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JOB TENURE IN FINNISH INDUSTRY

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ABSTRACT: This paper studies the effect of wages on the job tenure in the Finnish metal and forest industry using microeconomic data. The data come from administrative files of the Confederation of Finnish Industry and Employers. The data cover a period of 11 years starting from the first quarter of 1980 and contain several pieces of information on workers, jobs and plants. According to the results the wage groups of the workers and relative wage within a plant is positively related to the job tenure. Also the duration-dependent effects were estimated. The effect of wages is of considerable importance for persons who have been working for a long time.

KEY WORDS: Job tenure, employment, wages, industry.

TIIVISTELMÄ: Tässä tutkimusraportissa tarkastellaan palkkauksen vaikutusta työsuhteen pituuteen Suomen metalli- ja metsäteollisuudessa käyttäen yksilötason aineistoa. Tutkimusaineisto on saatu Teollisuuden ja Työnantajain Keskusliiton laajasta palkka-aineistosta. Tutkimusaineisto on vuosilta 1980-1990. Aineisto sisältää tietoja työntekijöistä sekä työ- ja toimipaikoista. Tutkimuksen tulosten mukaan palkkaryhmät ja työntekijän suhteellinen palkkataso ovat positiivisessa riippuvuussuhteessa työsuhteen pituuden kanssa. Palkkatason vaikutus on suurempi pitkään työssä olevilla henkilöillä kuin vasta yrityksen palvelukseen tulleilla henkilöillä.

AVAINSANAT: Työsuhteen kesto, työllisyys, palkkaus, teollisuus.

Contents

Tiivistelmä

Korkea työttömyys on tällä hetkellä Suomen talouden pahin ongelma. Työttömyysaste oli viime vuonna keskimäärin 18.5 prosenttia. Lisääntyneet työttömyydestä aiheutuneet kustannukset ovat lisänneet valtion velkaa voimakkaasti. Siitä huolimatta Suomessa on tehty suhteellisen vähän perustutkimusta työmarkkinoiden toimivuudesta käyttäen luotettavaa ja monipuolista yksilötason aineistoa. Tässä tutkimuksessa selvitetään työsuhteiden päättymiseen vaikuttavia tekijöitä Suomen teollisuudessa.

Työntekijöiden määrä väheni teollisuudessa voimakkaasti 1980-luvun aikana. Tässä tutkimuksessa pyritään selvittämään työsuhteiden päättymiseen vaikuttaneita tekijöitä sekä työvoiman siirtymistä pois teollisuuden palveluksesta. Tämä tutkimus täydentää aiempia palkkarakenteen muutosta selvittäneitä tutkimuksia (Kettunen ja Marjanen, 1992, Kettunen, 1993b,f, Kettunen ja Vartiainen, 1993 ja Kettunen, 1994c,d).

Tutkimuksen tarkastelu perustuu Teollisuuden ja Työnantajain Keskusliiton yksilötason aineistoon metalli- ja metsäteollisuuden työntekijöistä. Tutkimuksen seuranta-aineisto koottiin vuonna 1990 työsuhteensa päättäneistä työntekijöistä, joiden päättyneitä työsuhteita seurattiin työsuhteen alkuun saakka mutta enintään vuoteen 1980 asti. Noin 86 prosenttia tutkimusaineiston työntekijöistä oli aloittanut työsuhteensa tämän 11 vuoden seurantakauden aikana. Aineisto sisältää tietoja työntekijöistä sekä työ- ja toimipaikoista.

Tutkimuksen erityinen mielenkiinto liittyy siihen, miten palkkaus ja työehtosopimuksissa määritellyt työsuhteen ehdot liittyvät työsuhteen päättymiseen. Tutkimusaihe

on tärkeä mm. sen vuoksi, että työvoiman vaihtuvuudesta aiheutuu työnantajille kustannuksia.

Empiirinen tarkastelu tehdään ns. kilpailevien riskien malleja käyttäen. Työsuhteen päättyminen teollisuuden sisällä työpaikkaa vaihtamalla sekä teollisuuden palveluksesta poistumalla käsitellään näissä malleissa erillisinä tapahtumina, joihin vaikuttavia tekijöitä tutkimuksessa arvioidaan.

Tutkimuksen tulosten mukaan pitkään samassa työssä pysyneillä henkilöillä on yleensä suhteellisen korkea palkkataso. Heidän aloituspalkkansa ovat olleet korkeampia kuin lyhyen aikaa työssä pysyneillä henkilöillä. Alhaisen aloituspalkan saaneilla henkilöillä on yleensä kasvava palkkaprofiili, mutta heidän työsuhteensa päättyy kuitenkin yleensä melko nopeasti.

Korkealla työn vaativuustasolla (työehtosopimuksen palkkaryhmä) olevien henkilöiden vaihtuvuus on erityisen vähäistä. Vähäiseen työvoiman vaihtuvuuteen liittyy yleensä myös suhteellisen korkea toimipaikan sisäinen palkkataso. Alhaisella palkkatasolla on suurempi vaikutus teollisuudesta poistuvien henkilöiden työsuhteen päättymiseen kuin teollisuuden sisällä työpaikkaa vaihtaneiden työntekijöiden työsuhteen päättymiseen.

Tutkimuksessa arvioitiin lisäksi, miten palkkataso vaikuttaa työsuhteen päättymiseen työsuhteiden eri vaiheissa. Tulosten mukaan palkkatason alhaisuus nopeuttaa erityisesti pitkien työsuhteiden päättymistä. Pitkään työssä olevilla henkilöillä palkkaus muodostuu taloudellisesti merkittävämmäksi kuin lyhyen aikaa työssä olevilla henkilöillä.

1. Introduction

The econometric analysis of labour-market transition data has in recent years become an active area of empirical research. It is known also as a hazard-function approach to duration data analysis, where the transition intensity to a new state is modeled using econometric methods. In these studies the process of state-to-state is based on the lengths of certain spells of time. In Finland the length of spells of employment has not previously been the subject of any notable interest in econometric study.

This study analyses the dynamic features of transitions from employment in Finnish industry. Special emphasis is devoted to the effects of wages on the probability of exiting from a firm. We analyze whether the workers having lower wages differ from those having higher wages. In addition, we examine the effects of many other factors which have been stipulated in the labour agreements and which affect the probability of leaving the job.

The empirical analysis is carried out in the competing risk framework. It makes possible to take into account the feature that employment spells may be terminated by different outcomes. The data allow one to make a distinction between the workers who change their jobs within Finnish industry or leave it. The average

number of industrial workers in 1980 was 627 000. During the 1980's there was a remarkable decrease in the number of workers, since in 1990 there were only 556 000 workers left. This study sheds some new light on the process of leaving the firm and industry.

An exhaustive survey of the literature of the movements from unemployment to employment is found in Devine and Kiefer (1991). Job-matching models of Jovanovic (1979), Miller (1984), Gottschalk and Maloney (1985) and a search model of Albrecht, Holmlund and Lang (1991) incorporate uncertainty of wages or unobservable job-specific characteristics and constitute a theoretical framework for job-to-job transitions. In addition, there is a huge body of literature on the duration of employment (see Kiefer, 1988, Björklund and Holmlund, 1989, Lindeboom and Theeuwes, 1990a,b, Brown and Light, 1992, Gritz, 1993 and Becker and Lindsay, 1994).

Belzil (1993) has analyzed in a recent study the statistical relationship between accepted job duration and the job-to-job transition strategy using Canadian data. He found that jobs preceded by unemployment tend to be shorter than the jobs preceded by employment. For those who have comparative advantages in searching for a job choosing unemployment does not seem to raise the subsequent job duration. If similar reasoning is valid for Finland, we could expect that long spells of employment tend to be followed by job-to-job transitions.

This study is organized as follows. In the next section the theoretical background of the determination of

the wage is exposed briefly. The data of this study are presented in section 3. The econometric models and the results of estimations are presented in section 4. The concluding chapter summarizes and discusses the results of the study.

2. Determination of the Wage

This section presents and discusses a simplified version of the conventional search model by Stiglitz (1985). According to the basic assumptions the workers are continually searching for a higher paid job. Firms are assumed to pay the fixed training costs T for each entrant when they are entering the firm. The interest rate for the training costs is denoted by r. The workers quit when they find a better paid job. The workers leave the ranks of the workers at the rate of q(w). The quit function is assumed to depend on the present wage of the worker w. The workers are replaced by an equal number of new workers. The quit function acts like the depreciation factor on the human capital of the firm.

The production is characterised by the training costs, which are creating a flow of output per worker $f(T)$. The constant returns-to-scale property of the technology is assumed. The wage is the only decision variable. It is chosen to maximize the profits of the firm, which can be written as follows

$$(1) \qquad P = f(T) - w - [q(w) + r]T.$$

Since the free entry and constant returns-to-scale property of the technology is assumed, the zero-profit condition of firms is natural. Technically it is obtained by setting P = 0 in (1). The zero-profit condition is, however, a simplification which can be relaxed if deemed

necessary. As an implication the market clearing wage can be written as being equal to the production minus the training costs term. Clearly the wage is an increasing function of the production and a decreasing function of the quit rate and interest rate.

Implicitly the model describes the dynamic process of labour turnover. Let us assume that employed workers are identical and have the same search parameters. If for some exogenous reason the productivity of the workers decreases, their wage level will also decrease sooner or later. The decrease of the productivity may depend on the change of technology, motivation or health of the workers. In practice the decrease of wages takes place in terms of real wages. The worker does not get any raise in an inflation economy.

As a consequence of the wage dispersion the low-wage group will have a higher probability of leaving the firm. The workers sort themselves between employment and unemployment solely according to the opportunity cost of choosing unemployment. Then the model gives a prediction that low-wage workers would enter unemployment through quitting a job and leaving industry. In addition, one could expect that the low wage workers would seek better paid jobs and the job-to-job transitions would tend to be followed by higher wages.

The quit rate function is assumed to be a decreasing convex function. Stiglitz (1985) gives arguments why the quit rate function should have the given shape. In order to analyze the effect of the training costs, let the

subscripts denote the derivatives. Then the implicit-function rule of differentiation gives

$$(2) \qquad w_T = -P_{wT}/P_{ww} > 0,$$

since $P_{wT} = -q_w > 0$ and $-P_{ww} = q_{ww}T > 0$. Hence, the sign of w_T is determined by the sign of P_{wT}, which is positive. Consequently the wage is an increasing function of the training costs.

Setting $P = 0$ and differentiating with respect to w gives the optimal condition of the wages. It can be written as follows

$$(3) \qquad q_w(w) = -1/T.$$

The quit rate is a convex decreasing function. The tangency of the quit rate function with the straight iso-cost curve with slope $-1/T$ gives the optimal wage.

The reasons for quitting a firm can be classified into two categories. The workers quit the labour force or become voluntarily unemployed with probability $\mu(w)$ or alternatively they find better paid jobs. It is assumed that $\partial\mu/\partial w < 0$. For some workers an intervening spell of unemployment is observed immediately after they quit their job. For others consecutive employment is observed, since they quit their job in order to accept immediately a new one.

The probability of changing jobs depends on the number of searches during the search period s and on the

unknown wage offers. Wage offers are characterized by the distribution function F(w). The quit rate function can be written as follows

$$(4) \qquad q(w) = \mu(w) + s[1 - F(w)].$$

The probability that a worker finds a higher paid job is a product of the search activity s and the probability of finding an acceptable offer [1 - F(w)]. According to equation (4) the workers leave the ranks of the workers exponentially at the rate of q(w). The exponential distribution implies that a worker's expected tenure is E(t) = 1/q(w), where q(w) is the quit rate during each period.[1]

Job mobility induces expenditures on training for the recruiting firms. The optimal level of wages depends on the training costs. Lowering the relative wage of workers increases the quit rate. Therefore firms may be reluctant to lower the wage. Even though the workers are willing to work for less, they may consider it a temporary phase as they begin more actively to search for a new job.

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[1] Integrating by parts the remaining expected value of job tenure for any distribution can be written as follows $E(s) = \int_s^\infty tf(t)dt = sS(s) + \int_s^\infty S(t)dt$, where $f(t)$ is the density and $S(t)$ is the survivor function. For a worker entering a firm the expected value of job tenure $E(t) = \int_0^\infty S(t)dt$. In a case of exponential distribution $E(t) = \int_0^\infty \exp(-tq)dt = 1/q$.

Imperfect information on wages means that the firms can exploit the workers by using for some degree their monopoly power. They can keep the workers some time even though they pay less than the market clearing wage. Sooner or later the firms, however, lose the low paid workers to other firms. To some extent wage differentials reflect the exercise of monopoly power of firms.

External effects may affect the quit rate of a firm. If another firm increases the wage level in order to reduce its turnover costs, it increases the quit rate of the other firms. This finding raises an essential and interesting requirement for the data. The wage levels in the subsequent job of the worker should be higher than in the previous jobs if the argument of the wage gain is relevant.

3. Description of the Data on Job Tenure

3.1. Source, Structure and Descriptive Statistics of the Data

The investigation is based on data from the administrative files of the Confederation of Finnish Industry and Employers (TT). During a research programme conducted by The Research Institute of the Finnish Economy (ETLA) in collaboration with the Labour Institute for the Economic Research (PT) various samples were planned and taken. The cross section and panel data sets have been reported and analyzed in various studies (Kettunen and Marjanen, 1992, Kettunen and Vartiainen, 1993, Kettunen, 1993a,c, Kettunen 1994a,b and Asplund, 1994). The research programme on wages is interesting, because the vast data of TT have so far not been available for economic research, except for the study on sex discrimination of wages by Vartia and Kurjenoja (1992). Our study extends the previous investigation by analyzing the longitudinal data on the job tenure in Finnish industry.

The sample is based on the outflow of workers from employment. The files enable the researcher to document labour-market states occupied by individuals. The data are representative, because about 80 per cent of the Finnish industrial workers are working in the member firms of TT. The wage information is collected every quarter from all the blue-collar workers in the member firms.

The data are reliable, since they are obtained directly form the accounting figures of the firms. The number of workers is about 300 000 every quarter. The data have been primarily collected for the wage negotiations on the central and union levels. Also quarterly aggregate statistics are published using the data.

The sampling of spells of employment was made from the outflow of workers from the firms. The flow data generally lead to different kinds of models than the stock data as shown by Chesher and Lancaster (1983). About 55 000 persons left the member firms during 1990. In order to guarantee the random and seasonally representative sample, the workers were sorted into a random order and every 15th worker was picked from the outflow during 1990. This sample contains 3703 individuals who have experienced a transition from a job during 1990.

The workers in the three largest industries of the metal and forest industries were included to the final sample. The forest industry includes the wood and paper industry. A reason for selecting these industries is that the number of wage groups defined in the collective wage agreements is different between the industries. Some of the industries have too few observations in order to draw reasonable statistical conclusions about the effects of the wage groups. The selection of the three industries leaves 2929 workers in the sample.

Some of the workers in the sample have unbelievably high wages. These kinds of cases can occur if the workers have been working during a quarter only a few hours and

have got some parts of their earnings afterwards or in advance. The observations where the wage level exceeded FIM 110 were rejected. There were 30 excluded outliers. The final sample includes 2899 observations.

There are two kinds of transitions among the persons who left the firms. It can be observed from the data whether the workers immediately find another job in Finnish industry. Alternative forms of exit form a job may include transitions into non-participation. These alternative observations may include also workers who have found better paid jobs outside industry. Unfortunately we do not have information on the destinations of the persons who have left industry.

Every worker was followed backwards until they became employed in that particular firm. In this study we analyze the single spells of employment for each individual. The job tenure is considered to start if the worker has not obtained any income during the previous quarter. The follow-up went back to the year 1980. So the longest observed lengths of employment were 11 years in the sample.

About 14 per cent of the workers were working during the first quarter of 1980. It cannot be known if the workers were unemployed or employed in other firms in 1979. These workers were lost in the follow-up, because it would have been too expensive to go through hundreds of thousands of observations in order to get additional information for a few hundred workers. These observations are called censored, since the beginning of the employment

is not known to the researcher. The censoring is rather mild, but it has to be taken into account in econometric studies.

The quarterly information on the wages of the workers during the whole employment was compiled from the files of TT. Access to the reliable information on wages recording the sequence of actual wage payments throughout a spell of employment is a substantial advantage of this study. Access to administrative data has been a substantial advantage also in the recent studies of unemployment duration (see Solon, 1985, Katz and Meyer, 1990, Meyer, 1990 and Atkinson and Micklewright, 1991).

The dates of entry into and exit from a job is not known. Therefore the job tenure is calculated using the number of quarters during which the persons have been working. One could suspect whether the job tenure is accurately measured. There are, however, 11 years in the follow-up. That implies 44 different lengths of employment. It has been shown that the parameter estimates of transition models are not generally very sensitive to time aggregation in simple parametric or semi-parametric cases (see Bergström and Edin, 1992). So it can be argued that there is enough variation in the variable of interest.

Table 1 presents the descriptive statistics of the data. The workers who find new jobs within industry have been working in the firm on average 3.9 years, while the persons who do not find new jobs within industry have 2.5 years of experience in their jobs. Because 14 per cent of

the observations are censored, these figures do not represent the true job tenures. The notable difference in the job tenures supports the reasoning that job experience is related to the probability of finding new jobs within industry.

Those who move from one job to the next within industry are called movers. According to the descriptive statistics men are slightly overrepresented by the movers. Also the share of men is higher in the plants which the workers leave in order to get a job in industry. The persons who leave industry are called the leavers. The movers are nearly two years older than the leavers. The average age of men in the plant is slightly higher for the workers who relocate to other industrial firms. Women are older than men. The average age of men is 37.2 years in the whole sample whereas the average age of women is 41.3 years. Some plants have only male workers.

The high cost areas of Finland have been designated by the government. The areas include the largest towns, islands and Lapland. According to the collective wage agreements higher wages have to be paid in the high cost area. There are not remarkable differences in the high and low cost areas between the movers and leavers. Neither are there remarkable differences in the county of Uusimaa and the rest of the country.

The share of incentive hours is slightly higher in the firms where the persons leave in order to get a job from industry. This may indicate the strenuous nature of piece-rate work, because tired workers may search for

another job. In another study (Kettunen, 1994a) it has been shown that the hourly piece-rate wage based on the quantity of output is about 20 per cent lower for the persons who work all the time on a piece-rate basis compared to the persons who work only a small number of hours on a piece-rate basis. The shares of incentive hours based on quality and quantity are not different for the two destinations. The shares of overtime and sunday hours are not very different between the movers and leavers. Both the share of overtime and sunday work are on average around 4-5 per cent of all the working hours in a plant.

The means of the quarterly indicators show that the job-to-job movers change jobs most often during the last quarter of the year (47 per cent of the movers). On the other hand, the persons who leave their industrial jobs leave most often during the third quarter (42 per cent of the leavers). This conclusion is in great measure due to the considerable variation in the Finnish climate and annual holidays. The persons who are filling summer-time jobs or holiday vacancies start their studies or become unemployed when they leave the firm.

The wage groups are defined in the collective wage agreements according the required levels of skill in the job. The wage contacts are made in Finland on the level of trade unions, even though there are agreements on the central level. In practice it is impossible that the wage levels are related to similar kinds of requirements between the firms, even though this can be seen as one purpose of the wage agreements. There are three wage

groups in the metal industry and five groups in the forest industry.

The forest industry includes the wood and paper industries. The controlled wage effects of the wage groups are similar in these two industries (Kettunen, 1993c). Also the effects of wage groups on the job tenure were very similar. Therefore the wage groups in both the wood and paper industry were given joint indicators.

Most workers of the sample are on the middle levels of the wage groups both in the metal and forest industry. More often the persons on the highest levels of the wage groups move to the other industrial firms and the workers on the lowest levels leave industry. This characteristic of the data is more outstanding in the metal industry than in the forest industry. These findings support the reasoning that those moving from one job to the next in industry are often skilled workers.

The average relative wages of workers have been calculated in relation to the average wage of the plant and industry. The average relative wage of industry has been calculated using quarterly data over the whole spell of employment. Also the average relative wage of workers is calculated over the whole spell of employment. The average relative wage in Table 1 is calculated over the individuals. Concerning the average wage level in the plant there are data only on the year 1990. The relative wage in the plant is therefore a relative termination wage of a worker in a firm. There are two wage concepts in the data. The regular wage includes only the earnings based on

the ordinary hours of work. The total wage includes also the wage incrementals based on the overtime and sunday work.

The average relative total wage during the whole spell of employment for the persons who find new industrial jobs is clearly higher than the average relative wage for the workers who do not find new industrial jobs. The average relative total wage of the movers is 1.10 whereas the relative total wage of the leavers is 0.98. The higher wage of the movers is in accordance with the longer spells of employment. More experienced workers are usually better paid. The relative wage of the worker in a firm is clearly lower than the relative wage in industry. Low-wage firms are clearly overrepresented in the sample. The relative total wage of the movers in the firm is 0.96 whereas the corresponding wage for the leavers is 0.92.

These simple descriptive statistics of the data support the argument that wage differences between the workers in a firm create incentives for the workers to leave their employer. The results are in accordance with the prediction of the simple model of on-the-job search. Low-wage workers enter unemployment often by quitting their jobs and leaving industry.

Table 1. Descriptive statistics of the data on job tenure

The whole sample:

Variable	Mean	Std.Dev.	Minimum	Maximum
Job tenure, years	3.35	3.80	0.25	11.00
Sex, 1=male	0.79	0.41	0.00	1.00
Share of men, %	79.87	16.61	6.70	100.00
Age, years	33.10	11.83	15.00	65.00
Average age of men in a firm	37.17	3.28	25.00	47.00
Average age in a firm	38.04	2.76	26.00	47.00
High cost area, 1=yes	0.33	0.47	0.00	1.00
County of Uusimaa, 1=yes	0.16	0.37	0.00	1.00
Share of incentive work hours[1]	22.09	27.12	0.00	100.00
Share of incentive work hours[2]	27.69	34.15	0.00	100.00
Share of overtime hours, %	3.71	2.53	0.00	17.50
Share of sunday hours, %	4.44	4.38	0.00	18.10
Quarter, 1=yes: 1	0.20	0.40	0.00	1.00
2	0.15	0.36	0.00	1.00
3	0.29	0.46	0.00	1.00
4	0.35	0.48	0.00	1.00
Wage group, metal, 1=yes: 1	0.18	0.38	0.00	1.00
2	0.27	0.44	0.00	1.00
(low) 3	0.12	0.32	0.00	1.00
Wage group, forest, 1=yes: 1	0.10	0.29	0.00	1.00
2	0.10	0.31	0.00	1.00
3	0.11	0.31	0.00	1.00
4	0.07	0.25	0.00	1.00
(high) 5	0.06	0.23	0.00	1.00
Relative regular wage in industry	1.04	0.23	0.53	2.08
Relative total wage in industry	1.05	0.26	0.50	2.28
Relative regular wage in a firm	0.95	0.16	0.46	2.51
Relative total wage in a firm	0.95	0.18	0.40	2.36

The number of observations is 2899.

The workers who find new jobs in Finnish industry:

Variable	Mean	Std.Dev.	Minimum	Maximum
Job tenure, years	3.92	3.90	0.25	11.00
Sex, 1=male	0.82	0.39	0.00	1.00
Share of men, %	81.21	15.16	13.30	100.00
Age, years	33.83	11.27	16.00	64.00
Average age of men in a firm	37.44	3.10	25.00	47.00
Average age in a firm	38.22	2.69	26.00	47.00
High cost area, 1=yes	0.35	0.48	0.00	1.00
County of Uusimaa, 1=yes	0.14	0.35	0.00	1.00
Share of incentive work hours[1]	23.86	28.34	0.00	100.00
Share of incentive work hours[2]	27.26	33.45	0.00	100.00
Share of overtime hours, %	3.67	2.41	0.00	17.50
Share of sunday hours, %	4.70	4.52	0.00	18.10
Quarter, 1=yes: 1	0.20	0.40	0.00	1.00
2	0.12	0.32	0.00	1.00
3	0.21	0.40	0.00	1.00
4	0.47	0.50	0.00	1.00
Wage group, metal, 1=yes: 1	0.20	0.40	0.00	1.00
2	0.27	0.45	0.00	1.00
(low) 3	0.09	0.28	0.00	1.00
Wage group, forest, 1=yes: 1	0.08	0.27	0.00	1.00
2	0.10	0.29	0.00	1.00
3	0.11	0.32	0.00	1.00
4	0.08	0.27	0.00	1.00
(high) 5	0.07	0.25	0.00	1.00
Relative regular wage in industry	1.08	0.23	0.54	2.03
Relative total wage in industry	1.10	0.26	0.51	2.28
Relative regular wage in a firm	0.96	0.14	0.50	2.23
Relative total wage in a firm	0.96	0.17	0.40	2.21

The number of observations is 1707.

The workers who do not find new jobs in Finnish industry:

Variable	Mean	Std.Dev.	Minimum	Maximum
Job tenure, years	2.54	3.50	0.25	11.00
Sex, 1=male	0.76	0.43	0.00	1.00
Share of men, %	77.97	18.33	6.70	100.00
Age, years	32.07	12.52	15.00	65.00
Average age of men in a firm	36.78	3.48	25.00	47.00
Average age in a firm	37.79	2.83	26.00	47.00
High cost area, 1=yes	0.31	0.46	0.00	1.00
County of Uusimaa, 1=yes	0.19	0.39	0.00	1.00
Share of incentive work hours[1]	19.57	25.08	0.00	99.10
Share of incentive work hours[2]	28.30	35.16	0.00	100.00
Share of overtime hours, %	3.77	2.69	0.00	17.50
Share of sunday hours, %	4.07	4.15	0.00	18.10
Quarter, 1=yes: 1	0.21	0.41	0.00	1.00
2	0.19	0.40	0.00	1.00
3	0.42	0.49	0.00	1.00
4	0.18	0.39	0.00	1.00
Wage group, metal, 1=yes: 1	0.15	0.36	0.00	1.00
2	0.25	0.44	0.00	1.00
(low) 3	0.16	0.36	0.00	1.00
Wage group, forest, 1=yes: 1	0.12	0.32	0.00	1.00
2	0.11	0.32	0.00	1.00
3	0.11	0.31	0.00	1.00
4	0.05	0.22	0.00	1.00
(high) 5	0.05	0.21	0.00	1.00
Relative regular wage in industry	0.98	0.20	0.53	2.08
Relative total wage in industry	0.98	0.23	0.50	2.07
Relative regular wage in a firm	0.93	0.18	0.46	2.51
Relative total wage in a firm	0.92	0.19	0.42	2.36

The number of observations is 1192.

1. The incentive wage based on quantity (%).
2. The incentive wage based on quality and quantity (%).

3.2. Nonparametric Estimates of Job Tenure

It is useful to describe the data of job tenure using a simple nonparametric actuarial method. The life table method introduced by Cutler and Ederer (1958) is used to evaluate the distribution of job tenure. The method is widely used in statistical packages of transition data. The lengths of employment are divided into intervals and the midpoints of the intervals are used to locate the hazard, density and survivor functions.

If the persons are working during the first quarter of 1980, it can not be known when the persons started to work. These observations are censored. Censoring is taken into account in the estimations. In small cohorts there may constitute only a few observations in the later intervals. Then the estimated variances are not good approximations of the true variance. Therefore it is reasonable to use larger intervals for the longer spells. Because the actuarial method is well known, the full description of the procedure is omitted here to save space. Only the main characteristics of the method are summarized briefly.

The conditional proportion of exiting is the ratio of workers who leave the cohort during an interval and the risk set. The risk set in the life table is the estimated number of workers who are working during the interval. It is assumed that the censored observations are uniformly distributed over the interval. Hence the number of

censored observations is halved in order to take them into account in the risk set.

The value of the survivor function at the beginning of an interval can be calculated by multiplying the previous conditional proportions of staying over the intervals in the risk set. The estimate of the survivor function at the midpoint of an interval is an average of the survivor functions at the ends of the interval. The density function is calculated as a difference of the survivor functions at the ends of the interval divided by the length of the interval.

The hazard function is the ratio of the density and survivor functions at the midpoint of an interval. Consequently the hazard function of job tenure has been calculated for a unit of interval (year). The hazard function is sometimes called the instantaneous or conditional probability of exiting a risk set. It is a rate of two probabilities but not, however, a proper density, because its value is not necessarily less than one.

Tables 2-4 present the results of estimations. There is a remarkable difference between the two categories of the data. The hazard function of the workers who find new industrial jobs is clearly lower than the hazard function of the persons who leave industry. That is outstanding during the first 1.5 years of employment. Starting from the second year the hazard functions of the two groups are rather similar.

The descriptive statistics support the argument that more experienced and skilled workers tend to change their jobs within industry and less skilled workers leave industry. This is, however, only a preliminary outcome of the investigation of the data, which needs more rigorous analysis. In order to be able to better evaluate the nature of the many simultaneously affecting factors, a variety of variables must be controlled for. This will be done in the later sections of this study.

It can be seen that the first interval has the highest value of the hazard function, but also the later few intervals have high values. One reason for the short spells of employment is that the persons who are filling the summer-time or holiday vacancies leave the firms during the third quarter of the year.

The second reason for the short spells of employment is maternity leave. It is normally about 11 months in Finland. If the newcomer is filling a vacancy of a worker who is on maternity leave, the newcomer can expect a termination of the employment.

The third reason is that the temporary contract of employment can not renewed. Otherwise the worker has a permanent job, which may be expensive to the employer, because the job is terminable only if the employer gives two month's notice. Unfortunately we do not have information on holiday vacancies, maternity leaves or temporary contracts in the data.

The fourth reason for the short spells of employment is that there is a test period of three months for every

worker. If it turns out that the probationer does not fulfil the standards of the firm, the worker is dismissed after the three months. A period of three months has been continued often in two quarters. Since the dates of entry and exit are not known in the data, it is therefore classified as continuing two quarters.

In addition, it can be argued that the data probably reflect the fundamental features of industrial relations. Short spells of employment are typical for the assisting personnel. In addition, short spells may be related to the temporarily increased demand for the products of the firm. That may lead to recruiting of personnel with short contracts.

Figure 1 illustrates the hazard functions of the job tenure using slightly shorter intervals than in Tables 2-4. The intervals of a quarter were used up to four years. Thereafter half-year intervals were used. There is weak evidence about the seasonal effects. The workers who find new jobs have low values of the hazard function at 1, 2 and 3 years of employment. This reflects the seasonal demand for labour. If there is enough work to be done and hence possibilities to earn well, the workers are probably not seeking actively new job opportunities in other firms. In addition, the variation of the hazard function may reflect the typical increases of the wages at 1, 2 and 3 years. They are based on the accumulating seniority of the workers. According to economic theory wage increases decrease the labour turnover. It seems also that the

workers who leave industry have higher values of the hazard function over the short spells of employment.

Table 2. Life table of job tenure for the workers in Finnish industry

Interval in years (lower, upper]	Exiting	Conditional proportion exiting	Cen-sored	Risk set	Density	Cum. survival	Hazard
					Std.errors in parentheses		
0 -	913	0.315	0	2899	0.525	1.000	0.623
					(0.014)	(0.000)	(0.020)
0.5 -	416	0.209	0	1986	0.287	0.685	0.468
					(0.013)	(0.008)	(0.023)
1 -	256	0.163	0	1570	0.177	0.542	0.355
					(0.011)	(0.009)	(0.022)
1.5 -	212	0.161	0	1314	0.146	0.453	0.351
					(0.010)	(0.009)	(0.024)
2 -	80	0.073	0	1102	0.055	0.380	0.151
					(0.006)	(0.009)	(0.017)
2.5 -	104	0.102	0	1022	0.072	0.353	0.214
					(0.007)	(0.009)	(0.021)
3 -	84	0.092	0	918	0.029	0.317	0.096
					(0.003)	(0.009)	(0.010)
4 -	60	0.072	0	834	0.021	0.288	0.074
					(0.003)	(0.008)	(0.010)
5 -	51	0.066	0	774	0.018	0.267	0.068
					(0.002)	(0.008)	(0.010)
6 -	141	0.195	0	723	0.049	0.249	0.216
					(0.004)	(0.008)	(0.018)
7 -	39	0.067	0	582	0.014	0.201	0.069
					(0.002)	(0.007)	(0.011)
8 -	83	0.153	0	543	0.029	0.187	0.166
					(0.003)	(0.007)	(0.018)
9 -	33	0.072	0	460	0.011	0.159	0.074
					(0.002)	(0.007)	(0.013)
10 -	29	0.127	398	228	.	0.147	.
						(0.007)	

Total 2899, Complete spells 2501, Censored 398 (14 %).

Table 3. Life table of job tenure for the workers who find new jobs in Finnish industry

Interval in years (lower, upper]	Exiting	Conditional proportion exiting	Cen-sored	Risk set	Density	Cum. survival	Hazard
					Std.errors in parentheses		
0 -	381	0.223	0	1707	0.372	1.000	0.419
					(0.017)	(0.000)	(0.021)
0.5 -	219	0.165	0	1326	0.267	0.777	0.360
					(0.016)	(0.012)	(0.024)
1 -	171	0.155	0	1107	0.200	0.649	0.335
					(0.015)	(0.012)	(0.026)
1.5 -	151	0.161	0	936	0.177	0.548	0.351
					(0.014)	(0.012)	(0.028)
2 -	44	0.056	0	785	0.052	0.560	0.115
					(0.008)	(0.012)	(0.017)
2.5 -	90	0.122	0	741	0.105	0.434	0.259
					(0.011)	(0.012)	(0.027)
3 -	59	0.091	0	651	0.035	0.381	0.095
					(0.004)	(0.012)	(0.012)
4 -	43	0.073	0	592	0.025	0.347	0.075
					(0.004)	(0.011)	(0.011)
5 -	38	0.069	0	549	0.022	0.322	0.072
					(0.004)	(0.011)	(0.012)
6 -	113	0.221	0	511	0.066	0.299	0.249
					(0.006)	(0.010)	(0.023)
7 -	24	0.060	0	398	0.014	0.233	0.062
					(0.003)	(0.010)	(0.013)
8 -	60	0.160	0	374	0.035	0.219	0.174
					(0.004)	(0.009)	(0.022)
9 -	23	0.073	0	314	0.014	0.184	0.076
					(0.003)	(0.009)	(0.016)
10 -	25	0.158	266	158	.	0.171	.
						(0.009)	

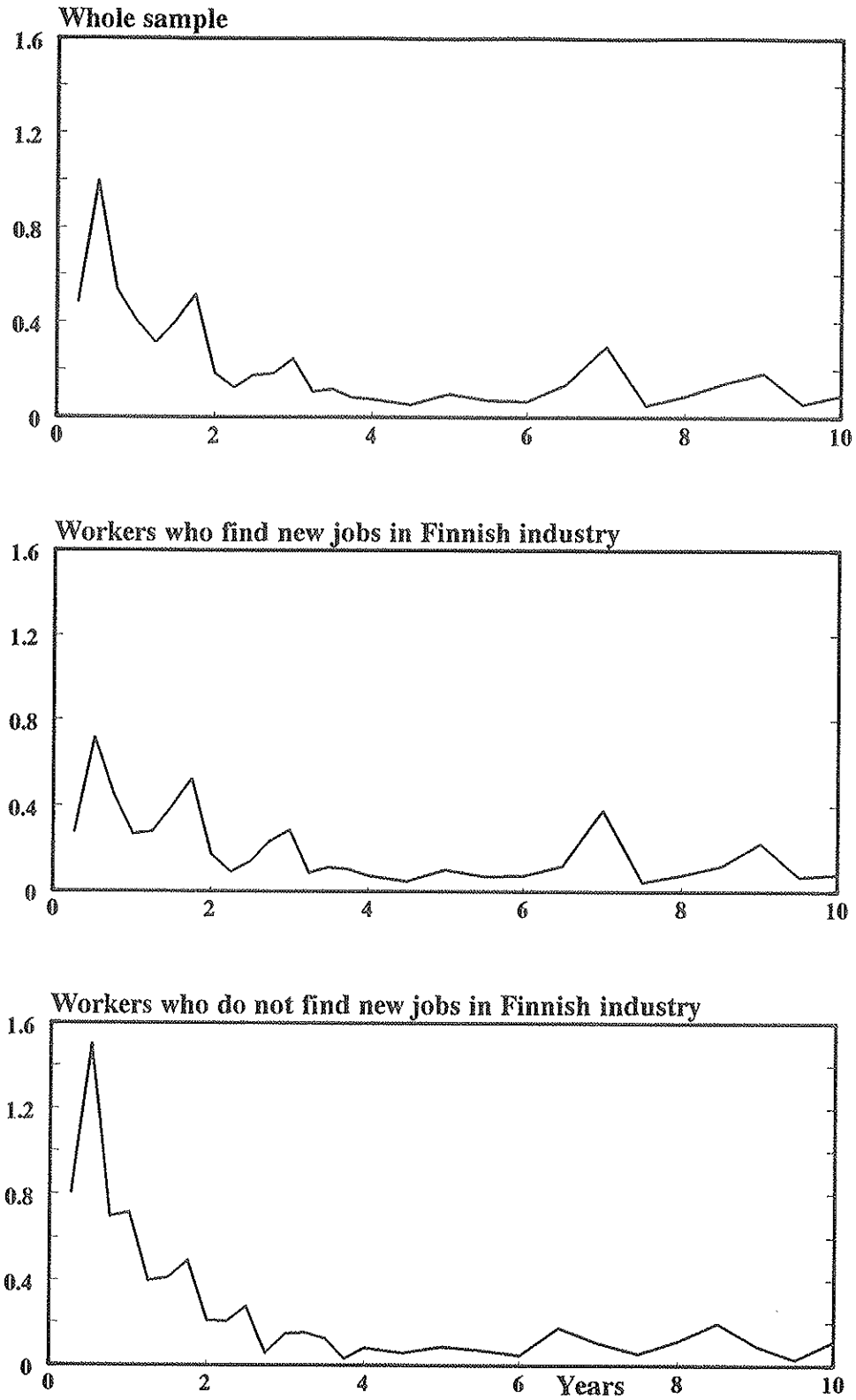
Total 1707, Complete spells 1441, Censored 266 (16 %).

Table 4. Life table of job tenure for the workers who do not find new jobs in Finnish industry

Interval in years (lower, upper]	Exiting	Conditional proportion exiting	Cen-sored	Risk set	Density	Cum. survival	Hazard
					Std.errors in parentheses		
0 -	532	0.446	0	1192	0.744	1.000	0.957
					(0.024)	(0.000)	(0.040)
0.5 -	197	0.299	0	660	0.331	0.554	0.702
					(0.022)	(0.014)	(0.049)
1 -	85	0.184	0	463	0.143	0.388	0.404
					(0.015)	(0.014)	(0.044)
1.5 -	61	0.161	0	398	0.102	0.317	0.351
					(0.013)	(0.013)	(0.045)
2 -	36	0.114	0	317	0.060	0.266	0.241
					(0.010)	(0.012)	(0.040)
2.5 -	14	0.050	0	281	0.024	0.236	0.102
					(0.006)	(0.012)	(0.027)
3 -	25	0.094	0	267	0.021	0.224	0.098
					(0.004)	(0.012)	(0.019)
4 -	17	0.070	0	242	0.014	0.203	0.073
					(0.004)	(0.011)	(0.018)
5 -	13	0.058	0	225	0.011	0.189	0.059
					(0.004)	(0.011)	(0.016)
6 -	28	0.132	0	212	0.024	0.178	0.141
					(0.003)	(0.011)	(0.027)
7 -	15	0.082	0	184	0.013	0.154	0.085
					(0.004)	(0.010)	(0.022)
8 -	23	0.136	0	169	0.019	0.142	0.146
					(0.004)	(0.010)	(0.030)
9 -	10	0.068	0	146	0.008	0.123	0.071
					(0.003)	(0.010)	(0.022)
10 -	4	0.057	132	70	.	0.114	.
						(0.009)	

Total 1192, Complete spells 1060, Censored 132 (11 %).

Figure 1. Nonparametric hazard functions of job tenure



3.3. Wage Profiles

Figure 2 illustrates the wage levels in 1990 prices for the persons who are leaving their jobs in 1990. The wage index of manufacturing is used as a deflator in order to eliminate the nominal and real increase of wages. Therefore the wages are expressed in terms of the wage level of 1990. Figure 3 illustrates the sequence of relative wages of the workers compared to the wages of all the workers who are working in each quarter. The aggregate wage level in industry have been used in these calculations. These figures are drawn for the four overlapping cohorts of workers who exit their jobs during the quarters of 1990.

Figures 2 and 3 have been drawn for two wage concepts which are the regular and total wage. The total wage includes the incrementals based on the overtime and sunday work. The persons who have found new industrial jobs have also obtained on average more wage incrementals. This finding can be used as an argument that the larger wage concept including wage incrementals is relevant in econometric studies.

A general remark is that the wage of the cohorts of all the workers are typically 3-10 per cent higher than the wage of the persons who are working. Only the cohorts of the workers who do not find new jobs in industry have lower average wages than the stock of the workers. Very strong conclusions can not be drawn about these figures, since many explanatory variables may affect these graphs.

In the next sections of this study many other variables are included in order to obtain independent effects of explanatory variables. For example, older workers who are well paid may be overrepresented in the group having long spells of employment.

Another remark about Figures 2 and 3 is that the average wage of the cohorts are decreasing during the five last years in a firm. If the relative wage of a worker decreases due to an exogenous reason, one might expect according to the economic theories that the worker will initiate on-the-job search. The decreasing average wage of the cohorts easily leads, however, to incorrect conclusions, because the distribution of job tenure strongly affects the average wage. Short spells of employment with low wages strongly affect the decreasing average wage of the cohorts. This can be concluded from the data analysis of wage profiles.

Figure 4 illustrates relative wage profiles of workers over their whole spells of employment. Usually wage profiles are derived from the studies of cross-section data, where the age of the workers is used as an explanatory variable. In our case the average wage profiles have been calculated for a group of persons who have experienced equal lengths of employment. To our knowledge this kind of information on the wage profiles has so far been unknown in Finland.

The wage profiles have been calculated for the job tenures of 1-7 years. In consecutive order the sample sizes are 76, 35, 48, 70, 91, 17, 10 and 8 workers,

respectively. The sample sizes are generally decreasing, because most spells of employment are short. Therefore there is more random variation in the groups of longer spells.

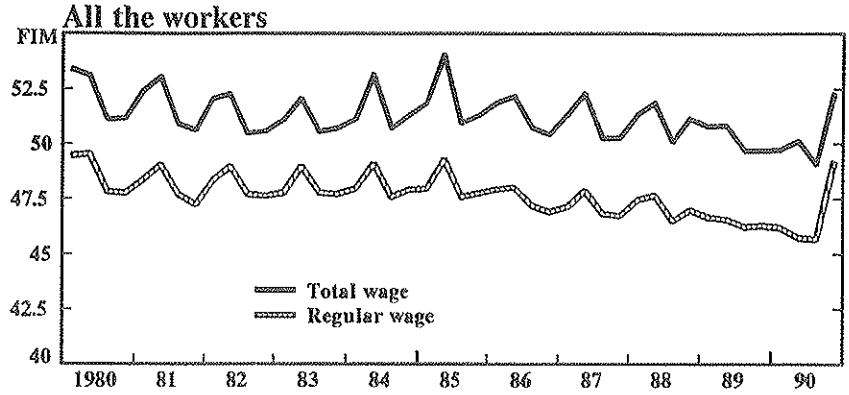
It can be seen that the wage profiles are increasing for the short spells of four years or less. The wage profiles are constant for the spells of five years or more. The workers with longer spells have on average higher wages than the workers who have short spells of employment. The wage differentials are rather small between the short- and long-term workers.

The regular starting wage of the persons who enter a firm has been equal or higher than the average regular wage of the stock of the workers in 1982 - 1985. The starting wage is important from the point of becoming employed. In order to increase the probability of becoming employed the stating wage should be low. In 1986 - 1989 the starting wages were lower than the average wage level. On the other hand, a low starting wage may, however, be a reason for an increasing wage profile. A low wage drifts within a few years towards the average wage level. A low starting wage is according to the figures correlated also to the faster turnover of labour.

Figure 5 illustrates the wage profiles for the workers who find and who do not find new jobs in industry when they exit a firm. The wage profiles have been calculated for 1, 2, 3 and 7 years. There are 76, 35, 48 and 70 observations for the workers who find new jobs and 91, 17, 10 and 8 observations for the rest of the workers,

respectively. According to the figures the wage profiles are increasing for the short spells of employment in both of the destinations. It turns out also that the relative wage level is clearly lower for the short-term employed persons who leave industry than for the persons who find new industrial jobs.

Figure 2. Sequence of the wage levels of the workers who left their jobs during 1990



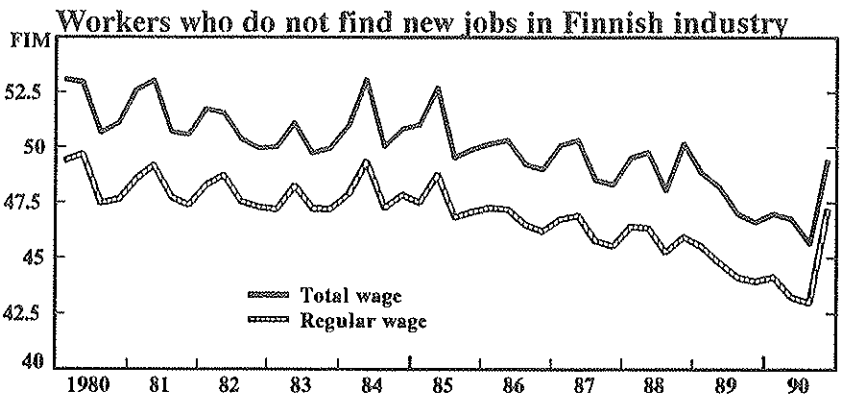
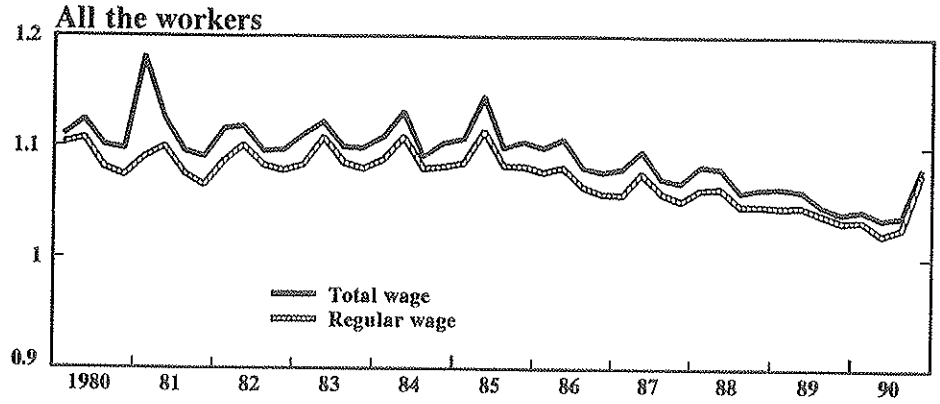
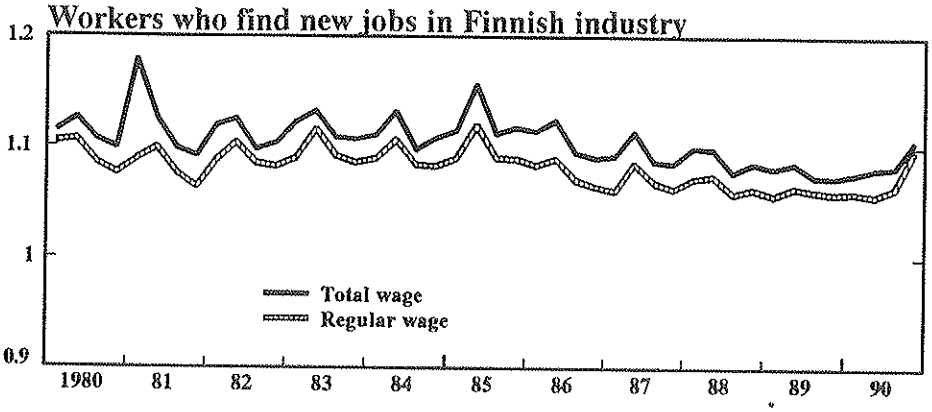


Figure 3. Sequence of the relative wages of the workers who left their jobs during 1990





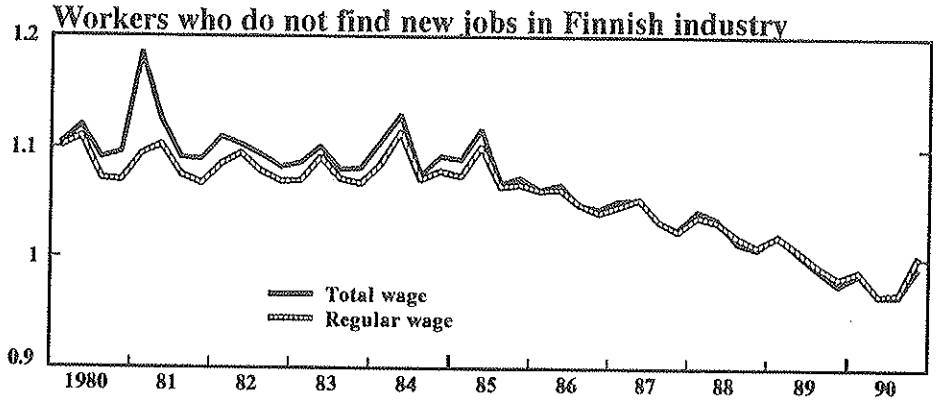


Figure 4. Wage profiles of relative wages by the job tenure

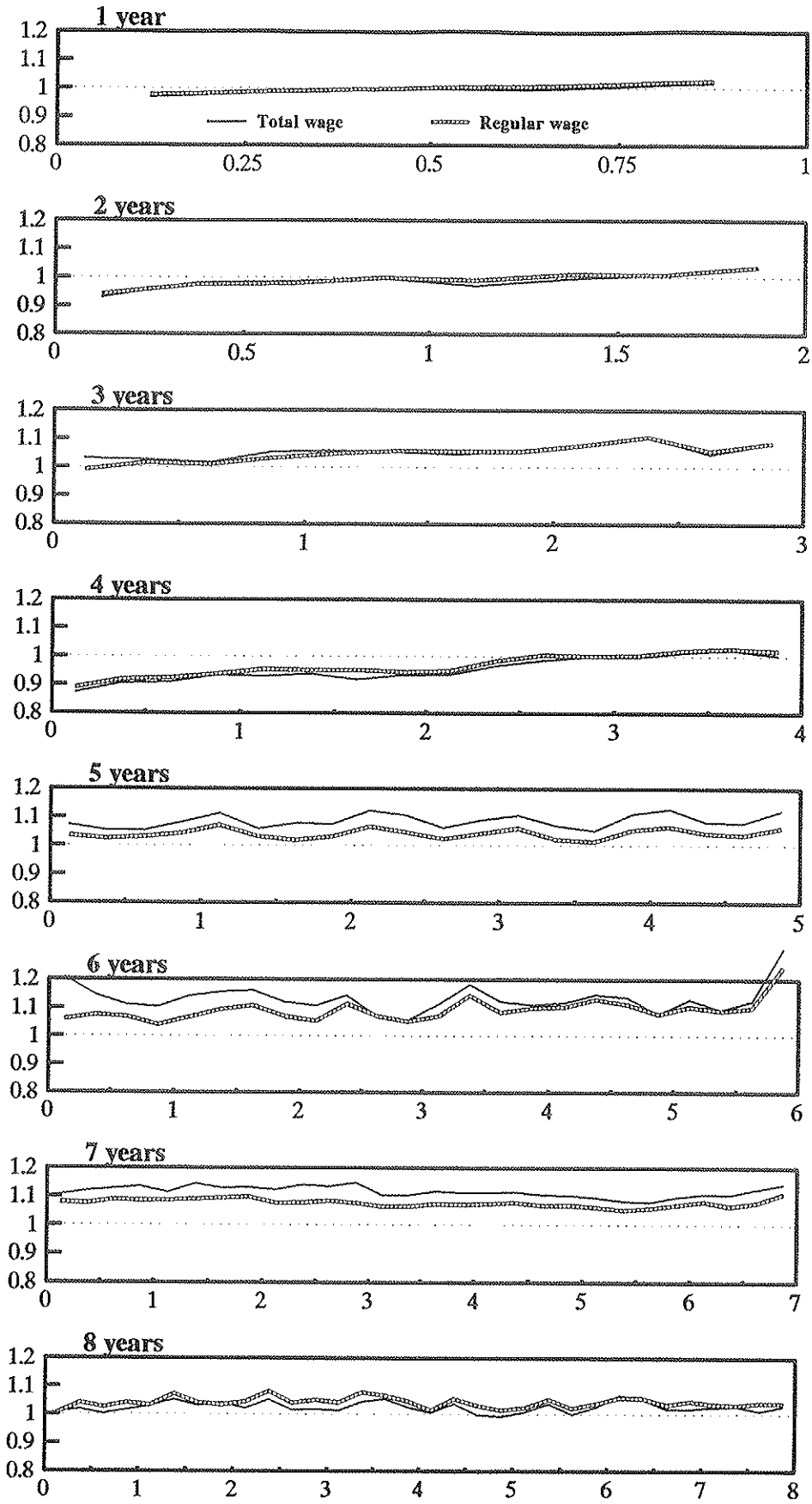
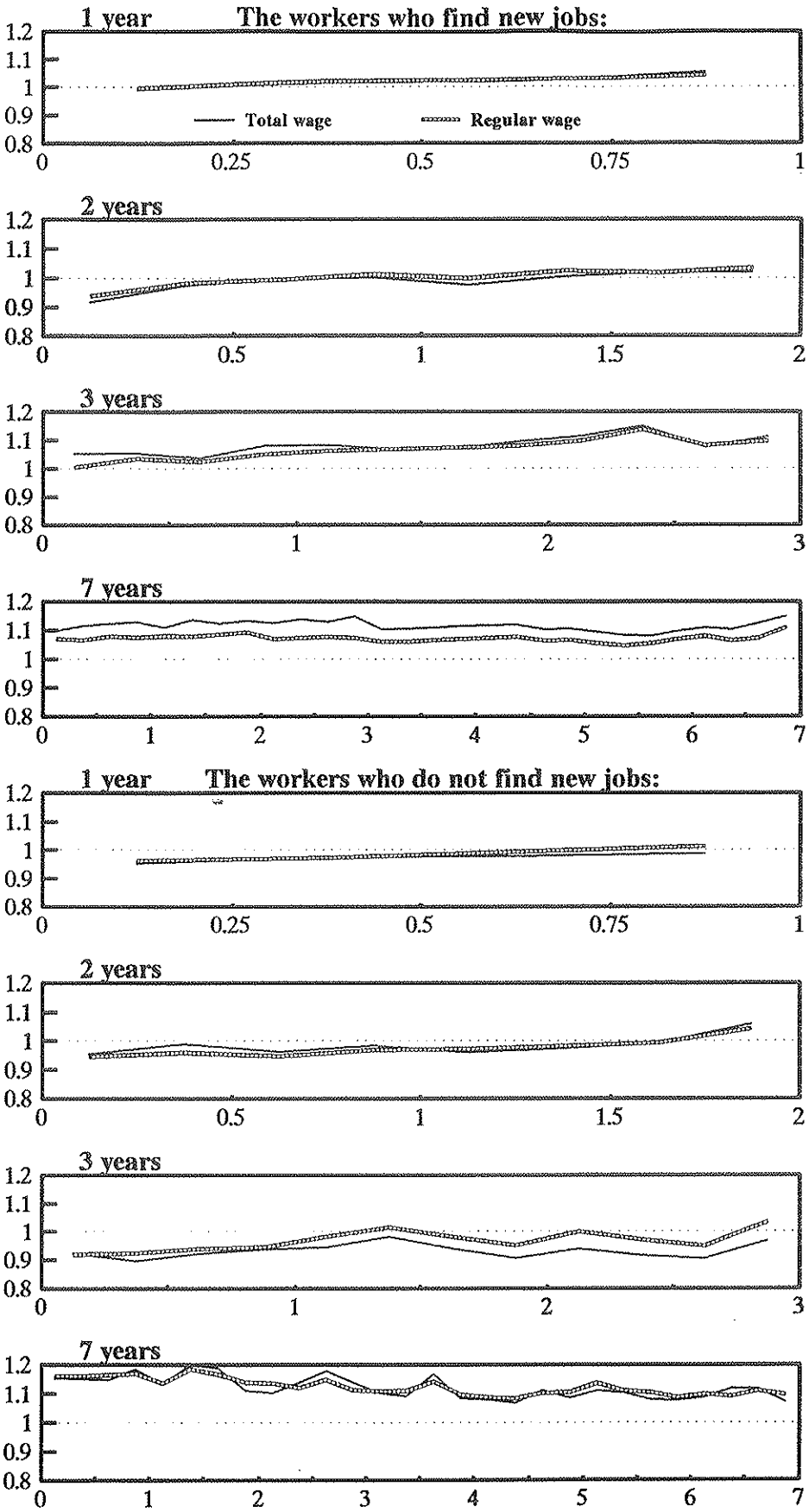


Figure 5. Wage profiles of the relative wages by the persons who find and who do not find new jobs in Finnish industry



3.4. Wage Level of the Subsequent Job

The wage level of the subsequent job is interesting from the point of on-the-job search. Better earnings opportunities in other firms may attract the workers to initiate a job search. There may, however, be other reasons for the termination of an employment than a search. Therefore the means of the wages in the subsequent jobs can not necessarily be used in order to give strong support to the wage gains implied by the search theory.

Table 5 illustrates the descriptive statistics of the levels of the termination and starting wages. The average wage levels have been calculated for the last quarter of an old job and for the first quarter of a new job. According to the data the persons who find new industrial jobs get on average only one per cent higher total wages during the next quarter in a new job. As the average growth rate of the wages from quarter to quarter during 1990 was two per cent, it can be concluded that on average the persons do not benefit from changing their jobs. These average figures of the data do not support the theory of search for a better paid job.

The persons who find new industrial jobs usually have higher wages in their previous jobs than the workers who leave industry. This can be seen as evidence for the discouragement of the workers. If the persons realize that they can not obtain better paid jobs within industry they leave the industrial firms. The opportunity cost of choosing unemployment is lower for a person who has a low

wage. Therefore these figures can be seen in that respect as evidence for a search theory.

According to a Swedish study (Björklund and Holmlund, 1989) a majority of job leavers report that they have received higher pay on the new job. The excess wage growth for job leavers is 7-8 per cent. On the other hand, a minority of job losers reported that they have received higher pay. Unfortunately there is no information on the voluntary leavers and job losers in our data.

Table 5. Descriptive statistics of the termination and starting wages of the workers who find and who do not find new jobs within industry

Variable	Obs.	Mean	Std.Dev.	Minimum	Maximum
Termination wage of the whole sample:					
Regular hourly wage	2899	45.63	9.30	23.00	104.88
Total hourly wage	2899	48.79	11.38	23.50	107.70
The workers who find new jobs:					
Termination wage					
Regular hourly wage	1707	47.36	9.07	23.50	104.88
Total hourly wage	1707	50.91	11.18	23.50	104.88
Starting wage					
Regular hourly wage	1707	47.74	8.40	23.62	99.63
Total hourly wage	1707	51.42	11.15	23.62	118.03
Termination wage of the workers who do not find new jobs:					
Regular hourly wage	1192	43.17	9.08	23.00	100.75
Total hourly wage	1192	45.75	10.99	23.50	107.70

The regular wage is based on ordinary working hours. The total wage includes the incrementals based on overtime and sunday work.

4. Econometric Models of Job Tenure

4.1. Competing Risk Models

The econometric approach of this study is to estimate models of job tenure. The models are used to identify the personal, job and labour-market characteristics that are related to the probabilities of finding another industrial job and leaving industry. The fact that there are alternative channels out from a firm is explicitly accounted for. A two-alternative competing risk model with censoring is an obvious candidate for analyzing the problem.

In a competing risk framework the destinations are assumed to be mutually exclusive and to exhaust the possible destinations. Let d_j be an indicator taking the value 1 if state j is entered and 0 otherwise. For a random variable T representing the waiting time until a particular event takes place the hazard function of a destination j can be written as follows

$$(5) \qquad h_j(t) = \lim_{dt \to 0} \Pr(t \leq T \leq t+dt,\ d_j = 1 | T > t)/dt.$$

$$= f_j(t)/S(t),$$

where $f_j(t)$ and $S(t)$ are the density and survivor functions. The transition intensities, $h_j(t)$, $j = 1,\ldots,J$, represent instantaneous rates for the worker leaving the

firm to enter state j during a small interval (t+dt) given that the person is still working in the firm. In a small interval the probability of the departure to state j is expressed by $h_j(t)dt$.

The cause-specific hazard functions related to the distinct destinations define the total hazard functions for job tenure as follows

$$(6) \qquad h(t) = \sum_{j=1}^{J} h_j(t).$$

The total hazard function is of relevance towards writing the integrated hazard

$$(7) \qquad I(t) = \int_0^t h(\tau)d\tau$$

$$= \int_0^t \sum_{j=1}^{J} h_j(\tau)d\tau$$

$$= \sum_{j=1}^{J} I_j(t).$$

The survivor function can then be written as follows

$$(8) \qquad S(t) = e^{-I(t)}.$$

S(t) is the probability that the person is still working in a firm. Then the probability of exiting to destination j, the density function, can be written as follows

$$(9) \qquad f_j(t) = h_j(t)S(t).$$

A complete or censored duration of employment is observed. Let c be a censoring indicator. If c = 1, then a complete spell of employment is observed, otherwise c = 0. The contribution of an individual to the likelihood function for a complete spell can be expressed using the density function. In the case of censoring the contribution comes via the probability that the duration was at least t units of time. The probability is expressed using the survivor function. The likelihood function can then be written as follows

$$(10) \qquad L(\theta) = \prod_{n=1}^{N} \prod_{j=1}^{J} h_j(t)^{cd_j} S(t),$$

where N is the size of the sample.

In order to solve the maximum likelihood estimates of the unknown parameters the sum of individual log-likelihood components is maximized with respect to the parameters. The log-likelihood contribution of an individual n for a failure type j can be written as follows

$$(11) \qquad \log L_n(\theta) = cd_j \log h_j(t) - I(t)$$

$$= cd_j \log h_j(t) - I_j(t) - \sum_{k \neq j}^{J} I_k(t).$$

The examination of equation (11) leads to a substantial advantage in estimating the model. It turns out that the log-likelihood contribution can be partitioned into separate terms of cause specific terms (see also Kalbfleich and Prentice, 1980, p. 168-171). Therefore the parameters of a particular cause specific hazard can be estimated separately by treating each time the durations terminated by other reasons as censored. So far the log-likelihood function (11) of job tenure has been written in a general form. The distribution of job tenure needs to be parametrized in order to estimate the model.

4.2. Discrete Mixing Distribution

In this section the econometric model of job tenure is studied. Special attention is paid to the effects of unobserved heterogeneity across workers. The mass point approach to the incorporation of the effects of unobserved explanatory variables is applied. A standard way of incorporating unobserved heterogeneity is to assume some parametric distribution for it. The estimates of the structural parameters may, however, be sensitive to the selected parametric form of the distribution.

The procedure of discrete mixing distribution has been derived in order to minimize the impact of distributional assumptions in the econometric models of duration data. Since the earlier work by Kiefer and Wolfowitz (1956) the properties of the mixing distribution have been studied by Simar (1976), Laird (1978), Lindsay (1983a,b) and Heckman and Singer (1984a,b). Furthermore, there exists a wide set of applications. Davies and Crouchley (1984), Dunn, Reader and Wrigley (1987), Davies (1987) and Card and Sullivan (1988) have applications in the context of discrete choice models. Brännäs (1986a,b), Trussell and Richards (1987) and Ham and Rea (1987) have applied the method in the context of duration models.

The Weibull distribution has been widely used in the applications of job tenure. (see Lindeboom and Theeuwes, 1990a,b and Lilja, 1990). Assuming a parametric Weibull distribution the mixing likelihood contribution for a destination j can be written as follows

$$(12) \qquad f_Q = \sum_{i=1}^{m} p_i h_i(t)^c e^{-I_i(t)},$$

where $h_i(t) = \alpha t^{\alpha-1} e^{u_i+x\beta}$ and $I_i(t) = t^{\alpha} e^{u_i+x\beta}$ are the hazard functions and integrated hazards for the different unobserved groups and m is the number of points of support of the discrete mixing distribution Q. The subscript j has been left out for convenience.

The indicator c = 1 if a complete spell and a destination j is observed, otherwise c = 0. The constant

of the basic Weibull model is split into the parameters u_i and the corresponding densities are given probabilities p_i. Hence, the discrete mixing distribution is consistently estimated with the structural parameters.

For the probabilities p_i it is required that $p_i \in (0, 1)$ and that $\Sigma\, p_i = 1$. These requirements are satisfied using a multinominal logit type of formula

$$(13) \qquad p_i = \frac{e^{g_i}}{1 + \sum_{k=1}^{m-1} e^{g_k}}, \quad i = 1,\ldots,m-1,$$

where g_k, $k = 1,\ldots,m-1$ are the parameters to be estimated. The logit formula implies that $p_m = 1 - p_1 - p_2 - \ldots - p_{m-1}$. The parameters g_k do not have an interesting economic interpretation. They work only as a device in order to obtain the probabilities p_i.

The standard errors of the probabilities p_i are approximated by the well-known delta method. The first order Taylor series expansion gives

$$(14) \qquad \hat{p_i}(g) = p_i(g) + (\hat{g} - g)' \frac{\partial p_i}{\partial g},$$

where $g = (g_1 \ldots g_{m-1})$. The variance can then be approximated by

$$(15) \qquad \mathrm{Var}[\hat{p_i}(g)] = \frac{\partial \hat{p_i}}{\partial \hat{g}}' \mathrm{Var}(\hat{g}) \frac{\partial \hat{p_i}}{\partial \hat{g}}.$$

The procedure for estimating a discrete mixing distribution is to increase the number of mass points until the influence of unobserved variables disappear. The stopping rule is found by Lindsay (1983a). Following Lindsay (1983a) and Heckman (1984b) it can be seen that the log-likelihood function $L(\theta)$ is differentiable. The Gateaux derivative of the functional L is taken at L_{Q_i} with i mass points towards $L_{Q_{i+1}}$, which can be written as follows

$$(16) \qquad D(u;Q) = \lim_{p \to 0} \{L[(1-p)f_{Q_i} + pf_{Q_{i+1}}] - L(f_{Q_i})\}/p$$

$$= \sum_{n=1}^{N} [(f_{Q_{i+1}} - f_{Q_i})/f_{Q_i}]$$

$$= \sum_{n=1}^{N} f_{Q_{i+1}}/f_{Q_i} - N.$$

The number of points of support is increased until $D(u;Q) \leq 0$. Then the procedure is stopped and the semi-parametric maximum likelihood estimator is obtained (see also Brännäs and Rosenqvist, 1988). A simple first order check for a global maximum is to verify that the second derivative $D''(u^*; Q) \leq 0$ at the support points of measure Q. The maximum likelihood algorithms can be used to estimate the unknown parameters when the number of mass points are fixed. In our case the Berndt, Hall, Hall and Hausman (1974) algorithm is used to estimate the unknown parameters.

According to the descriptive statistics the characteristics of the two destinations are in many respects different. It is not, however, possible to draw strong conclusions from these simple statistics. Also the explanatory variables may have different effects on the probability of exiting the firm. In order to evaluate the independent effects of explanatory variables, a variety of factors must be controlled for in the two different destinations.

Table 6 presents the results of the estimations. The estimation has been done in a competing risk framework separately to both of the destinations following the mass point approach of incorporating unobserved heterogeneity to the model. The number of observations is 2899 and the explanatory variables are the same in both of the groups. The data of the models differ only with respect to the indicators of the destinations.

Two points of support of the discrete mixing distribution are enough to rectify the effect of unobserved heterogeneity in the model for the persons who find new jobs. Unobserved heterogeneity split the observations into two groups having 32 and 68 per cent of the observations. It is not, however, possible to identify these observations from the data set. Correspondingly in the model of the persons who do not find new jobs three points of support are needed. They take the probabilities of 37, 30 and 33 per cent. Accordingly this group consists of more heterogenous workers.

According to the results the sex of the workers or the share of men in a firm do not have statistically significant effects on the probability of leaving a firm. Similar results were obtained in both of the destinations.

The age of the workers has a negative effect on both of the destinations. Older persons have longer spells of employment. The effect of age was studied also using the age squared and indicators for the age groups. These estimations show, however, a linear increasing effect of age. Therefore the age was included as a continuous explanatory variable.

The average age of the workers in a plant takes a negative coefficient. It indicates that the turnover of the labour force is small in the firms where the average age is high. It is, however, surprising that the average age of men has a positive effect for the workers who find new industrial jobs.

The high cost area is positively related to the exit rate for the persons who find new jobs. The high cost area is situated mainly in the southern part of the country. The islands and Lapland are also high cost areas, but there are rather few industrial jobs there. In the southern part of the country there are plenty of jobs available. That can be a reason for shorter job tenures. In the county of Uusimaa the labour turnover is high for the persons who leave industry. There are usually plenty of vacancies in Uusimaa. Most of them are not in the metal and forest industry.

The incentive work based on quality and quantity is negatively related to the exit rate for the persons who find new industrial jobs. The incentive work is better paid, but it is more effective. Another study shows that the incentive work is given to the skilled persons (Kettunen, 1994a). Therefore one reason for the negative signs of the coefficients of incentive work is that experience and a rather long job tenure is required until the person is accepted into incentive work schemes.

The share of overtime hours is positively related to the exit rate. A laborious job may exhaust the workers and therefore increase the exit rate. The share of sunday hours is negatively related to the exit rate for the persons who do not find new jobs.

The quarterly indicators are included into the model in order to take the non-stationarity of the economic environment into account. The job-to-job transitions are frequent during the third quarter. The exit rate from industry is high during the second and third quarter. One reason is that there are short job tenures during the summer when the ordinary staff has their summer holiday. For example, students often fill short summer-time or holiday vacancies. During the last quarter the turnover of labour is low. These findings are in line with the re-employment probabilities of unemployed workers (Kettunen, 1993b).

The wage group has been defined in the labour market agreements using the respective job requirements. In the metal industry the lowest wage group is denoted by number

three and in the forest industry it is denoted by number one. The reference group in the models is the wage group number three of the metal industry. It turns out that the wage groups with high requirements are negatively related to the exit rate. The coefficients of the indicators are similar in both of the destinations. These findings support the argument that highly skilled labour can not be replaced easily and therefore they are better paid.

The relative wage represents the average relative wage of the worker during the whole spell of employment. The relative wage of the worker is calculated in relation to the average wage of industrial workers. The relative wage is negatively related to the exit rate for the persons who do not find new jobs within industry. This is a result which was expected by the economic theory. A low wage increases incentives to seek another job or go back to school.

It is little bit surprising that the relative wage is positively related to the exit rate for the persons who leave the firm in order to get another industrial job. These persons have on average higher wages than the persons who leave industry. Those moving from one job to the next within industry have on average one per cent higher starting wage in the new jobs than their wage was during the last quarter of their previous job. If these persons are highly qualified, the employer tries to keep some of these persons by offering an increasing wage profile and paying more than to others. Then we will find a positive relationship between the wage and the exit

rate. This finding needs, however, a more rigorous analysis, which is done in the next section of this study.

Also the models using the deflated average wage levels during the whole spell of employment were estimated. The models with the wage levels gave, however, similar kinds of results as the relative wages. The relative wages were used, because they led to higher values of the log-likelihood functions. Therefore the results based on the wage levels have been omitted to save space.

Table 6. Results of estimations of the models of job tenure

(A) The persons who find new jobs in industry
(B) The persons who do not find new jobs in industry

	(A)	(B)
Shape parameter	1.505	1.330
	(0.065)	(0.075)
Sex, 1=male	-0.099	0.009
	(0.103)	(0.134)
Share of men	-0.059	0.456
	(0.355)	(0.461)
Age, 10 years	-1.015	-0.613
	(0.051)	(0.046)
Average age of men, 10 years	1.221	0.381
	(0.379)	(0.481)
Average age of workers, 10 years	-2.180	-0.871
	(0.433)	(0.542)
High cost area, 1=yes	0.194	-0.188
	(0.085)	(0.116)
County of Uusimaa, 1=yes	0.037	0.541
	(0.095)	(0.130)
Share of incentive hours[1]	0.010	-0.248
	(0.161)	(0.224)
Share of incentive hours[2]	-0.319	-0.087
	(0.127)	(0.159)
Share of overtime hours	8.498	9.497
	(1.367)	(1.958)
Share of sunday hours	-0.666	-4.183
	(1.162)	(1.647)
Quarter 2, 1=yes	-0.216	0.388
	(0.115)	(0.138)
Quarter 3, 1=yes	0.101	0.881
	(0.096)	(0.131)
Quarter 4, 1=yes	-0.046	-1.101
	(0.096)	(0.138)
Wage group, metal, 1=yes: 1	-0.538	-0.535
	(0.140)	(0.194)
2	-0.255	-0.537
	(0.122)	(0.167)
(reference group, low) 3		
Wage group, forest, 1=yes: 1	0.020	0.010
	(0.182)	(0.225)
2	-0.232	-0.160
	(0.158)	(0.209)
3	-0.728	-0.362
	(0.159)	(0.207)
4	-1.265	-1.494
	(0.196)	(0.259)
(high) 5	-1.634	-1.640
	(0.219)	(0.281)
Relative wage in industry	1.505	-1.492
	(0.065)	(0.217)
p_1	0.315	0.375
	(0.040)	(0.078)
p_2	0.685	0.296
	(0.040)	(0.133)
p_3		0.329
		(0.211)
Log likelihood	-3474.7	-2504.0

1. The incentive wage based on quantity (%).
2. The incentive wage based on quality and quantity (%).

The data include also information on the average wage of the plant in 1990. Unfortunately the data do not include the average wage of the plant over the whole period of study. The plant data can be used in order to calculate the relative wages of the workers within the plant. The average wage of the plant can be remarkably different from the average wage of industry. These differences can be reasons for workers to search for better jobs.

The results based on the relative wages within the plants are presented in Table 7. The other structural parameters are only slightly different from the previous estimates in Table 6. Therefore they have been omitted. Also the log-likelihood functions are quite near the previous values. The number of mass-points are the same as in the previous models.

It turns out that the relative wage of the worker is negatively related to the exit rate in both of the destinations. According to the evidence the relative wage within a plant has a statistically significant effect on the exit rate. The relative wage within the plant is more important than the relative wage within industry. Also the descriptive statistics are in accordance with these estimates, because the relative wages on the plant level are lower than the relative wages on industrial level.

The negative effect of the wage is also in these models larger for the persons who leave industry. The effect of the wages for those moving from one job to the next in industry is negative, statistically significant

but rather small compared to the other destination. The small value of the coefficient can to some extent reflect the positive effect caused by the employer who tries to keep these workers in a firm by offering an increasing wage profile.

Table 7. Results of estimations of the models of job tenure using the relative wage within a plant

(A) The persons who find new jobs in industry		
(B) The persons who do not find new jobs in industry		
	(A)	(B)
Relative wage within a plant	-0.370	-1.836
	(0.195)	(0.247)
Log likelihood	-3489.0	-2500.4

Other explanatory variables are: Sex, share of men, age, average age of men, average age of workers, indicators for the high cost area and county of Uusimaa, share of incentive hours, share of overtime hours, share of sunday hours, indicators for quarters and indicators for wage groups.

The economic importance of the explanatory variables of the model on the job tenure is illustrated by a way of example for a fictive person in industry. For the illustration the expected value of a job duration has to

be derived. The survivor function is obtained from the mixing likelihood contribution by setting c = 0. It can be written as follows

$$(17) \qquad S(t) = \sum_{i=1}^{m} p_i e^{-I_i(t)} .$$

Thus the expected value of the job tenure can be written as follows

$$(18) \qquad E(T) = \int_0^{\infty} \sum_{i=1}^{m} p_i e^{-t^{\alpha} e^{u_i+x\beta}} dt$$

$$= \sum_{i=1}^{m} p_i e^{-(u_i+x\beta)/\alpha} \Gamma(1/\alpha)/\alpha,$$

where Γ is the gamma function and the integration is done by a change of variables letting $I_i = t^{\alpha} e^{u_i+x\beta}$.

Let the fictive person be a 30-year-old woman. During the first quarter of 1990 she left a plant where the share of men is 50 per cent, the average age is 30 years for the men and women, the share of incentive work is 0.2 and the shares of overtime and sunday work are 0.02. She is working in the metal industry and the required level of skill in her job was the lowest level (number 3). Her wage was on an average level in a plant. The plant is situated not in the county of Uusimaa and the location is classified not to be in the high cost area.

The effects of the changes of the explanatory variables on the job tenure are presented in Table 8. It can be seen that there is a prominent increase in job tenure when the wage group (the required level of skill) increases. The wage groups do not leave very much explanatory power for the relative wage. Also the elderly persons have long durations of employment. Long durations are found from the plants where the average age of workers is high. The persons who leave industry during the last quarter have had long periods of employment.

Table 8. Effects of explanatory variables on the expected duration of employment for a person

The change of the explanatory variable	The change of the expected duration of employment	
(A) Movers (B) Leavers	(A)	(B)
Gender: female → male	-0.1	-0.2
Share of men: 0.5 → 1.0	-0.0	0.1
Age: 30 → 40 years	2.0*	2.8*
Average age of men: 30 → 40 years	-1.2*	-1.1
Average age: 30 → 40 years	6.9*	5.2
High cost area: no → yes	-0.3*	0.9*
County of Uusimaa: no → yes	-0.1	-1.5*
Share of incentive hours[1]: 0.2 → 0.8	-0.2	1.0*
Share of incentive hours[2]: 0.2 → 0.8	0.2*	0.6
Share of overtime hours: 0.02 → 0.10	-0.8*	-1.9*
Share of sunday hours: 0.02 → 0.10	-0.1	2.1*
Quarter: 1 → 2	0.5*	-1.0*
Quarter: 1 → 3	-0.2	-2.0*
Quarter: 1 → 4	0.1	7.4*
Wage group 3 (metal) → 2 (metal)	0.2*	2.3*
Wage group 3 (metal) → 1 (metal)	0.5	6.0*
Wage group 3 (metal) → 1 (forest)	-0.0	-0.2
Wage group 3 (metal) → 2 (forest)	0.2	0.4
Wage group 3 (metal) → 3 (forest)	1.2*	1.2
Wage group 3 (metal) → 4 (forest)	2.7*	8.6*
Wage group 3 (metal) → 5 (forest)	3.8*	10.3*
Relative wage: 1.0 → 0.8	-0.1*	-1.1*
1.0 → 1.2	0.1*	1.4*

1. The incentive wage based on quantity (%).
2. The incentive wage based on quality and quantity (%).
* Statistically significant coefficient on the 5 % level.

4.3. Duration-Dependent Effects of Wages

In this section the relationship of wages and the job tenure is analyzed over the different lengths of employment. The economic importance of the wage on the decision to leave the firm can be different for the persons who have been working for a short or a long period. Using the microeconomic data it is shown that the wage level and relative wages are important for the persons who have been working for a long time in a firm. A low wage makes the jobs in other firms more attractive. The findings support the argument that the wage level is not an important reason to leave a firm for a person who has entered the firm some time ago.

There are in principle many ways to specify the wages and duration dependency in an econometric model.[2] The profiles of relative wages over the job tenure are usually constant or slightly increasing. In the case of the time trend the beginning-of-spell or the end-of-spell values would under- or overestimate the relevant wage level. Therefore the duration-dependent wages are replaced with

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[2] In the models of transition data the duration-dependency can be classified into three categories: 1) The covariates vary over the duration while the coefficients are fixed. 2) The covariates and their coefficients take different values in the intervals. 3) The covariates are fixed, but the coefficients are duration-dependent.

their within spell average. The variation of wages across the workers is used to estimate the duration-dependent effects.

One suspicion about the specification is that the time-trended variation of the covariates may be absorbed by the baseline hazard. In our case there is a large variation in the wages and the systematic part of the hazard across the workers. Therefore it is possible to distinguish between the duration dependency and sample heterogeneity (see Elbers and Ridder, 1982).

A proportional hazards assumption is commonly used in the models of transition data. The hazard function $h(t) = h_0(t)h_1(x)$ factors into the product of a function of the baseline hazard $h_0(t)$ and function of the explanatory variables $h_1(x)$. It implies constant effects of explanatory variables over the duration. The method used in this study relaxes the assumption. The probability of leaving a firm may change over the job tenure, because the effect of wages is not constant.

For simplicity it is assumed that the effects of wages remain constant within predefined intervals. Consider A intervals of job tenure $(t_0, t_1], \ldots, (t_{A-1}, t_A]$ with $t_0 = 0$ and $t_A = 11$. The hazard function of the Weibull model with time-dependent effects can be written for $t_{a-1} < t \leq t_a$, $a = 1, \ldots, A$, as follows

$$h(t) = \alpha t^{\alpha-1} e^{x\beta+w\beta_a}, \tag{19}$$

where the parameters β capture the constant effects of explanatory variables and β_a, a = 1,...,A, capture the duration-dependent effects. In our case x stands for an individual's vector of explanatory variables which are constant over time and w is the average relative wage within the spell of employment.

The constant effects within the intervals are assumed in order to obtain a closed-form expression for the integrated hazard. It is obtained by integrating by parts the hazard functions of the intervals. The integrated hazard in the interval a can be written as follows

$$(20) \qquad I(t) = \sum_{s=1}^{a-1} [I_s(t_s)-I_s(t_{s-1})] + [I_a(t)-I_a(t_{a-1})].$$

In the Weibull case, for instance, in the third interval, $I(t) = t_1^{\alpha} e^{x\beta+w\beta_1} + (t_2^{\alpha} - t_1^{\alpha}) e^{x\beta+w\beta_2} + (t^{\alpha} - t_2^{\alpha}) e^{x\beta+w\beta_3}$.

Short intervals would enable detailed analysis of the time-dependent effects. Such an analysis would lead, however, to a small number of observations in the intervals and to the larger standard errors of the time-dependent parameter estimates. In order to get robust results only three intervals were used and the time points were chosen in order to obtain a large number of observations in each of the intervals. The chosen intervals are (0, 1], (1, 3] and (3, 11] years. The number of observations in these intervals are 1329, 652 and 918, respectively.

The duration-dependent effects make the log-likelihood function more complicated than in the previous

section. The likelihood contribution of an individual can be written as follows

$$(21) \qquad \ell = \prod_{a=1}^{A} \left[\prod_{i=1}^{m} p_i h_i(t)^{c} e^{-I_i(t)} \right]^{D_a},$$

where D_a is an indicator for the interval. If $t_a < t \leq t_{a+1}$, then $D_a = 1$, otherwise $D_a = 0$. For an individual the first product is simply a density function, which is determined by the interval.

The results of estimations of the duration-dependent wage effects are presented in Table 9. The parameter estimates of the structural parameters do not differ remarkably from the models with fixed covariates presented in Table 6. The log-likelihood functions of the models with duration-depended effects of wages take, however, clearly higher values. Therefore the models with duration-dependent effects are preferred.

Two points of support for the discrete mixing distribution are enough to rectify the unobserved heterogeneity in both of the models. The duration-dependent effects of wages explain a certain portion of the unobserved heterogeneity, since the need to increase the number of points of support is now less than in the model with fixed covariates.

A general remark about the results of duration-dependent wage effects is that the effects of wages on the duration of employment are more important for the persons who have been working for a long time. Therefore the

determination of the wage is very important for these persons if the employer wants to keep them in the firm. The change of the wage coefficient over the job duration is large for the persons who leave industry. If a person who has been working for a long time has a relatively low wage, it is more probable that he or she leaves industry than changes his job within industry.

The effects of wages on the exit rate are negative except for the workers who find new jobs within industry and have been working for somewhat less than three years. The starting wage of these persons has been on average lower than the average. A low starting wage is obviously one reason why the wage profiles have been increasing. It seems, however, that the wage profiles have been too flat. The job duration remains short because the workers find better jobs. The persons who have been working at most one year received on average 3.4 per cent regular wage gains in the new job while the others lose -0.4 per cent. These findings support the argument that the workers who are relatively low paid search more actively for a better paid job within industry.

Table 9. Results of estimations of the models of job tenure with the duration-dependent effects of wages

(A) The persons who find new jobs
(B) The persons who do not find new jobs

	(A)	(B)
Shape parameter	2.069	1.869
	(0.092)	(0.097)
Sex, 1=male	-0.081	0.115
	(0.100)	(0.109)
Share of men	0.168	0.393
	(0.348)	(0.366)
Age, 10 years	-0.972	-0.489
	(0.055)	(0.041)
Average age of men, 10 years	1.055	0.364
	(0.377)	(0.377)
Average age of workers, 10 years	-2.012	-0.740
	(0.431)	(0.429)
High cost area, 1=yes	0.188	-0.050
	(0.082)	(0.097)
County of Uusimaa, 1=yes	0.049	0.476
	(0.093)	(0.105)
Share of incentive hours[1]	-0.071	-0.256
	(0.162)	(0.192)
Share of incentive hours[2]	-0.299	-0.123
	(0.124)	(0.135)
Share of overtime hours	7.214	6.383
	(1.306)	(1.565)
Share of sunday hours	0.442	-1.507
	(1.110)	(1.413)
Quarter 2, 1=yes	-0.193	0.352
	(0.110)	(0.116)
Quarter 3, 1=yes	0.060	0.879
	(0.094)	(0.110)
Quarter 4, 1=yes	-0.033	-0.758
	(0.094)	(0.128)
Wage group, metal, 1=yes: 1	-0.484	-0.466
	(0.132)	(0.154)
2	-0.287	-0.406
	(0.114)	(0.129)
(reference group, low) 3		
Wage group, forest, 1=yes: 1	0.025	-0.009
	(0.169)	(0.175)
2	-0.272	-0.224
	(0.149)	(0.163)
3	-0.698	-0.355
	(0.155)	(0.166)
4	-1.114	-1.150
	(0.193)	(0.230)
(high) 5	-1.445	-1.176
	(0.223)	(0.249)
Relative wage in industry, (0, 1] years	1.471	-1.202
	(0.207)	(0.206)
Relative wage in industry, (1, 3] years	0.927	-2.863
	(0.087)	(0.113)
Relative wage in industry, (3, 11] years	-0.326	-4.448
	(0.154)	(0.199)
p_1	0.178	0.429
	(0.031)	(0.106)
p_2	0.822	0.571
	(0.031)	(0.106)
Log likelihood	-3374.3	-2298.6

1. The incentive wage based on quantity (%).
2. The incentive wage based on quality and quantity (%).

5. Conclusions

This study on job tenures is based on quarterly data of blue-collar workers from the administrative files of the Confederation of the Finnish Industry and Employers. Every 15th worker was picked from the outflow of employment during 1990. The final sample contains 2899 individuals who have experienced a transition from a job in the metal or forest industries during 1990. The follow-up of the job tenure and wages went back to the year 1980. The job tenure is calculated using the quarters of the year. About 14 per cent of the workers are censored, because some of the persons were working during the first quarter of 1980.

Usually wage profiles of workers are estimated from the studies of cross-section data. In our study the wage profiles are illustrated for groups of persons over their spells of employment. The wage profiles are increasing for the short spells of four years or less. The wage profiles are constant for the spells of five years or more. The wage differentials are rather small between the short- and long-term workers. The workers who have long spells of employment have on average higher wages than the workers who have short spells.

The starting regular wage of the workers who have long spells of employment is higher than the average wage level of the stock of the workers. For the short spells of employment the starting wages have been lower than the average wage level. An increasing wage profile is related

to the low starting wages, short employment and faster turnover of labour.

In the data there are two kinds of transitions among the persons who left the firms. The workers can immediately find another job within industry or they may leave industry. About 59 per cent of the workers found another industrial job and 41 per cent of workers left industry. The relative wage level is lower for the persons who leave industry. This gives support to the search models. For the low wage workers the opportunity cost of unemployment is lower. Therefore the low wage workers are expected to leave industry.

The models of job tenure were estimated in a competing risk framework. According to the results of estimations the age of the workers has a negative effect on both of the destinations. Older persons have longer spells of employment. The average age of the workers in a plant takes a negative coefficient. It indicates that the turnover of the labour force is small in the plants where the average age is high. The average age of men takes a positive coefficient for the persons who find new industrial jobs.

The high cost area is positively related to the exit rate for the persons who find new jobs. In the county of Uusimaa the labour turnover is high for the persons who leave industry. The incentive work has negative coefficients. The share of overtime hours is positively related to the exit rate. The share of sunday hours is negatively related to the exit rate for the persons who do

not find new jobs in industry. The industry job-to-job transitions are frequent during the third quarter. The exit rate from industry is high during the second and third quarters. During the last quarter the turnover of labour is low.

The required level of skill, which is the wage group of the collective wage agreements, is negatively related to the exit rate. The coefficients of the indicators are similar in both of the destinations. The turnover of workers is higher in the jobs which have low requirements. This remark supports the argument that highly skilled labour can not be replaced easily and therefore they are better paid.

The relative wage of the worker with respect to the aggregate wage level in industry is negatively related to the exit rate for the persons who do not find new jobs within industry. A low wage increases incentives for seeking better paid jobs or going back to school. On the other hand, the wage is positively related to the exit rate for the persons who leave the firm in order to get another job. These workers are better paid than the others within industry. It seems that these workers are able to compete for better jobs in the other industrial firms.

The relative wage of the worker with respect to the wage level in the plant is negatively related to the exit rate. The relative wage within the plant is remarkably lower than the average wage in industry. These differences are reasons for workers to search for better paid jobs. It turns out that the low relative wage within the plant

spurs workers to search for better paid jobs. The negative relationship of the wages is larger for the persons who leave industry.

Also the duration-dependent effects of relative wages within industry were estimated. It turned out that the effects of wages on the exit rate are more important for the persons who have long spells of employment. The effect of wages was the most notable for the persons who had been working for a long time and left industry when leaving the firm. The wage effect was positive for the workers who find new jobs within industry and have been working for somewhat less than three years. These workers are characterized by low starting wages, increasing wage profiles and better paid jobs in other industrial firms.

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