäntti, M. (1993): The Distribution of Earnings in Finland, 1971-90, mimeo, Åbo Akademi.

Eriksson, T. (1994): Unemployment and the Wage Structure - some Finnish Evidence, Proceedings of the Symposium on Unemployment, VATT publications 14, Government Institute for Economic Reseach, Helsinki.

Gittleman, M. and Wolff, E. (1993): International Comparison of Inter-Industry Wage Differentials, Review of Income and Wealth.

Katz, L. (1986): Efficiency Wage Theories: a Partial Evaluation. In NBER Macroeconomics Annual, MIT press.

Krueger, A. (1993): How Computers Have Changed the Wage Structure: Evidence from Microdata, 1984-1989, The Quarterly Journal of Economics, February 1993.

Krueger ja Summers (1988): Efficiency Wages and the Inter-Industry Wage Structure, Econometrica, vol. 56.

Maliranta, M. (1993): Paperiteollisuuden palkat ja tehdasteollisuuden palkkarakenne, ETLA discussion paper 412.

Mincer, J. (1974): Schooling, Experience and Earnings, NBER, New York.

OECD (1993): High and Persistent Unemployment: Assesment of the Problem and its Causes.

Vainiomäki, J. and Laaksonen, K. (1992): Inter-Industry Wage Differences in Finland, 1975-85, Tampere Economic Working Papers 3/1992.

Data appendix A.

Table A.1 Definitions of included variables

Variable	Definition
Dependent variable:	
LOGWAGE	Natural logarithm of average monthly earnings (in FIM) calculated from before-tax annual wage income for main occupation from tax registers and the number of months worked.
Explanatory variables:	
IND1	Dummy=1; agriculture and forestry
IND7	Dummy=1; mining and quarrying
IND11	Dummy=1; food, beverages etc.
IND12	Dummy=1; textiles, wearing apparel etc.
IND141	Dummy=1; manufacture of wood
IND151	Dummy=1; pulp, paper and paper products
IND16	Dummy=1; printing, publishing etc.
IND17	Dummy=1; furniture
IND18	Dummy=1; chemical products
IND19	Dummy=1; petroleum refineries
IND21	Dummy=1; rubber and plastic products
IND22	Dummy=1; glass, clay and stone
IND231	Dummy=1; basic metal industries
IND24	Dummy=1; fabricated metal products, machinery etc.
IND29	Dummy=1; other manufacture
IND31	Dummy=1; electricity, gas and water
IND35	Dummy=1; building, general housing contractors
IND411	Dummy=1; wholesale trade and agency services
IND431	Dummy=1; retail sale
IND451	Dummy=1; automobile distributors and services
IND47	Dummy=1; restaurants and hotels
IND51	Dummy=1; land transport
IND57	Dummy=1; communication
IND61	Dummy=1; financial institutions, insurance
IND65	Dummy=1; real estate and rental services
IND71	Dummy=1; technical and busines services
IND85	Dummy=1; education services etc. institutes
IND87	Dummy=1; medical, dental, other health services
IND91	Dummy=1; recreational and cultural services
IND95	Dummy=1; personal and household services
MARRIED	Dummy=1; married
SEX	Dummy=1; male
EDUC1	basic education
EDUC3	Dummy=1; lower-level education
EDUC4	Dummy=1; upper-lewel of secondary education

(Table A.1 cont.)

EDUC5	Dummy=1; undergraduate university education
EDUC67	Dummy=1; university education (lower and upper level)
EDUC8	Dummy=1; researcher-level education
EXP	Work experience
EXP2	EXP*EXP
SENIOR	Years with the present employer (seniority)
SOUTH	Dummy=1; residence in the provinces of Uusimaa, Turku and Pori, Häme and Kymi
NORTH	Dummy=1; residence in the province of Oulu and Lappi
MIDDLE	Residence in central Finland (provinces of Vaasa, Keski-Suomi Kuopio, Mikkeli, North Carelia and Åland)
TRAIN	Dummy=1; employer-sponsored training during the year
PART	Dummy=1; employee working part-time
OCC31	Dummy=1; senior official and upper management
OCC32	Dummy=1; other senior official and employee in research and planning etc.
OCC41	Dummy=1; lower-level supervisors
OCC1	other lower-level official
OCC52	Dummy=1; manufacturing worker
OCC51	Dummy=1; other production worker
COMPUT	Dummy=1; employees working with computers
2SHIFT	Dummy=1; two-shift work
3SHIFT	Dummy=1; three-shift work
UNION	Dummy=1; unionized employee
INSIDER	Dummy=1; permanent job
EFWAGE1	Dummy=1; flexible working hours
EFWAGE2	Dummy=1; employee who can negotiate own working hours

Table A.2 Sample means and standard deviations by variables for all employers included in the data

Variable	Mean	Standard deviation
WAGE	8495.07	4308.02
LOGWAGE	8.94	0.4772480
IND1(1,0)	0.0244	0.1543601
IND7(1,0)	0.0017	0.0411484
IND11(1,0)	0.0437	0.2045589
IND12(1,0)	0.0336	0.1801519
IND141(1,0)	0.0305	0.1720391
IND151(1,0)	0.0359	0.1861831
IND16(1,0)	0.0329	0.1783855
IND17(1,0)	0.0085	0.0916975
IND18(1,0)	0.0180	0.1328728
IND19(1,0)	0.0027	0.0520225
IND21(1,0)	0.0146	0.1198894
IND22(1,0)	0.0163	0.1265591
IND231(1,0)	0.0092	0.0952623
IND24(1,0) (base group)	0.1197	0.3246673
IND29(1,0)	0.0051	0.0711499
IND31(1,0)	0.0125	0.1113257
IND35(1,0)	0.1051	0.3067605
IND411(1,0)	0.0570	0.2318217
IND431(1,0)	0.1126	0.3161330
IND451(1,0)	0.0264	0.1604955
IND47(1,0)	0.0515	0.2211398
IND51(1,0)	0.0485	0.2148378
IND57(1,0)	0.0078	0.0879832
IND61(1,0)	0.0488	0.2155493
IND65(1,0)	0.0353	0.1844831
IND71(1,0)	0.0475	0.2126859
IND85(1,0)	0.0092	0.0952623
IND87(1,0)	0.0176	0.1316360
IND91(1,0)	0.0142	0.1185076
IND95(1,0)	0.0092	0.0952623
EDUC1(1,0) (base group)	0.3835	0.4863256
EDUC3 (1,0)	0.3384	0.4732524
EDUC4 (1,0)	0.2045	0.4033867
EDUC5 (1,0)	0.0380	0.1911778
EDUC67 (1,0)	0.0346	0.1827649
EDUC8 (1,0)	0.0010	0.0318842
EXP	16.81	11.0581212
SENIOR	8.19	8.4647669
TRAIN (1,0)	0.3815	0.4858336
2SHIFT (1,0)	0.1234	0.3289878
3SHIFT (1,0)	0.0450	0.2148378

(Table A.2 cont.)

OCC31 (1,0)	0.0471	0.2119627
OCC32 (1,0)	0.0699	0.2549443
OCC41 (1,0)	0.0773	0.2671349
OCC1 (1,0) (base group)	0.2700	0.4439943
OCC52 (1,0)	0.3000	0.4583797
OCC51 (1,0)	0.2357	0.4244908
COMPUT (1,0)	0.4191	0.4934996
MARRIED (1,0)	0.5697	0.4952042
SEX (1,0)	0.5717	0.4949135
SOUTH (1,0)	0.6673	0.4712441
MIDDLE (1,0)(base group)	0.2265	0.4186487
NORTH (1,0)	0.1021	0.3027897
UNION (1,0)	0.6866	0.4643328
INSIDER (1,0)	0.9040	0.2945928
EFWAGE1 (1,0)	0.3964	0.4892334
EFWAGE2 (1,0)	0.0271	0.1624835
PART (1,0)	0.0702	0.25552
number of obs.	2949	

Table A.3 Number of observations, mean wages, standard deviations of mean wages and raw differences from average wages by industry

Industry	Number of obs.	Mean wage	Standard deviation	Differences from average wage (%)
IND1	72	7237.7	4213.34	-14.8
IND7	5	6512.77	1079.46	-23.3
IND11	129	8298.06	2997.44	-2.3
IND12	99	6576.9	3073.60	-22.6
IND141	90	7610.62	2577.83	-10.4
IND151	106	10294.56	2546.84	21.2
IND16	97	9743.9	5534.96	14.7
IND17	25	7351.07	2439.99	-13.5
IND18	53	10268.39	7313.79	20.9
IND19	8	16557.45	8104.64	94.9
IND21	43	9386	6050.0	10.5
IND22	48	8662.04	3454.46	1.9
IND23	27	10342.56	2458.36	21.7
IND24	353	9158	4440.53	7.8
IND29	15	7424.98	2086.85	-12.6
IND31	37	9289.54	3441.62	9.4
IND35	310	8904.86	3748.31	4.8
IND411	168	9789.16	4643.04	15.2
IND431	332	6615.65	3489.78	-22.1
IND451	78	7822.33	2914.46	-7.9
IND47	152	7207.43	2888.58	-15.2
IND51	143	8915.29	3696.35	4.9
IND57	23	10324.93	5501.96	21.5
IND61	144	9771.01	5438.10	15.0
IND65	104	6499.33	3363.46	-23.5
IND71	140	9679.15	5150.97	13.9
IND85	27	9219.43	5771.14	8.5
IND87	52	7901.79	4741.79	-6.9
IND91	42	8648.38	5250.51	1.8
IND95	27	4735.09	2016.27	-44.3
all industries	2949	8495.07	4308.02	

The classification of formal education

The Finnish Labour Force Survey provides information on formal schooling based on the classification in the Statistics Finland register. This classification shows the highest single course of education completed by each individual, as follows:

Upper secondary education:

3. lower level of upper secondary education

4. upper level of upper secondary education

Higher education:

5. lowest level of higher education

6. undergraduate level of higher education

7. graduate level of higher education

8. postgraduate or equivalent education (reseacher-level education)

In this study the level of formal education (EDUC3-EDUC8) is introduced as a classified variable and is based on the above classification. The 1989 Finnish Labour Force Survey only details formal education beyond primary education. Basic education equivalent to 9 years is common to all individuals with no formal schooling beyond primary education.

Occupational status

The Labour Force Survey comprises two-digit information on individuals' occupational status according to the standard Finnish classification of socio-economic groups in 1983 (CSO 1983). In the Finnish Labour Force Survey individuals are classified into three broad categories: upper-level salaried employees, lower-level salaried employees and manual workers. Each of the two categories of salaried employees is further divided into four subgroups. In the case of salaried employees the main criterion in the sub-division is the nature of the persons' occupation and work, in other words, the level of responsibility and intependency in working tasks. The sub-division of the category of manual workers is according to occupational group and industrial sector.

Upper-level employees with administrative, managerial, professional and related occupations:

31 Senior officials and upper management

32 Senior officials and employees in research and planning

33 Senior officials and employees in education and training

34 Other senior officials and employees

Lower-level employees with administrative and clerical occupations:

41 Supervisors

42 Clerical and sales workers, independent work

43 Clerical and sales workers, routine work

44 Other lower-level employees with adminintrative and clerical occupations

Manual workers:

51 Workers in agriculture, forestry and commercical fishing

53 Other production workers

54 Distribution and service workers

52 Industrial workers

In this study the indicators for different occupation levels are formed as follows. (OCC31) comprises group 31 (senior officials and upper management), (OCC32) comprises groups 32-34 (senior officials and employees in research and planning, senior officials and employees in education and training and other senior officials and employees), (OCC41) comprises group 41 (supervisors), (OCC52) comprises group 52 (industrial workers) and (OCC51) comprises groups 51, 53 and 54 (workers in agriculture, forestry and commercial fishing, other production workers and distribution and service workers). The (OCC1) indicator comprises other lower-level officials which is also treated as the base gategory.

Table A.4 ***The use of computers (COMPUT), unionization (UNION), permanent job i.e. insider position (INSIDER), flexible working hours (EFWAGE1) and ability to negotiate working time (EFWAGE2) by occupation groups. Percentages retained from the sample.***

	COMPUT	UNION	INSIDER	EFWAGE1	EFWAGE2
OCC31	77.0	39.6	97.8	73.4	10.8
OCC32	75.2	64.6	91.8	69.9	2.9
OCC41	58.3	76.8	96.1	51.8	2.6
OCC1	65.2	61.8	90.2	42.8	4.2
OCC52	22.5	83.5	90.6	25.1	0.8
OCC51	17.7	61.6	86.6	34.8	1.9
average	41.2	68.7	90.4	39.6	7.0

Appendix B.

Table B.1 Estimations of earnings function using cross-section data from Finnish Labour Force Survey for 1989. The dependent variable is log monthly earnings.

	model 1	model 2	model 3	model 4
Intercept	9.036**	8.331**	8.217*	8.215**
	(0.024)	(0.040)	(0.045)	(0.055)
Industry:				
IND1	-0.291**	-0.176**	-0.168**	-0.153**
	(0.058)	(0.051)	(0.051)	(0.051)
IND7	-0.265	-0.096	-0.142	-0.132
	(0.202)	(0.162)	(0.160)	(0.159)
IND11	-0.079	0.002	-0.002	-0.001
	(0.046)	(0.038)	(0.038)	(0.037)
IND12	-0.314**	-0.095*	-0.084*	-0.085*
	(0.051)	(0.042)	(0.042)	(0.042)
IND141	-0.151**	-0.033	-0.039	-0.032
	(0.053)	(0.043)	(0.043)	(0.043)
IND151	0.172**	0.149**	0.088*	0.099*
	(0.050)	(0.041)	(0.043)	(0.043)
IND16	-0.004	0.129**	0.111**	0.116**
	(0.052)	(0.042)	(0.042)	(0.041)
IND17	-0.178*	-0.075	-0.064	-0.070
	(0.093)	(0.074)	(0.074)	(0.073)
IND18	0.047	-0.009	-0.036	-0.015
	(0.066)	(0.054)	(0.054)	(0.053)
IND19	0.596**	0.141	0.083	0.091
	(0.161)	(0.129)	(0.129)	(0.127)
IND21	-0.056	-0.048	-0.078	-0.080
	(0.073)	(0.058)	(0.058)	(0.057)
IND22	-0.050	-0.013	-0.026	-0.031
	(0.069)	(0.055)	(0.055)	(0.054)
IND231	0.182*	0.084	0.059	0.057
	(0.090)	(0.072)	(0.072)	(0.071)
IND29	-0.160	-0.060	-0.043	-0.037
	(0.118)	(0.095)	(0.094)	(0.093)
IND31	0.042	-0.035	-0.031	-0.024
	(0.078)	(0.062)	(0.062)	(0.061)
IND35	-0.027	0.049	0.080**	0.097**
	(0.035)	(0.027)	(0.029)	(0.029)
IND411	0.056	0.040	0.026	0.033
	(0.042)	(0.037)	(0.037)	(0.036)
IND431	-0.332**	-0.119**	-0.123**	-0.113**
	(0.034)	(0.032)	(0.032)	(0.032)

(Table B.1 cont.)

	model 1	model 2	model 3	model 4
IND451	-0.144** (0.056)	-0.076 (0.048)	-0.096* (0.048)	-0.084 (0.047)
IND47	-0.221** (0.044)	0.042 (0.040)	0.010 (0.041)	-0.001 (0.040)
IND51	-0.008 (0.045)	0.074 (0.039)	0.060 (0.039)	0.072 (0.039)
IND57	0.128 (0.097)	0.060 (0.079)	0.073 (0.078)	0.087 (0.077)
IND61	0.060 (0.044)	0.099* (0.039)	0.088* (0.039)	0.088* (0.039)
IND65	-0.412** (0.050)	-0.086* (0.044)	-0.089* (0.044)	-0.091* (0.044)
IND71	-0.003 (0.045)	-0.035 (0.039)	-0.054 (0.039)	-0.044 (0.038)
IND85	-0.038 (0.090)	-0.053 (0.074)	-0.048 (0.073)	-0.045 (0.073)
IND87	-0.184* (0.067)	-0.030 (0.056)	-0.024 (0.056)	0.004 (0.056)
IND91	-0.223** (0.073)	-0.147* (0.061)	-0.147* (0.061)	-0.152* (0.060)
IND95	-0.719** (0.090)	-0.341** (0.074)	-0.325** (0.074)	-0.309** (0.073)
Marriage, gender, education, work experience, seniority, area of residence, unionization, firm-specific training, part-time work and occupation:				
MARRIED		0.039* (0.015)	0.033* (0.015)	0.034* (0.015)
SEX		0.257** (0.017)	0.255** (0.017)	0.251** (0.017)
EDUC3		0.063** (0.017)	0.064** (0.017)	0.065** (0.017)
EDUC4		0.133** (0.022)	0.131** (0.022)	0.132** (0.022)
EDUC5		0.220** (0.041)	0.205** (0.041)	0.215** (0.040)
EDUC67		0.459** (0.044)	0.458** (0.044)	0.463** (0.043)
EDUC8		0.481* (0.213)	0.522* (0.211)	0.525* (0.209)
EXP		0.022** (0.002)	0.021** (0.002)	0.011** (0.003)
EXP2		-0.001** (0.001)	-0.001** (0.001)	-0.001** (0.001)
SENIOR		0.004** (0.001)	0.004** (0.001)	0.003** (0.001)

(Table B.1 cont.)

	model 1	model 2	model 3	model 4
NORTH		0.020 (0.025)	0.017 (0.025)	0.016 (0.025)
SOUTH		0.085** (0.017)	0.071** (0.017)	0.069** (0.016)
UNION		0.063** (0.016)	0.056** (0.016)	0.297** (0.049)
TRAIN		0.081** (0.015)	0.060** (0.016)	0.059** (0.016)
PART		-0.040 (0.029)	-0.018 (0.029)	-0.021 (0.029)
OCC31		0.388** (0.038)	0.384** (0.037)	0.384** (0.037)
OCC32		0.195** (0.033)	0.199** (0.033)	0.106* (0.050)
OCC41		0.088** (0.030)	0.094** (0.030)	0.096** (0.029)
OCC52		-0.043 (0.027)	-0.032 (0.028)	-0.212** (0.061)
OCC51		-0.079** (0.025)	-0.050* (0.025)	0.053 (0.056)
Use of computers in work, shift-work, insider position and efficiency wages:				
COMPUT			0.070** (0.017)	0.070** (0.017)
2SHIFT			0.063** (0.022)	0.063** (0.022)
3SHIFT			0.136** (0.036)	0.127** (0.035)
INSIDER			0.092** (0.025)	0.088* (0.046)
EFWAGE1			0.032* (0.015)	0.023 (0.015)
EFWAGE2			0.034 (0.041)	0.032 (0.041)
Interaction effects of selected variables:				
(OCC32)*(EFWAGE1)				0.137* (0.056)
(INSIDER)*(EXP)				0.012** (0.002)
(INSIDER)*(UNION)				-0.261** (0.051)
(OCC52)*(INSIDER)				0.200** (0.058)
(OCC51)*(INSIDER)				-0.114* (0.056)

(Table B.1 cont.)

	model 1	model 2	model 3	model 4
R^2(adj.)	0.1151	0.4223	0.4334	0.4456
SEE	0.44894	0.35732	0.35389	0.35006
F	14.225	44.464	41.508	40.014
F_2	---	4.1084	3.6408	---
N of obs.	2948	2913	2913	2913

1 Standard errors are in parentheses. * is a significant estimate at the 5% level, ** is a significant esimate at the 1% level, R^2(adj.) is the adjusted coefficient of determination, SEE is the standard deviation, F is a measure of the overall significance of the estimated regression and F_2 is a measure of the joint significance of industry dummies at the1% level; $F_{.01}$ $(29,\infty)$ = 1.70. F_2 is obtained using the information of the restricted and unrestricted models.

Appendix C. *Method for testing the joint significance of industry effects*

General F testing provides a method for testing hypotheses for the parameters of the k-variable regression model:

(3) $$y_i = \alpha_1 + \alpha_2 X_{2i} + \ldots + \alpha_k X_{ki} + \varepsilon_i.$$

A hypothesis such as

(4) $$H_0 = \alpha_3 = \alpha_4 = 0$$

implying that some explanatory variables are omitted, can be tested by an F test expressed in terms of R^2 as follows:

(5) $$F = \frac{(R^2_{UR} - R^2_R)/m}{(1 - R^2_{UR})/(n-k)},$$

where R^2_{UR} and R^2_R are, respectively, the R^2 values obtained from the unrestricted and restricted regressions, *m* is the number of regressors omitted from the model, *k* is the number of parameters in the unrestricted regression and *n* is the number of observations.

Consider our earnings function (2): $\ln W_{ij} = I_j\alpha + X_i\beta + \varepsilon_{ij}$. Supposing that individuals' *i* log earnings in industry *j* are not affected by the vector of industry dummies I_j , we can write the hypothesis:

(6) $$H_0 : I_j = 0.$$

The restricted regression then becomes:

(7) $$\ln W_{ij} = X_i\beta + \varepsilon_{ij},$$

and the unrestricted regression is the earnings function (2).