HUMAN CAPITAL AND WAGE FORMATION

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ABSTRACT: This study uses linked employer-employee data from Finland over the period 1989-1996 to examine human capital, wage formation and its relation to firm characteristics such as high wages in large firms. The mean wage differential between plants in the 10^{th} and 90^{th} size classes equals 21% of the overall mean wage. R&D-intensive firms have an average 10% percent higher wages. One can show that human capital based on educational competencies cannot explain the differences. Compensations on education are transferable and widely dispersed over all firms, and the firm-size effects are modest. Unobserved human capital is less transferable. Compensations for unobserved human capital consist of high wages of the individual throughout his/her work career not explained by experience, sex or education. It is shown that unobserved human capital explains most of the higher wages in large firms. The second reason for the firm-size premium is that in large R&D-intensive firms the share of the educated workforce is higher than in small firms. In large firms with no R&D the wage level even turns out to be no higher than average.

Why large firms pay higher wages? One internationally often proposed argument is that unwanted job seeking of employees is lower in high-wage firms, which in itself leads to large firm size. A related argument is that large firms may have a more long-standing history as a good wage payer. Therefore, high wages more convincingly lower the costly job search.

In Finland, worker mobility is, however, not lower in larger than in small firms. One argument is that large firms are prepared to hire workers at some risk, also because large part of the human capital is not directly observable. Bad performers are subsequently fired or leave the firm when not promoted. Risky workers receive an option value on good performance. Both hirings at risk and exits increase worker mobility. Indeed, non-permanent jobs are more frequent in large firms in Finland.

High wages can also work as a substitute for large monitoring costs. Small firms have more information on the worker effort of their employees and can monitor employees better than large firms.

This explains why fixed-term contracts between employers and employees are more common in small firms. Firm-specific payments are indeed not higher in large firms.

It is shown that R&D-intensive firms have on average higher wages but do not pay high starting wages (except technology firms with very high R&Ds). One explanation is that by choosing to work in R&D-intensive firms employees acknowledge that they can accumulate general human capital. The wage profile is, on the other hand, relatively steep as human capital is accumulated. Hence, seniority payments are bigger in R&D-intensive firms.

It is shown that firms with high wage-earners, irrespective of firm size, earn higher profits. Another finding is that R&D transforms educational compensations into structural capital of the firm that improves profitability. In large firms a good reputation as a wage payer and the recruitment of potentially good workers at some risk are the methods by which to improve firm performance. Small firms use, on the other hand, fixed-term contracts or rent sharing. These are particularly efficient to inhibit quits of good workers.

One can see that small firms impose more flexible wages. One reason is that employers face relatively high exit costs if the employee leaves the firm. Firing of any single employee has a cost effect on the firm profitability. Raising exit costs for employers through legislation would further deteriorate the relative labour market position of small firms. Large firms with moderate R&D intensity have high wages, low worker mobility and possibly a good reputation in labour markets with no necessary shortage of labour. Higher wages ensure enough job fillings in labour market where there are large fixed costs in job search. Firings costs are less important as high wages inhibit large exits. In some large firms, as in technology firms, it is still important to have an option to get rid of bad performing high wage workers.

Theme: Compensation policy

Keywords: wages, compensation policy, productivity, industry differentials

JEL Classification numbers: J21, J31, J50, C22

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TIIVISTELMÄ: Tutkimus tarkastelee yhdistetyllä työntekijä-yritysaineistolla osaamispääomaa, palkanmuodostusta ja näiden suhdetta yritystekijöihin kuten suurten yritysten korkeampiin palkkoihin. Suuret yritykset maksavat keskimäärin 21% parempia palkkoja kuin pienet yritykset. Tutkimuksen mukaan koulutuspääomalle maksettavat kompensaatiot eivät ensisijaisesti selitä palkkaeroja. Koulutuspääoma on liikkuvaa myös suurten ja pienten yritysten välillä. Sen sijaan suurten yritysten työntekijöillä on enemmän ns. kätkeytynyttä inhimillistä pääomaa. Tämän voi päätellä korkeista palkoista, jotka eivät selity työkokemuksesta, sukupuolesta, koulutuksesta tai yrityskohtaisista palkoista. T&K-intensiivisten yritysten palkkataso on myös keskimäärin 10% korkeampi. Toinen selitys korkeille palkoille isoissa yrityksissä on koulutetun työvoiman suuri osuus T&K-toimintaa harjoittavissa yrityksissä. Muissa isoissa yrityksissä palkat ovat jopa keskimääräistä alemmat.

Miksi palkat ovat korkeammat suurissa yrityksissä? Yksi selitys on pienissä yrityksissä etenemismahdollisuuksien rajallisuus ja alueellinen sijoittuminen kasvukeskusten ulkopuolelle, jolloin kilpailu työvoimasta on suhteellisesti vähäisempää. Lisäksi on selvää, että pääomaintensiteetti on alhaisempi pienissä yrityksissä. Yksi kansainvälinen väittämä on, että suurten parempaa palkkaa maksavien yritysten työntekijöiden uuden työn etsintä on vähäisempää. Vähäinen irtisanoutuminen kasvattaa luonnostaan yrityksen kokoa. Voi olla, että suuret yritykset koetaan myös turvallisena työnantajana, mikä lisää palkkauksen tehokkuutta työntekijöiden vaihtuvuuden vähentämisessä.

Suomessa työntekijöiden vaihtuvuus ei ole kuitenkaan erityisen paljon pienempää suurissa kuin pienissä yrityksissä. Yksi selitys on työntekijöiden palkkaus "riskillä". Kätkeytynyt osaamispääoma ei ole suoraan havaittavaa ja korkeapalkkaisen rekrytoimiseen liittyy epävarmuutta. Tällöin huonoiksi osoittautuneista korkeapalkkaisista työntekijöistä halutaan myöhemmin päästä eroon. Huonosti menestyvät työntekijät joko irtisanotaan tai he eivät saa ylennystä. Rekrytoiminen riskillä ja irtisanoutumiset molemmat lisäävät työntekijöiden vaihtuvuutta. Suomessa määräaikaiset työsuhteet ovatkin yleisempiä suurissa yrityksissä.

On myös ilmeistä, että työntekijöiden monitorointi on vaikeampaa suurissa yrityksissä. Korkeilla palkoilla voidaan myös kannustaa työntekoon, kun muu kannustinpalkkaus on vaikeaa. Pienessä yrityksessä monitorointi on helpompaa. Tämä voi myös selittää sen, miksi pienissä yrityksissä kannustinpalkkaus on yleisempää. Toisin sanoen palkat vaihtelevat yrityksestä toiseen selvemmin pienissä kuin suurissa yrityksissä. Palkat vaihtelevat myös enemmän yrityksen tuloksen mukaan. Tällä pystytään selvemmin vaikuttamaan työntekijän kannustimiin ja työpaikan etsintään.

Palkkaprofiilit vaihtelevat myös yrityksittäin. T&K-intensiiviset yritykset maksavat parempia palkkoja, mutta alkupalkat eivät ole välttämättä korkeat. Yksi syy alhaisille alkupalkoille on se, että työntekijä tietää osaamispääoman karttuvan yrityksessä. Palkat nousevat vasta ajan myötä. Eräiden teknologiayritysten suhteellisen matalaa palkkatasoa voi siten selittää työvoiman kokemattomuus: työntekijät ovat vasta uraputken alussa. Poikkeuksen muodostavat korkean T&K -intensiivisyyden teknologiayritykset, joilla on työvoimapula.

Tutkimuksen mukaan korkeapalkkaisia rekrytoivat yritykset menestyvät riippumatta yrityskoosta paremmin kuin muut yritykset. Kätkeytynyt osaamispääoma ei merkitse ainoastaan palkkakustannusta, vaan myös lisää yrityksen kannattavuutta. T&K-toimintaa harjoittavilla yrityksillä myös koulutuspääoma on tärkeä. Pienissäkin yrityksissä osaamispääoma palkitaan ja yrityskohtainen palkkaus lisää yrityksen kannattavuutta.

Työntekijän irtisanoutumisen kustannukset ovat suuremmat pienissä yrityksissä, kun irtisanomiskustannusten vaikutus yrityksen tulokseen on suurempi. Tästä syystä yrityskohtaisella palkkauksella pyritään erityisesti vähentämään työntekijöiden irtisanoutumista. Irtisanomiskustannusten nostaminen lainsäädännöllisesti vaikeuttaisi entisestään pienten yritysten asemaa työmarkkinoilla. Suurissa yrityksissä jotka harjoittavat T&K-toimintaa, työntekijöillä on paljon osaamispääomaa ja vähäisempi vaihtuvuus. Irtisanoutumiskustannukset vaikuttavat vähemmän yrityksen toimintaan. Toisaalta eräissä suurissa yrityksissä voi olla tärkeätä, että huonosti menestyvistä korkeapalkkaisista työntekijöistä päästään eroon.

Preface

Labour markets in Europe are under transformation. Well functioning labour markets take an increasing role under unified monetary policy. There has been increasing public debate on the future of the labour market and institutions in Finland. There are, however, relatively few studies on wage formation in Finland, at least in comparison with the research dedicated to the study of employment. This study examines wage formation in Finland and its relation to firm characteristics. It is clear that there exist differences in wage policy at the firm level, some of them common to other countries in Europe or elsewhere. This is so despite the fact that labour market institutions and centralised wage negotiations explain an important part of wage formation.

The study also evaluates payments on human capital, whether unobserved or explained by educational abilities. This is important to determine the differences in wage policy in small, large, technology or non-technology firms. This study uses linked employer-employee data from Statistics Finland, covering the period 1987-1996.

The study is part of the ongoing labour market research conducted at ETLA and funded by The National Technology Agency, Tekes. The Research was done by Dr. Hannu Piekkola.

Helsinki, June 2001

Pentti Vartia

Author's preface

It can be safely claimed that the picture of wage formation in Finland is still relatively unclear. The recent two decades have increased the complexity of wage formation because of the rising importance of human capital and relatively fast technological change. This study uses a particular methodology to separate the human capital of workers and firm-level compensations. Some of the firm-level differences in wage policy are more apparent in the analysis of wage components rather than total wages. I hope to be able to illuminate, in some respect, the wage formation and its greater flexibility in Finland than what is, at first sight, apparent under the centralised wage negotiations.

I am grateful to Tekes for funding the project and Eija Ahola for acting as the supervisor. Acknowledgements are also due to Statistics Finland and the Business Structure and Employment Units for making the data source available and for providing the facilities for the empirical research. The Study has used Finnish "lama-aineisto" from Statistics Finland, which has been utilised in cooperation with the Helsinki Business School and the Government Institute for Economic Research. I also thank Paul Dillingham for correcting the text into proper English.

I thank Mika Maliranta for leading me into the world of data sources in Statistics Finland. I also thank Jukka Lassila, Kari Alho, Tomi Hussi and my supervisor group: Eija Ahola, Mika Maliranta, Pekka Ilmakunnas, Pekka Ylä-Anttila for all their comments. The usual disclaimer applies.

Hannu Piekkola

Contents

1 INTRODUCTION AND SUMMARY

This study considers wage formation in skill- and non-skill- intensive firms and its relation to worker mobility in the Finnish labour market during 1989-1996. The analysis uses recent methodology in wage formation, where the person and the firm factors are separated following Abowd, Kramarz and Margolis's (1999) "the person effects first" approach. This is closest to the small sample solution for simultaneous analysis of person and firm effects in France (Abowd, Kramarz and Margolis, 1999, p. 303). Industry differences in wages can be similarly thought to consist of both person and firm factors. In Abowd, Kramarz and Margolis's (1999) firm-specific payments explain 25% of industry effects (7% in the alternative order-independent solution where the firm effects are estimated without eliminating person effects). In the U.S. person and firm effects receive equal importance in Abowd and Kramarz (2000). One can see that at least half of the industry differences in wage levels are determined by person effects. If these are fully prized in the market, they should have no effect on the market value of the firms.

The linked employer-employee data, hence, allows us to separately analyse transferable personal human capital and non-transferable structural human capital that is firm-specific. If the human capital of the employees is transferable and fully priced in the market, i.e. wage level equals labour productivity, high wages have no positive effect on the profitability of the firm. High ability associates with high wages with no effect on the market value of the firm. One finds that educational abilities are of this kind. High compensations for education do not lead to the firm's high profitability. However, R&D investments are an example of activity that also leads education abilities to contribute to the structural capital and profitability of the firm. The human capital can also be unobserved. This consists of the individual's high wages throughout his/her work career not explained by experience, sex or education.

It has long been recognised that large firms pay higher wages.[1] Piekkola (2000) and this study show that wages increase in firm size

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[1] See e.g. Oi (1983), Brown and Medoff (1989), Troske (1999).

in Finland, too. This particularly relates to high wage workers rather than to firms paying high wages. In other words, large firms do not necessarily pay wages that exceed the market level but recruit high-wage workers. The mean annual wage differential between plants in the 10th and 90th size classes is about 23,000 (FIM, 1990 prices), which equals 21% of the overall mean wage. The 23,000 wage increase is explained first and foremost by unobserved human capital. The fact that unobserved human capital explains the wage difference, however, also indicates that much of the wage difference relates to human capital that is less transferable. Our results do not contradict those of Troske (1999) and Davis and Haltiwanger (1996), who find that the firm-size premium in the U.S. can be explained by the fact that workers with observed skills are concentrated in large firms, and Dunne, Foster, Haltiwanger and Troske (2000) that emphasize the complementarity between worker skill and physical capital. All these studies emphasize that a large part, more than or equal to half, of the firm-size wage premium remains unexplained.

One can argue that unobserved human capital is less transferable. The current employers can observe and compensate for the unobserved ability better than other potential employers. One can see that high wages are explained by human capital that is not fully transferable but not directly related to a firm that implements superior technology. This calls for wage formation explanations for the high wages. In the Nordic countries the mobility of the educated work-force is high, but associates with very low unemployment of educated workers (Graversen et al., 2001). One possible reason for this is that skilled workers increase the wage level best by switching jobs. Potentially, employees may increase their wages best by switching jobs, since wages within each firm are relatively compressed in the Nordic labour market.

Besides wage compression and the inability to pay incentive payments there can be other differences in wage formation that explain the firm-size premium. It is argued that (1) large and/or skill intensive firms pay higher wages that decrease unwanted job seeking, also because of their good reputation and long work history, (2) large firms can reward risky workers with good performance, since bad performers can be fired and a greater burden of profit variation – also as a result of severe competition and globalisation – is borne by employees, and (3) large firms substitute high wages for high monitoring costs.

It is shown that, irrespective of firm size, firms recruiting personnel with unobserved human capital perform better. It pays to recruit high wage earners. From labour market viewpoint, one reason for this can be the recruitment of high wage earners at risk. An opposite to this view is low worker mobility in high-wage firms explained by good reputation of the high-wage firm as employer. Small firms also use their better monitoring of employees and incentive-based payments to reduce excess separations. Compensations adjust more to the profit flows.

R&D also transforms educational compensations into structural capital of the firm that improves profitability. All of the firm-size premium increase also takes place in firms that practise investment in R&D. In large firms with no R&D wages even decrease in firm size.

Firms with R&D investment pay higher wages but not particularly at the beginning of work career. One explanation is that by choosing to work in R&D firms employees acknowledge that they can accumulate general human capital. The wage profile is relatively steep. The 250 large technology firms with high R&D intensity are an exception. The shortage of skilled labour requires large starting wages. The wage level is the highest, 30% over the average. There are no firm-size differences in wage compensations so these firms do not explain the firm-size premium. High wages are explained by transferable human capital, education, and not by unobserved human capital. R&D-intensive firms pay higher wages (1) to attract educated workforce, (2) because of accumulation of general human capital raising seniority profile, (3) in technology firms to practise rent sharing and high starting wages to attract new workers. Rent sharing or fixed term contracts in small firms rather aim at lowering quits or excess worker reallocation.

Small firms impose more flexible wages. One reason is that employers face relatively high exit costs in case the employee leaves the firm. Raising exit costs for employers would further deteriorate the relative labour market position of small firms. As has been discussed, small firms recruiting high wage workers fare better, but have difficulty inhibiting quits of high ability workers. Large firms with moderate R&D intensity have high wages, low worker mobility and a better reputation in labour markets with no necessary shortage of labour. Higher wages ensure enough job fillings in the labour market where there are large fixed costs in job searches. Firing costs are less important as high wages inhibit large exits.

Large firms with extensive worker reallocation, on the other hand, also suffer from big firing costs. An example of these firms is relatively low-wage large firms with no R&Ds and technology firms with high R&D intensity. These large firms recruit risky workers with an option value and quits of bad performers are essential.

This study also considers skill-biased technical change and employment. Skill intensity can take various forms: R&D, physical capital, the share of the educated workforce, or unobserved human capital. All of these may include elements that lead to the excess demand of a skilled workforce at the expense of an unskilled. What explains the good employment of the skilled and the high unemployment rates of aged and unskilled in Finland? This can be best explained by division of firms into winners and losers. The good employment in R&D-intensive firms with high share of educated has not taken place at the expense of unskilled in these firms, but at the expense of unskilled in losing firms. Hence, there might have been an increasing gap in employment performance in winning and loosing firms. Besides this, capital intensity is negatively related to employment demand, especially so in large firms. Physical capital and an unskilled workforce have been substitutes in large firms. In small firms physical capital has, on the other hand, lowered the use of the educated workforce.

Dunne et al. (2000) in the US find the quantitative changes in the share of an educated workforce do not explain the increase in wage dispersion. The use of R&D and unobserved human capital together with a different time span in the use of new technology in firms may then better explain the increase in wage dispersion and employment performance that has taken place between firms. This is an area for future research.

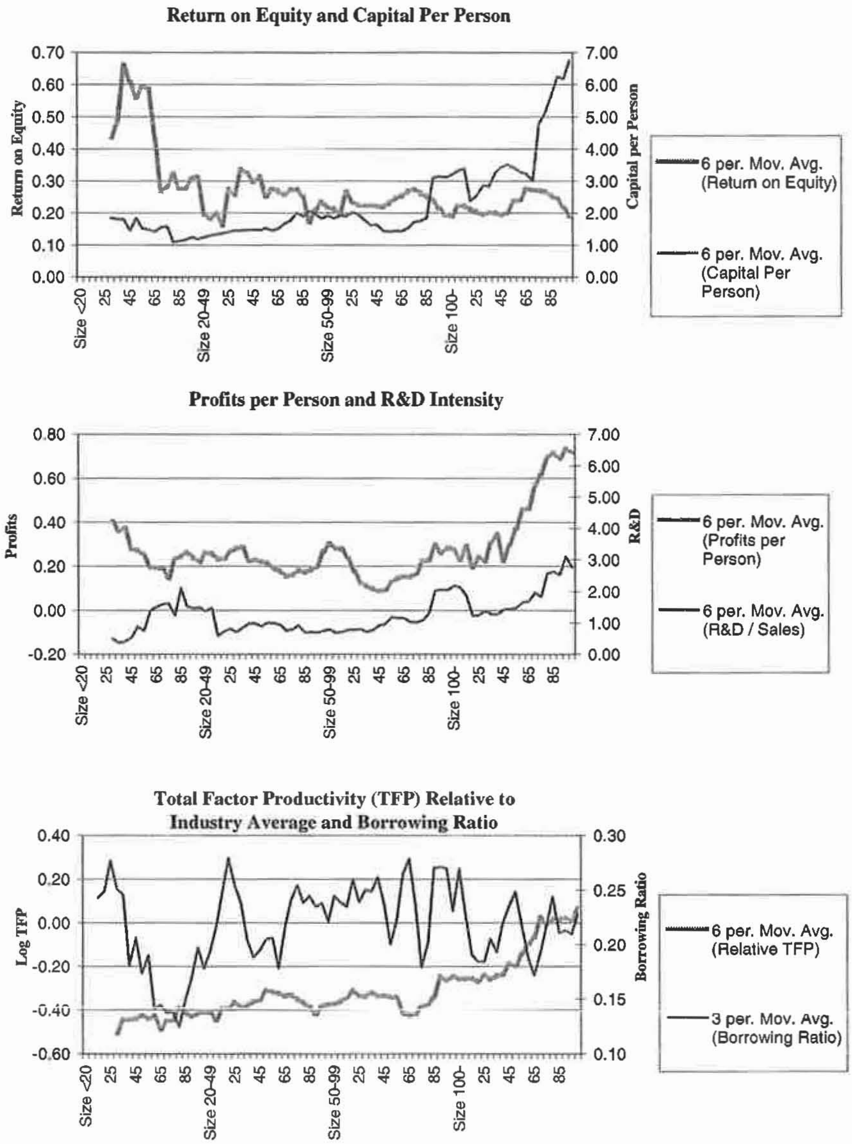
2 WAGE FORMATION, FIRM SIZE AND PERFORMANCE

This section gives an introduction to wage formation and firm characteristics, including R&D intensity and firm size, and the alternative theories explaining the differences are elaborated in next Section 3. The firm-size effect is found particularly striking in some components of wages such as unobserved human capital.

Figure 1 shows some average figures for firms in the years 1989-1996. Firms are divided first into 4 firm-size categories and each category is divided into 20 classes that each contain 5 percent of the workforce in that firm-size category. Figures include three- or six-period moving averages given the large fluctuation of the values. It is seen from the top figure that capital intensity unambiguously increases in firm size. The middle figure shows that R&D intensity increases on average in firm size as well as profits per person. The bottom figure shows total factor productivity as compared with the industry average at the two-digit level (defined in section 4). This increases in firm size so that in capital-intensive large firms the total factor productivity is higher. An unsolved puzzle is the clear decrease in return on equity in the top figure.

Let us next consider some basic figures for wage formation and firm size. Figure 2 depicts the mean annual wages in firms and its coefficient of variation by 100 establishment-size classes, each representing 1% of the total employment One can see from Figure 2 that wages are higher in the largest firms. The mean wage differential between plants in the 10th and 90th size classes is 23,000 FIM (in 1990 prices), which equals 21% of the overall mean wage. The figure is less than the 62% figure obtained in US manufacturing data for production workers by Davis and Haltiwanger (1996). The wage difference is, on the other hand, rather modest between small firms and middle-sized firms with an average 100 employees. The rise of 21% in wages in Figure 2 can be explained by a 14% contribution of unobserved human capital, 12% from education (including the sex effect), while experience compensations are 3% lower.

Figure 1. **Firm Performance, R&D Intensity and Borrowing Ratio**



The decrease in wage dispersion as firm size increases is substantial throughout the scale. Moving from plants that employ a 10th of the workforce to the largest 90th of the workforce the coefficient of variation decreases from 62% to 43%. The decrease in wage dispersion exceeds that obtained for US markets in Davis and Haltiwanger (1996).

Figure 2. Wages and Coefficient of Variation by 100 Establishment Size Class

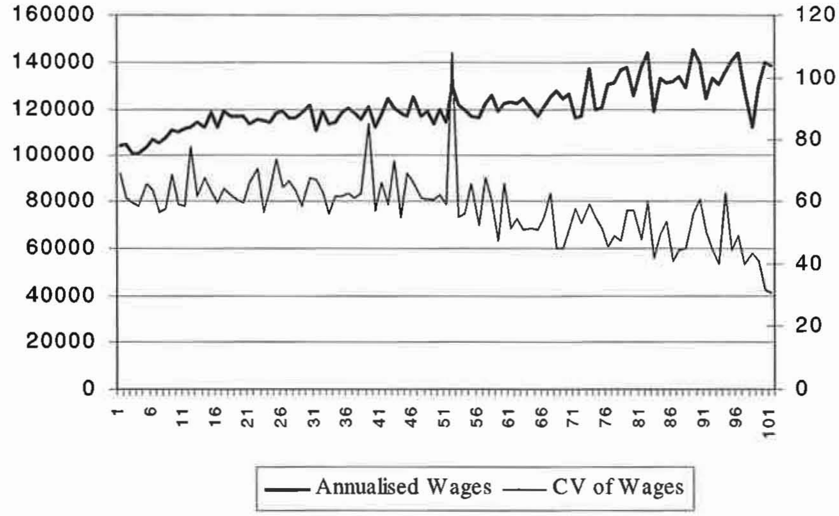
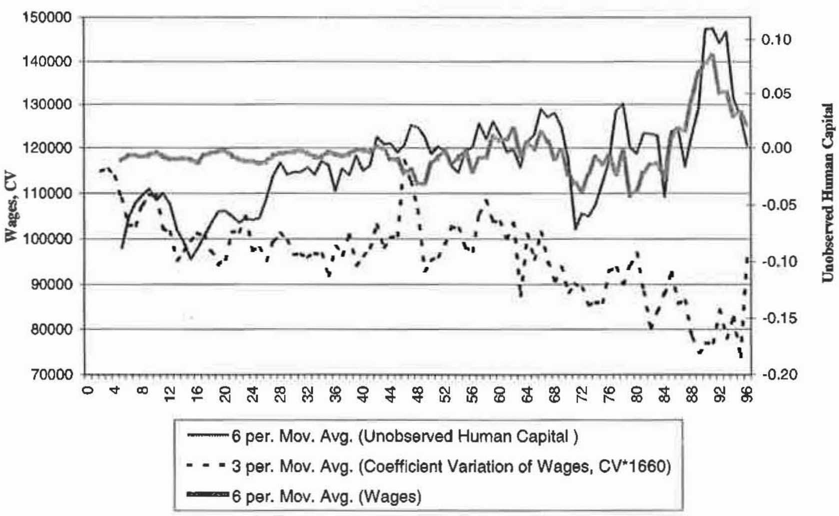


Figure 3 shows wages when in each firm-size category firm wages are weighted by the corresponding share in total employment. Figure 3 also includes the unobserved human capital component of wages (based later on the estimation of equation (8) in section 4.2; the estimation results are shown in table A.3 in the Appendix).

Figure 3. Wages, Coefficient of Variation of Wages, Unobserved Human Capital



One can see that in Figure 3 wages are relatively flat until the 80th decile, after which wages increases in firm-size. Hence, in each firm-size category the firms with the largest number of employees are not necessarily the ones with the highest wages. This is because the firm-size effect becomes lower when average wages in firms are weighted by a corresponding share in total employment in Figure 3 as compared with Figure 2. The firm-size effect holds stronger when one compares the firms between different firm-size categories without the employment weights. The mean wage differential between plants in the 10th and 90th size classes still remains about the same 23,000 FIM as in Figure 1. It also appears that the unobserved human capital component of wages rises strongly in firm size. It explains the most substantial share of the higher wages in large firms.

The following figure (4) shows wages and firm size depending on R&D intensity.

One can see from top figure that wages decrease in firm size in firms that have no R&D investment. All of the wage increase in large firms takes place in firms that practice R&D investment.

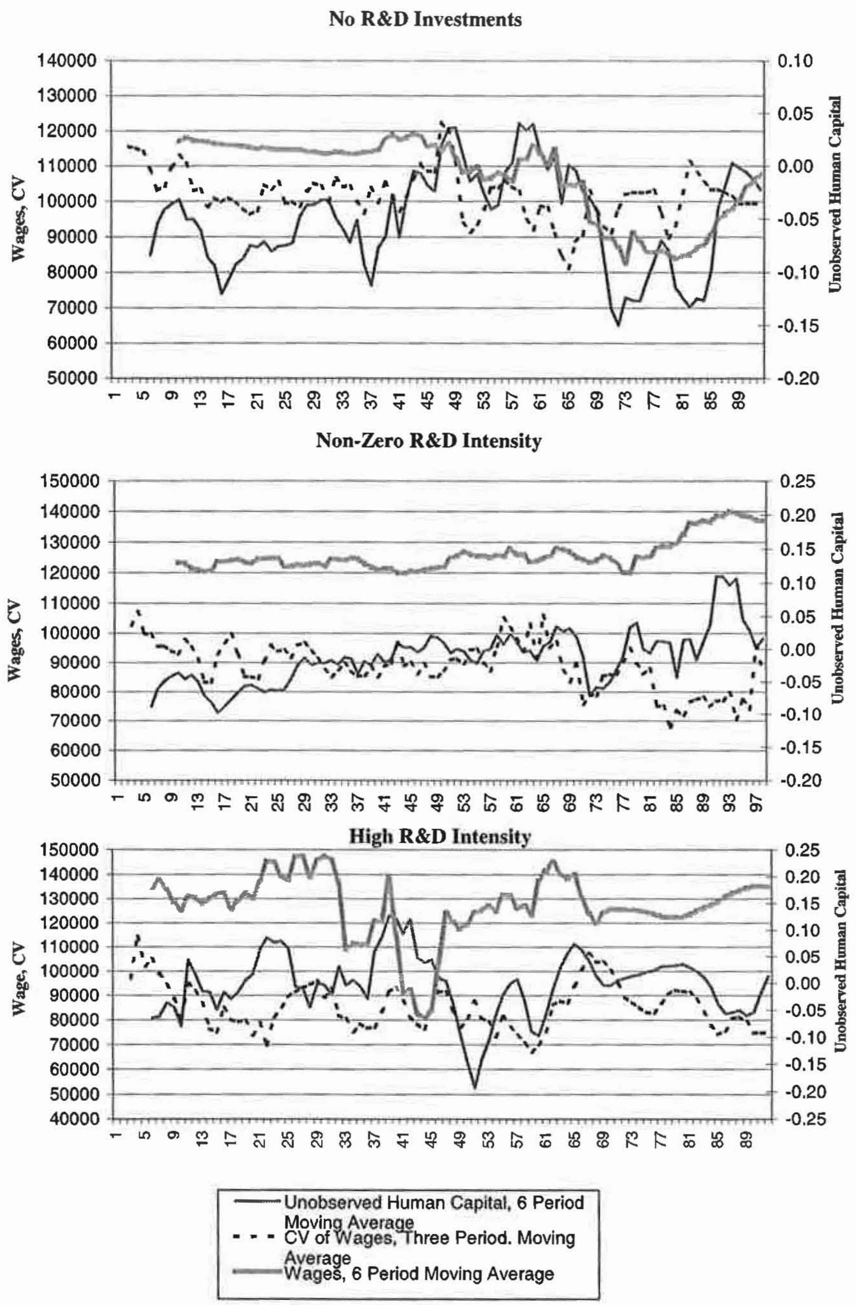
The following table (1) considers wages and its main components: unobserved human capital and compensations for education in firms with different average R&D intensities. Firms are divided into four categories depending on the average of R&D relative to sales. Firms that report R&D in some year are around 25% of all firms included in the sample of Financial Data (see later Table 2). The firms with no R&D in any year are used as the reference.

Table 1. Wage Level and R&D Intensity

R&D Intensity	Wages	Unobserved Human Capital	Educational Compensations	Wages, Share of Educated Controlled
<1%	7% (12%)	4% (8%)	3% (1%)	3% (10%)
1%-4%	8% (9%)	3% (5%)	4% (2%)	1% (7%)
4 >%	11% (8%)	3% (3%)	8% (3%)	0% (4%)

Numbers in parentheses are for the higher educated. Estimations include experience, experience squared and 28 industry dummies. The last column also includes the share of the educated.

Figure 4. **Wages, Coefficient of Variation of Wages, Unobserved Human Capital and R&D Intensity**



The wage level increases in R&D intensity. One can notice that wages are, on average, 10% higher in firms that have R&D investment (first column). The figures in parentheses show the wage level of the higher educated with university degrees. For the higher educated, the 10% premium also holds, although wage level is not the highest in technology firms with high R&D intensity, where over 4 percent of the sales go to R&D. Wages do not rise linearly with R&D intensity except for the component of wages explained by education (third column).

The last column shows the relative wage level after controlling for the share of an educated workforce. This leads to a very modest wage rise of around 2% in R&D-intensive firms. Hence, the major reason explaining higher wages in R&D-intensive firms is the higher share of the educated workforce.

From the second column it also appears that compensations for unobserved human capital are only on average 3 percent higher in R&D-intensive firms. One finds no larger difference in compensations for unobserved human capital that was important in explaining the firm-size premium. From the third column compensations for education, particularly, are higher in R&D-intensive firms.

This introduction section shows that unobserved human capital and the higher share of the educated in large R&D-intensive firms explain why wages are bigger in large firms. R&D intensity calls for an educated workforce, and compensations for education are also higher, both in small and large R&D firms.

3 WAGE FORMATION THEORY

This section examines various explanations for the relationship between wages, firm size and R&D intensity. One basic observation requiring explanation is the difference in wage formation in small and large firms, given that wages are higher in large firms. Another issue dealt with is wage policy in skill-intensive firms with R&Ds.

3.1 Wage Formation and Firm Size

What is the reason for higher wages in large firms than in small firms, while wage variation is lower and wages are more compressed. One reason is institutional factors such as more powerful labour unions and wage-setting rules in large firms. It may be easier to pay high wages during new recruitment, while old workers are complied to follow particular compensation rules. This remains an open issue. The decrease in wage dispersion as firm size increase, however, also takes place in the US where the degree of unionisation is low (see previous chapter). Four arguments that are not directly related to labour market institutions are proposed.

High wages decrease unwanted job seeking

A straightforward argument is that high-wage firms become large as fewer and fewer employees leave them to look for a firm with even higher wages. Following Burdett and Mortensen (1998) higher wages themselves lead to large firm size as the quit rate is lower. The employee has a lower chance of finding a firm offering even higher wages. Acemoglu and Shimer (2000) include concurrent investment decisions, and find high-wage firms filling job openings more rapidly and making more irreversible investments in complementary inputs, such as capital. An important conclusion of this job search approach is that large firms may have high total factor productivity. Free competition should ensure that they do not end up being more profitable. Some of the empirical findings like Bayard and Troske (1999) in the US are in line with this.

Reputation wages

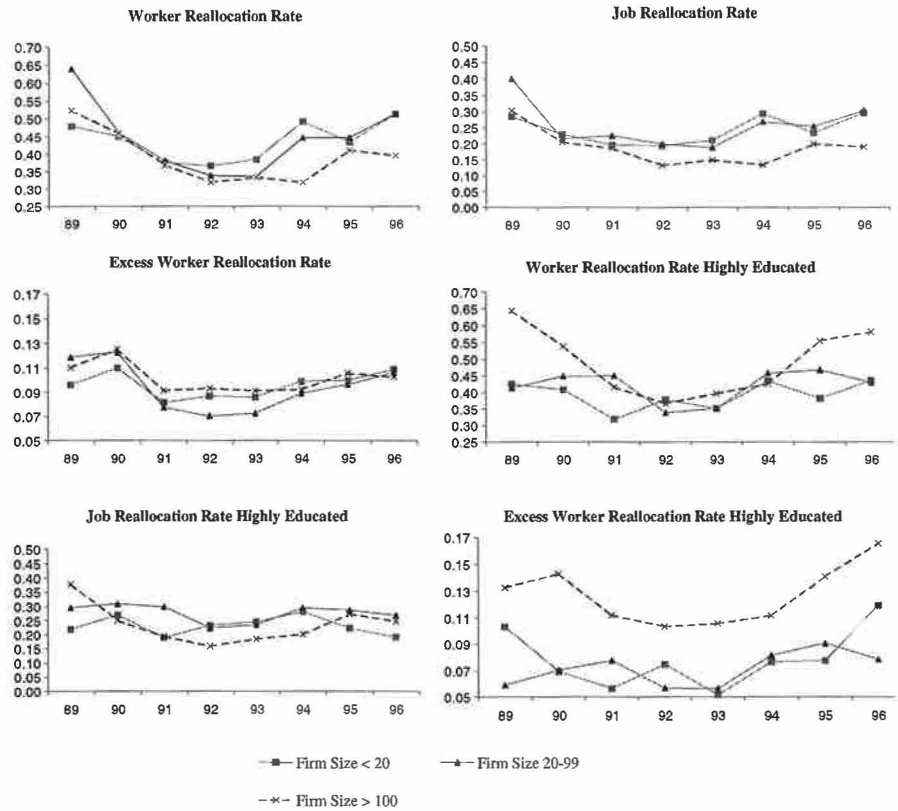
Large firms may also have some comparative advantage in the labour market. One argument is a better reputation and a longer-standing history of the firm as a good wage payer. Large firms can use high wages better to lower the costly job search, as argued by Fujiwara-Greve and Greve (2000). The future of the firm performance can be more uncertain in small firms (see the later discussion). In large firms, the lower unwanted job seeking and the possible monopsony power of large firms may also raise the profitability.

We, however, do not find necessarily strong evidence that excess worker reallocation and job turnover decrease in firm size. The job search is not lower in large firms. Excess worker reallocation describes worker mobility that is based both on firm decisions and voluntary separations. It is equal to hirings when jobs are lost (separations exceed hirings) and to separations when jobs are created, at firm level half of the more familiar churning rate (see equation 6 in section 4.1 following Davis, Haltiwanger and Schuh, 1996).

Figure 5 shows job reallocation, worker reallocation and excess worker reallocation rates in three firm-size categories: less than 20 employees, 50-99 employees and more than 100 employees. The figure also shows the respective figures for highly educated workers with higher degrees (master's degrees):

It is evident from Figure 5 that worker reallocation rate (the sum of hirings and quit rates) and, especially, job reallocation rate (the sum of job creation and destruction rates) do not greatly decrease in firm size. Excess worker reallocation rate (the sum of hirings and separations less absolute change in employment) is even somewhat higher in the largest firms. Ilmakunnas and Maliranta (2000) similarly find that excess worker reallocation (churning) increases in firm size in the private sector in Finland after controlling for firm age and industry. The only exception to this is manufacturing. This is different to the US market, where job turnover decreases in firm size (see Burgess, Lane and Stevens, 1996). One reason can be that employment on longer tenures is better recorded while job turnover in short-term employment might be decreasing in Finland, too (our data have information on employment only at the end of the year that leads to underestimation of short -tenure mobility).

Figure 5. Worker and Job Reallocation Rate, Excess Worker Reallocation and Firm Size



The last figure shows that excess worker reallocation is particularly high for highly educated in large firms. The worker reallocation rate has remained high for highly educated since 1995. The fact that excess worker reallocation does not decrease in firm size, and particularly for the highly educated, contrasts with the basic presumption that skill-intensive large firms should have an incentive to decrease job turnover since it is costly. On the other hand, Acemoglu and Shimer (2000) argue that job search of employees may be essential for workers to reap part of the higher productivity if high wages associate with higher investment. This is also efficient as higher wages ensure enough job fillings in the labour market where there are large fixed costs in job searches.

Large firms have a higher survival rate and reward workers for good performance

Besides reputation wages, Piekkola (2000) shows evidence that large firms use a wage policy to tackle the uncertainty of the performance of employees. Large firms hire good workers at some risk. Lazear (1995) argues that firms that expect to live for a long time and grow fast can also hire riskier workers with an option value. Bad performers are fired. Alternatively, following Kahn and Huberman (1988), bad performers leave the firm when not promoted. This, together with the recruitment at risk, increases job turnover but also raises the wage level of experienced workers. The effect of plant growth on firm survival is found to be positive in many studies (Mata et al. 1995), while the evidence on firm size is less clear.

To begin with, firm age and size are positively correlated and firm age has a positive effect on firm survival (Boeri and Bellmann, 1995; Baldwin et al., 2000; Nucci, 1999). The positive effect on survival diminishes as the firm ages. One more direct implication of the firm growth effect is, at least, that current size should have a more positive effect on survival than the initial size. The finding of a positive correlation between firm size (age) and survival is also consistent with the theories of learning-by-doing as an important factor determining the likelihood of survival (Agarwal & Gort, 1999). The evolutionary view also suggests that new firms are the agents of change, of whom only a few survive. Second, Audretsch et al. (1999) also find a positive relationship between size and the likelihood of survival in almost every US manufacturing sector over the period 1976-86. There is, though, no clear relationship between firm size and the likelihood of survival in Italian manufacturing over the period 1987-93. It is also evident that for newly founded firms the survival rate can stay high for certain period. Small firms can also overcome some inherent size disadvantages through cooperation and thereby have higher chances of survival. Some studies like Salvanes and Tveterås (1998) find that the exit function is U-shaped in plant age, owing to learning and vintage capital effects.

There is also some international evidence that layoff risks are higher in large firms. Using data from Austria Winter-Ebmer (1995) shows that controlling for this reduces the wage-size premium by a third. Risky workers with good performance still retain a wage premium, when the firm can enjoy the returns of investing in well-performing employees for a long time. Lazear (1995) also claims that the wages for all new workers have to be the same. Hence, there is a probation period in recruitment after which the well performing workers are rewarded.

Overall, the survival rate of large firms is likely higher. This explains the good reputation of large firms as wage payers and the recruitment of risky workers following Lazear (1995). The latter implies that good workers are rewarded after some probation period so that starting wages are non-necessarily high. There is some evidence of 'probation years' in Finland as seniority payments in large firms are postponed to lengthen seniority. One also finds that a high level of hirings and separations and, hence, excess worker reallocation improves firm performance. This hints that in large firms separations are frequent, leading to well performing workers staying in the firm.

Lazear's model requires that the firm has private information about a worker's output or that workers suffer from mobility costs when moving to another firm. There are reasons to believe that job turnover and, especially, exit costs are relatively more greatly borne by employees in large firms. It may be difficult for higher-paid skilled workers in a large firm to find another large firm with even higher compensation for unobserved human capital. Using Norwegian data, Fujiwara-Greve and Greve (2000) show that employees in large firms, especially, encounter difficulties in finding a new large firm with even higher wages. Kremer (1993) and Kremer and Maskin (1996) suggest that the job reallocation problems of skilled risky labour are also more easily solved in large firms. It can be easier to form team groups where workers are more alike and thus efficient or there are greater benefits from segregation. It is shown that the larger the firm, the lower the fixed costs per worker are in recruitment and this may also hold for skilled employees. One reason for this can be that the ratio of applicants to job vacancies is higher.

High excess worker reallocation may, though, also be explained by other factors. Bhagwati and Dehejia (1994) suggest that globalisation pressures strengthen job turnover and labour market pressures. Reorganisation in firms may be more easily carried out in large firms. Finland also experienced a deep recession in the beginning of the 1990s. Job destruction rose substantially, while there was a dramatic decrease in voluntary separations.

Monitoring Costs and Fixed-Term Contracts

The higher wages could also be explained by large firms substituting high wages for monitoring costs. Small firms may more easily use fixed term contracts (Malcomson, 1997). Wages are then agreed between employer and employee and remains unnegotiated unless one of the parties gets a better deal (outside option) elsewhere. Negotiations are not beneficial to either party as long as outside options are not binding. There is no hold-up problem for general investment since outside options are independent of the level of investments.

The following figure 6 shows firm-level payments depending on firm size that are based on the empirical formulation shown in later section 4.2.

The upper figure shows wages explained by firm factors and not by personal characteristics. The firm intercept in the bottom figure shows one component of the firm effect that cleariest relates to fixed-term contracts. (The intercept of wage regression for each firm, the other components of firm effect are seniority payments and the effect of the level of recruitments.) It is also equal to starting wages on top of which seniority payments accumulate. Fixed-term contracts seem more frequent in small firms, see also the later tables 5 through 10. As discussed, fixed-term contracts result from negotiations between employees and employers. Following Hall and Lazear (1984), fixed term contracts should lower inefficient separations and excess worker reallocation, especially if wages are set at too low a level when the firm works as a monopoly. Later, firm intercept is indeed shown to lower excess worker reallocation, but only in small firms.

The lower wage dispersion in large firms also gives evidence that fixed-term contracts and/or rent sharing is lower. Rent sharing is also used more in small firms (see Piekkola, 1999). Rent sharing, partly captured by the total firm effect, is a substitute for fixed-term contracts, the firm intercept. It is preferrable when employers know the reservation wages (outside options) of employees.[2].

The top figure shows that the total firm effect is somewhat higher in R&D-intensive firms and, in contrast to firm intercept, also increases in firm size. In any case, firm-level payments are higher in R&D intensive firms. (See again the later Tables 5 through 9.)

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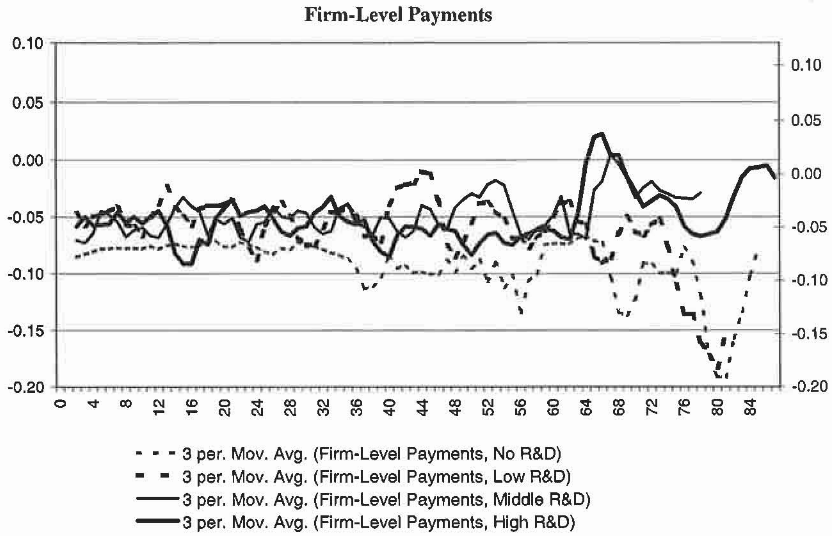
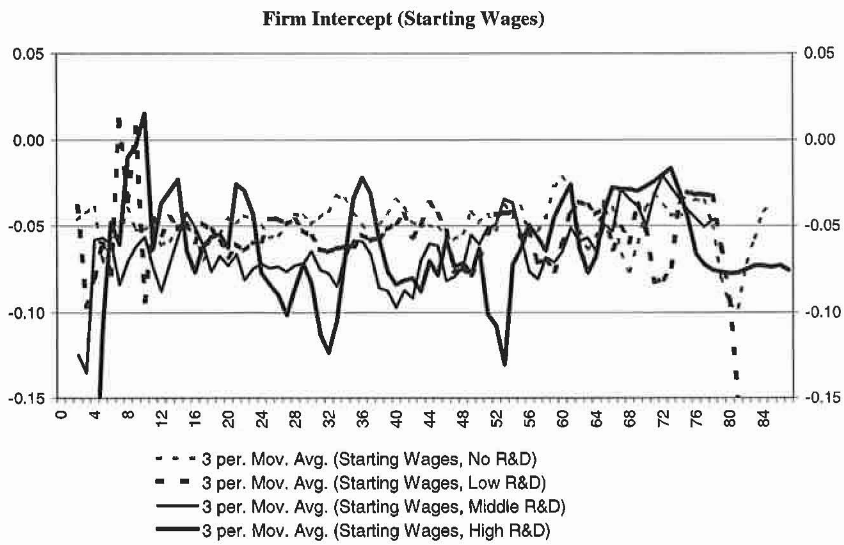
2 Also plausibly explaining much of the decrease in between-plant wage dispersion in Davis and Haltiwanger (1996).

Figure 6. Firm-Level Payments





All in all, the unimportance of firm-level payments (incentive payments) in large firms then relates to the organisational aspects of monitoring employees: following Bulow and Summers (1996) large firms substitute high wage earners for high monitoring costs. The lack of incentive-based payments is indicated by the modest within-plant wage dispersion in large firms, as is also found in the US by Davis and Haltiwanger (1996).

In large firms, fixed contracts may be less based on mutual agreements in wage negotiations between employers and employees. A mutual agreement may rather constrain the employer to fire employees if they turn out to perform badly. Employees are also less informed about the true outside options of the employer in large firms. Following Nickell (1999), high monopoly rents may not signal profitability, whereas that workers do not receive their share of the firm's success.

What explains relative high firm-level payments in the 250 (approx.) technology firms in Finland with high R&D intensity? Following seminal work by Becker (1964), specific training and, hence, firm-specific ability, may give rise to a bilateral monopoly situation and the returns from this are shared between the firm and the worker. The mobility costs may also emerge from technological complementarity between transferable and firm-specific human capital or strengthened by incentive complementarity giving rise to situations where returns from transferable human capital are also shared. (See Acemoglu D. and Pischke J.-S. (1999) and Kessler and Lulfesmann (2000)).

3.2 Wage Formation and Skill-Biased Technical Change

Davis and Haltiwanger (1991) and recently Dunne, Foster, Haltiwanger and Troske (2000) show compelling evidence that the overall increase in wage inequality in the US over the past three decades is a between-establishment phenomenon. Both for production and non-production workers the wage dispersion between plants has increased and the dispersion within plants decreased. Beside this, the mean wages for non-production workers have relatively increased. This explains the moderate increase in the overall, within plant dispersion (since it is also a function of the spread in mean wages between production and non-production workers). This suggests that the increase in relative demand for skilled workers is not due to a simple shift in product demand across industries. The mean wages between industries have remained relatively stable during the period. Dunne et al. (2000) find no clear association between changes in the non-production wage and productivity dispersion at the industry level.

Maliranta (2001) finds considerably lower increase in dispersion in mean wages between plants in Finland, especially in the 1990s. He explains that the main reason for the lower effect is that between establishment productivity has not risen to the same degree as in US. Most of the increase in productivity in the last recession, for example, is due to the destruction of low-productivity plants rather than from an increase in productivity or its dispersion in continuing plants.

There are some recent papers that link the dispersion in productivity between plants to skill-biased technical change. Caselli (1999) lists some major technical changes and new inventions over the last 200 years: steam engine, assembly line, information technology, computers or other types of machines. Under technical change special workforce is required for the use of new inventions and the workforce is segregated. A skill-biased-technical change occurs when there exist high-skilled for whom it is less costly to acquire the new skills required to operate the new machine. It is not worthwhile to teach the low-skilled the new costly skills and they continue to operate with the old technology. All technologies have diminishing marginal returns so that high technology plants use an abundance of high-skilled employees and new capital until the returns equal the market rate.

Dunne et al. (2000) indeed find a rising productivity differential across high and low computer investment per worker plants and high and low capital intensity plans. However, this relates to efficiency in the use of new machinery since changes in the quantitative amount of new machinery or capital explain the rather low share of the rise in wage dispersion. This is at odds with Caselli (1999) that predicts not only the large segregation of the workforce between low and high productivity plants but also that highly skilled workers use *better* and *more* machines.

Kremer and Maskin (1996) explain wage dispersion shifts by changes in skill distribution that can emerge from skill-biased technical change, among other things. A high and low-skilled workforce can be substitutes or complements. The asymmetry of tasks favours less segregation while more segregation is needed in the Caselli (1999) type of technical revolution. The skill distribution is important since if the gap between low and high-skilled becomes too large, it may be optimal to use entirely high-skilled. The work of low and high-skilled then become substitutes. Hence, an increase in the worker dispersion in skills leads to segregation of workers by skill across plants. If the skill dispersion is wide to begin with, an increase in the mean skill-level may also strengthen the case of increased wage and productivity dispersion.

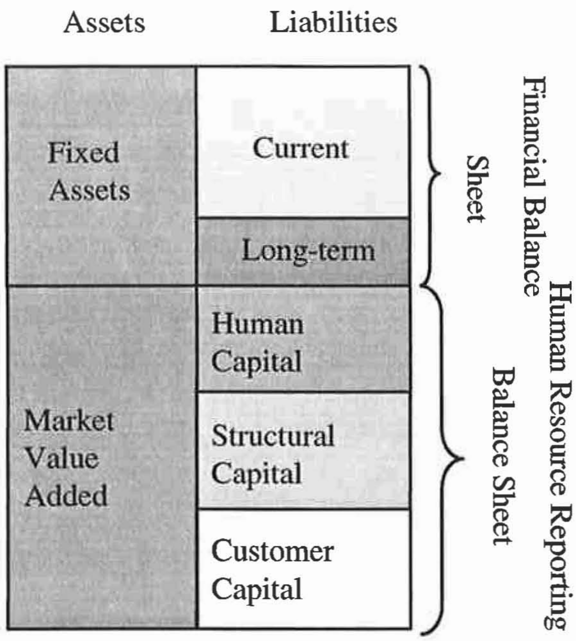
Kremer and Maskin (1996) do not explain where the increase in effective skill dispersion originates. One particular difference between the US and Europe is the shortage of skilled labour in the former. In Finland the supply of educated labour may be claimed to have risen more in pace with the demand for highly skilled employees. This may, in principle, explain why the forces are not necessarily set in motion where there is large segregation of the skilled labour force. The supply side is not elaborated in Dunne et al. (2000), neither do they try to explain the general positive trend in non-production wages that can be explained by a number of other factors besides the industry and plant-level differences in productivity.

In the context of firm size, Kremer (1993) suggests that job reallocation problems of skilled risky labour are also more easily solved in large firms, i.e. there are large fixed costs in hiring skilled workers. It is later shown that the level of hirings does not raise wage compensations similarly in large and in small firms (see section 8). The easier recruitment of skilled labour in large firms may also emerge from higher segregation of the skilled workforce or task complexity, as considered by Kremer and Maskin (1996).

3.3 Wage Formation and Investment in Human Capital

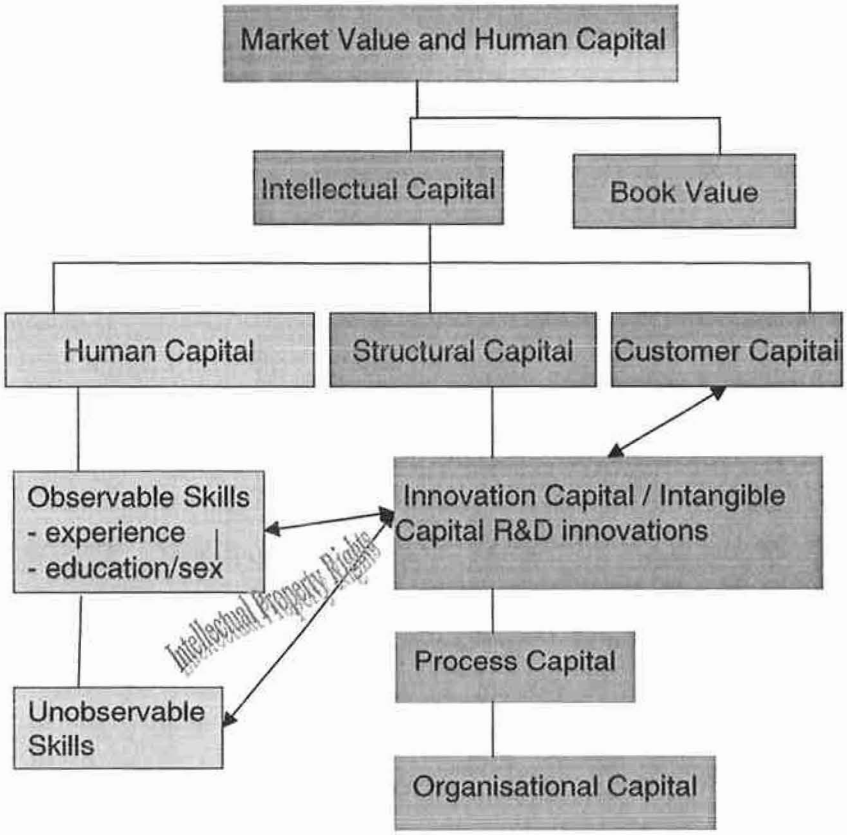
The interaction between R&D investments and human capital has not been considered extensively in the human capital literature. R&D investments are, however, one of the few observable variables that may work as a proxy for intangible human assets or human resources. Still, what is economically valuable is strings of information that are less and less related to scientists or engineers to produce knowledge in an R&D laboratory. Quah (2000) describes New Economy as "Weightless New Economy" as strings of information are less physically placed in a certain location or attached to a certain academic profession. This calls for a broader definition of intellectual capital.

Figure 7. Intangible assets



First of all, products are infinitely expansible: their enjoyment by one consumer does not preclude consumption or use anywhere else. Knowledge-intensive consumer goods, hence, have characteristics similar to public goods. A public park can be enjoyed by any additional individual and not at the expense of the enjoyment of other pedestrians in the park, at least before it becomes congested. Second knowledge-products are inherently unknowable: what a knowledge-product does is impossible to reveal without at the same time revealing the knowledge-product itself. A knowledge-product satisfies a second condition for public good character: the externalities are large. Both the difficulty of charging a marginal consumer, or zero costs attached to this, and the easy diffusion of the good make the economics very demanding. Moreover, patents related to its production are non-necessarily efficient. As Quah (2000) puts it, "a knowledge product gets hawked directly for consumption without getting heavy metal slapped around it". All this calls for new measures of intellectual capital, not only relating to physical measures such as the physical assets attached to a firm.

Figure 8. Human Capital



James Tobin was the first to measure the value of human resources as the difference in market value and book value of a financial balance sheet. Edvinson and Malone (1997, p. 146) divide intellectual capital further into human capital, structural capital and customer capital in the following tabulation.

80 percent of R&D expenses are wage expenses so that substantial part of it deals with an accumulation of human capital. Human capital can be divided into observable skills and unobservable skills. Structural capital consists of innovation capital, process capital and organizational capital. R&D investment is also part of innovation capital. The following figure shows the different parts of intellectual capital and human resources[3]:

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[3] I am thankful to Tomi Hussi for his tabulation based on Edvinsson and Malone (1997), of which this is an adaptation.

Unobservable skills are referred to as unobserved human capital which essentially consists of personal compensations not explained by education or sex. Observable skills are an important part of wage compensations and depend on labour market experience, education attained and other fixed factors such as sex. Since R&D investments take place in firms, a lot of the attained skills are unobserved. This can be measured by personal compensations not explained by education or sex or other observable skills.

In this study firm-level payments are separated from compensations for structural or customer capital characteristics for the firm. It is evident that R&D include elements that relate to structural capital and innovation capital. An important issue in the study of R&D investment is surely to what extent the knowledge can be diffused throughout the economy. Intellectual property rights, patents for example, inhibit the knowledge spillovers that would result from innovations becoming a public good.

This study does not deal with customer capital that is becoming a more and more important part of intellectual capital. This is a major deficiency. Quah (2000), in particular, describes the " Weightless New Economy" as knowledge intensity to create a direct link between consumers and knowledge as if the consumer products itself and not only manufacture inherits strings of information.

R&D and Diffusion of Knowledge

Since Arrow's (1962) article it has been well known puzzle that firms may not be willing to invest in general skills, e.g. in R&D knowledge that is diffused, as there is a chance of employees leaving the job. Employers are more willing to invest in specific training because it cannot be transferred to outside firms. Spillover occurs when a researcher paid by one firm to generate new knowledge transfers to another firm and the former employer is not compensated for the general skills accumulated in the job. If R&D investment is specific human capital and not diffused, firms that invest in it can earn a monopoly rent. When an essential part of it also consists of human capital, employees and employer can form a duopoly in sharing the rents (see the discussion below). Arrow (1962) also suggests the sharing of returns from specific-investment between employer and employee. It still remains a puzzle as to how to provide incentives for general training.

If R&D skills are observable and can be diffused the efficiency of this rent sharing is questionable. If R&D investment can be diffused and investments replicated by competitors even if structural capital in nature, the return on it may not exceed a normal rate return. There is no case for sharing rents that do not exist. Workers are compensated for general human capital that can be diffused. Scientists and engineers can fully extract the benefits of R&D when moving to work in another firm. In cases where R&D investment is structural capital but can be replicated, R&D yields excess returns only in a limited period before it is replicable e.g. when protected by patent. The market value does not necessarily materialize only in the firm but may be diffused outside the firm. There is no difference between market value and book value of an individual firm to the extent that all knowledge can be diffused.

Wage Formation and Diffusion of Knowledge

Some recent studies that are particularly relevant in knowledge intensive firms give a substantial amendment to basic wage theory. Moen (2000) argues, following human capital models such as Pakes and Nitzan (1983), that if workers in an R&D-intensive firms get access to valuable knowledge in the firm, they can expect high wages in the future. This seems a relevant argument in the accumulation of general knowledge in particular. Employees should accept wages below their alternative wage when holding such jobs. Big technology companies such as Nokia can be typical examples where starting wages are relatively low. Moen (2000) finds that scientists and engineers have to accept a wage discount of six percent in their first year after graduation if choosing an "R&D-intensive" career. Seniority payments compensate for this at the end of a career. Hence, the current value of wages equals the general knowledge gained in the firm, but a steep wage profile ensures that the workers stay longer in the firms to accumulate the human capital.

Structural human capital can also be shared between employers and employees. This changes the wage formation considerably, at least for high-wage earners. If the returns from specific training or the bargaining power of employees is sufficiently large the returns from specific training exceed outside option wages (the wages available in the market). This approach may be particularly relevant in R&D investments where the specific returns from investment can be relatively large. The implication is that alternative wage offers in the job market are non-binding. The employer may reap part of the return from general training, too. Following Kessler and Lulfesmann (2000) an incentive complementarity then prevails between specific and general training. The first reason is that high firm-specific training makes outside options non-binding. Another reason is that if the return from specific investment turns out to be low and an outside option becomes binding, the employer reaps a full return from specific investment but no excess return from general training. In cases of a bad outcome, the employer is compensated by a full return on specific human capital instead of a partial return both from specific and general human capital. Specific and general training are incentive complements.

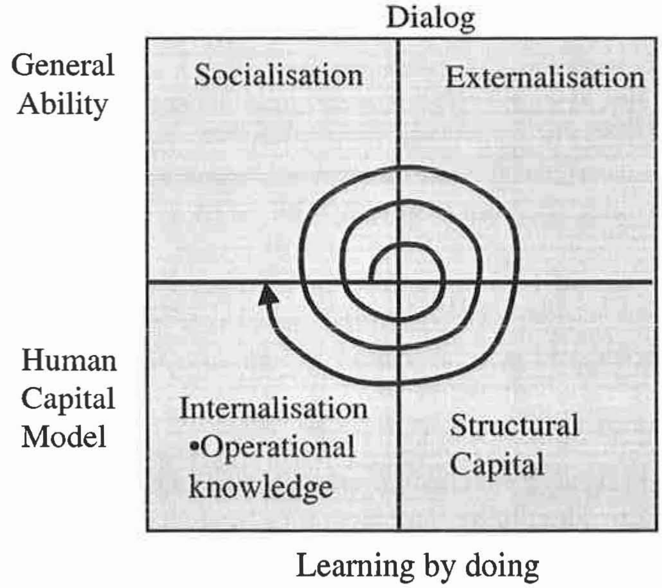
Acemoglu D. and Pischke J.-S. (1999) suggest that specific and general knowledge are also complements in technical terms. It is obvious that production complementarity between employer-sponsored general and specific investments can explain investment in general skills. Specific training, e.g. related to R&D investment, also allows the employer to invest in general human capital.

R&D over the Time Horizon

It is clear that in R&D investments the time horizon matters and mature and infant firms apply different wage schedules. Maliranta (2001) finds that investment in R&D leads to an increase in productivity with a long lag of two to four-year years.

The following Figure 9 summarizes the dialog over time and various interactions in compensating work in innovative capital. It is an adaptation of the figure in Nonaka & Takeuchi: The Knowledge Creating Company. The basic human capital model of Arrow (1962) implies that wages in work related to innovative work are higher. The bottom-left corner shows the implications of basic model. There are two reasons why the wage curve is flat when specific human capital is important. To begin with, the employee loses the specific ability gained when moving to work in another firm. Second, there can also be depreciation of human capital as time goes by. Following incentive complementarity as in Kessler and Lulfesmann (2000) and/or technological complementarity as in Acemoglu D. and Pischke J.-S. (1999), over a period of time the em-

Figure 9. Compensating Innovative Capital



ployer may also have an incentive for the accumulation of the employees' general abilities and one moves to the socialisation of abilities, as indicated by the second box at top-left. First, specific abilities in innovative capital can be sufficiently high so that the alternative wages are non-binding. There is rent sharing not only in specific capital but also in general capital. Alternatively, following Pakes and Nitzan (1983) workers in an R&D-intensive firm get access to valuable knowledge in the firm, they can expect high wages in the future. This implies a rising wage curve.

Rent sharing and high firm-level payments may also emerge from the shortage of skilled labour, as seems later evident for the 250 large technology firms with high R&D intensity. At the final third stage it is indeed likely that diffusion and knowledge spillovers rise in importance in the externalisation phase. The employer should pay high starting wages. The extent of the importance of a job search either determines whether this effect dominates or the implications of the accumulation of general ability that work in the opposite direction.

Replication of knowledge also becomes a more important source of knowledge spillovers as the innovation matures. Structural R&D capital remains essential to the firm as this enables a new spiral of R&D knowledge accumulation. The firm may enlarge the use of innovative capital. This can lead to greater segregation of the workforce. (See Kremer and Maskin (1996).) This makes a distinction between the concentration of the highly skilled in the firm due to segregation (via hirings) and skill accumulation using the existing workforce (reduced worker reallocation).

It is seen that depending on the time horizon, R&D-intensive firms may (1) reap all the return from firm-specific investment leading to flat wage curves, (2) pay not such high starting wages with a deep wage profile, especially when accumulation or socialisation of general abilities is important, (3) practise rent sharing in return from both general and specific abilities. It is likely that as time goes by employees will enjoy more and more from the fruits of intellectual capital in the second and third phases. As seen later, R&D is also a way to combine educational abilities and research into structural capital of the firm that improves productivity. This would explain the long lags in the relation between R&D and productivity in Maliranta (2001).

4 LINKED EMPLOYER-EMPLOYEE DATA

4.1 The Data and Variables

Data on individual employees from Employment Statistics is a large database that combines various registers kept by Statistics Finland and other authorities. The total data of employees is matched with the firm sample of Financial Statistics held by Statistics Finland. The variables used in the analysis for person i and firm j at time t obtainable directly from the data are:

Annual employment L_{jt}: Average number of salaried and hourly employees in firm *j* over the course of the calendar year in Financial Statistics.

Capital K_{jt}: Accumulated investment with 15 percent depreciation for machinery and 7 percent for other capital from 1987 using initial stock values in Financial Statistics.

Employment E_{kt}: Employment in establishment k in period *t*, determined by the employment at the end of December in each year in Employee Statistics.

Annual wages W_{it}: Real compensation (wage) for person i divided by months worked and multiplied by 12, and deflated by the consumer price index (1990=1.00) in Employee Statistics.

Years of Experience: Age minus years of education and age when school started.

Education: Highest education level obtained in 8 grades.

Higher educated/Employees: The share of employees with bachelor's degree (lower university and non-university degrees) or higher

Seniority γ: Duration of a job measured in years.

Value added per worker (part of quasi-rent): Value added divided by the producer price index at the two-digit level.

R&D Intensity The share of R&D investment from total sales.

Market share: Real sales relative to sales at the two-digit industry level (NACE95).

Borrowing ratio: Expenditures on interest-bearing debts divided by cash-flow (Nickell and Nikolitsas, 1999, use all long-term interest payments). The borrowing ratio can obtain infinite high or low values and is set at the minimum (zero) or at the maximum (four) if it deviates more than five standard deviations from the estimated value. The OLS regression yielded $R^2 = 0.019$ with the explanatory variables: unobserved individual effect, education effect, hirings effect, seniority effect, seniority squared effect, real sales per capita, short-term loans per capita, interest-bearing debt per capita, return on capital, dividends per capita, exports per capita, total factor productivity, market share and 32 industry dummies (see definitions later). 1.7 percent of observations receive the maximum value (4) for the borrowing ratio (426 observations out of 25,016).

Net profits: Gross profits (sales less wages, salaries, rents etc.) less interest on loans and depreciation.

Quasi rent: Value added less wage and capital expenses in firm j (average interest expenses times capital). The interest rate is obtained by multiplying interest expenses by three and dividing by the level of interest-bearing debt. This is averaged over the industry at the two-digit level when positive taking into account consumer price inflation.

The log of relative total factor productivity:

$$\ln TFP = \ln\left(\frac{Y_{jt}/L_{jt}}{\bar{Y}/\bar{L}}\right) - \frac{I_{jt}^{pre} + \bar{I}}{2} \ln\left(\frac{K_{jt}/L_{jt}}{\bar{K}/\bar{L}}\right) , \qquad (1)$$

where Y_{jt} is value added and I_{jt}^{pre} is the predicted cost share of the capital input for firm j at time t obtained by a fit from estimating the following:

$$I_{jt} = I_j + \beta_j \ln(K_{jt} / L_{jt}), \qquad (2)$$

where the cost share of the capital input in year t is:

$$I_{jt} = \frac{KCOST_{jt}}{KCOST_{jt} + LCOST_{jt}} , \qquad (3)$$

and where $KCOST_{jt}$ is the nominal capital costs, $LCOST_{jt}$ is the costs of labour (wages and social security payments, all from Financial Statistics) and I_j is the average cost share of the capital input. The capital costs are the sum of depreciation of the total capital stock and 5 percent of the net capital stock in current prices (evaluated with 15 depreciation in machinery and 7 in others). The share of capital in value added using firm-level data is rather volatile. This suggests measurement error, and the observed shares of capital are smoothed by using a predicted value I_{jt}^{pre} from the estimation of (2). This follows Harrigan (1997) that uses the properties of the translog production function to smooth the observed shares of capital. $\bar{I}$ denotes the average capital cost share among all plants in a given two-digit industry. The TFP of the benchmark plant is equal to one. $\bar{Y}$, $\bar{L}$ and $\bar{K}$ are the geometric means of value added, labour and capital, respectively, in each industry (Caves et al., 1982).

Let $H_{(k,\,t)}$ denote the number of workers in establishment k at time t who did not work at the establishment at time $t\text{-}1$ in Employee Statistics. $S_{(k,\,t)}$ is the number of workers in establishment i at time $t\text{-}1$ who do not work at the establishment at time t, $JD_{(k,\,t)} = \sum_i \Delta E_{ik}^{-}$ is the number of jobs lost, where E denotes employment in establishment k in year t and the superscript "-" refers to negative changes. These conventions mean that our measures of the hiring rate HRR, the separation rate SRR and separation rate in excess of job destruction rate, the excess worker reallocation rate EWR, for a given group of the workforce can be defined as follows:

$$\mathrm{HRR}_{(k,\,t)} = \sum \mathrm{H}_{(k,\,t)} \,/\, ((\textstyle\sum_i E_{it} + \sum_i E_{i,\,t-1})\,/2), \qquad (4)$$

$$\mathrm{SRR}_{(k,\,t)} = \sum \mathrm{S}_{(k,\,t)} \,/\, ((\textstyle\sum_i E_{it} + \sum_i E_{i,\,t-1})\,/2), \qquad (5)$$

$$\begin{aligned}\mathrm{EWR}_{(k,\,t)} &= \textstyle\sum (\mathrm{S}_{(k,\,t)} - \mathrm{JD}_{(k,\,t)}) / ((\sum_i E_{it} + \sum_i E_{i,\,t-1})\,/2)] \qquad (6)\\ &= 0.5 \textstyle\sum [(\mathrm{S}_{(k,\,t)} + \mathrm{H}_{(k,\,t)} - |\mathrm{H}_{(k,\,t)} - \mathrm{S}_{(k,\,t)}|)/\\ &\qquad ((\textstyle\sum_i E_{it} + \sum_i E_{i,\,t-1})\,/2)].\end{aligned}$$

The separation rate in excess of the job destruction rate $\mathrm{EWR}_{(k,\,t)}$ is referred to as excess worker reallocation. It is equal to one half of churning, as seen from the second equality in (6). At the industry level it also includes excess job reallocation, which is the difference between job reallocation and employment change (zero at the firm level).[4] Very short tenures and job relations are under-represented since there is no information on the division of the working months into other jobs within a year.

The original sample of Financial Statistics consists of 6,092 firms. The average size distribution of the final data of 5,361 observations is shown in Table A.2 in the Appendix. It also shows the sales-based inverse of sample weight used by Statistics Finland before 1995. In the firm-level regressions, the weights used are the sample weight times the average number of employees (corrected for the loss of small firms due to entering data one year only and thus omitted, see the third column). The plant-level job and worker flows are calculated from the 8,021,902 person-year observations from total data on employees that work at least one year in selected firms. Following the method by Baldwin, Dupuy and Penner (1992), the birth and death of firms are considered as a mere transfer of the firm, when persons employed either at the old firm at date t-1 or at the new firm at date t amount to more than 60 percent of all persons working in those firms at dates t-1 and t. Using this criterion, unreal deaths and births are less than two percent of all firm births and deaths and these firms are linked. Firm deaths and births are roughly one fourth of all job flows so that the worker reallocation rate is around 0.5 percent lower after this correction. The employee data on personnel in 5,361 selected firms cover 3,099,342 observations and 791,437 persons. The division of firms into industries and the formation of data from the original sample are shown in Appendix A.

4.2 Empirical Formulation

The basic model is

$$\ln(w_{ijt}) = \theta_i + \psi_j + \beta x_{it} + e_{ijt}, \qquad (7)$$

4 These identities follow from WR=EJR + CHR + |NET|, where WR=HR+SR is worker reallocation, EJR=JC+JD-|NET| is excess job reallocation, CHR is churning and NET is employment change at the industry level.

where the wage is explained by time-varying person characteristics: experience and time dummies, hence βx_{it} contains time dummies, a dummy indicating whether person i has switched jobs and experience up to the fourth power. The dummy is included to measure whether the time-varying compensations for experience differ for persons that frequently switch jobs. The subscript j refers to the firm as before, θ_i is the individual fixed effect, ψ_j the firm-specific payment, and e_{ijt} represents a statistical error term. The estimation proceeds by first estimating an equation where the wage is explained, in addition to experience, also by variables Z, which include interactions of person average and firm characteristics (interactions of average experience, seniority, average number of workers and industry dummies). The model is estimated in deviations from the individual means to purge the person fixed effects. The results of the estimation are shown in table A.2 in the Appendix. The subsequent error term includes, in addition to the original error e_{ijt}, the projection of the firm effects on the interaction variables. The person average of the original error e_{ijt} is the person effect. The person effect is decomposed into unobserved and education effects:

$$\theta_i = \alpha_i + u\eta_i + \varepsilon_i , \qquad (8)$$

using the variance of θ_i as the weight. α_i is the unobserved person effect and η_i is the education/sex effect for group u. The firm effect

$$\psi_j = \phi_j + \gamma_j seniority + \gamma_{2j} seniority^2 + h_j hirings \qquad (9)$$

includes a firm intercept ϕ_j, seniority slope γ_j, seniority slope squared γ_{2j} and hirings effect h_j. These also give the average of the marginal seniority effect $\gamma_j + 2 * \gamma_{2j} seniority$.

The explanatory variables are average firm-level excess worker reallocation, employment and performance. The estimation equation for excess worker reallocation EWR_j in firm j is

$$EWR_j = b_1 x\beta_j + b_2\alpha_j + b_3 u\eta_j + b_4\psi_j + b_5\kappa_j + \varepsilon_{jt} , \qquad (10)$$

where $x\beta_j$ is the average predicted effect of time-varying personal characteristics, α_j is the average of unobserved individual effects, $u\eta_j$ is the average of the education/sex effect, ψ_j is the average firm effect divided into the firm intercept, seniority and hirings effects, κ_j measures the firm-level factors: skilled share of labour, quasi rent, borrowing ratio and market share, and ε_{jt} is a statistical error. Firm factors include the deviation of quasi rent from its mean time quasi rent to capture its nonlinearity and interaction between quasi rent and experience effect.

5 WAGE COMPENSATIONS, R&D AND WORKER MOBILITY

Table A.1 in the Appendix shows the summary statistics for the variables used in the statistical analyses (see also figure 1 in section 2). The average borrowing ratio indicates that around 28 percent of the cash flow goes to capital expenditures from borrowing (doubled in the recession years 1991-1992). Valued added per labour is 769 on average and quasi rent per labour 614 614 (all in thousands of FIM at 1990 prices). The difference is explained by real wages (105 on average) and by compensations for capital. The average market share is a little below 1 percent and the average return on equity is close to zero.

Firms with an average of less than 20 employees in employee statistics are referred to as small firms. They all belong to the lowest firm-size group in the classification where each 20 firm-size class represents 5 percent of all employees recorded in the financial statistics (where small firms are under represented). These firms are contrasted with large firms with an average of 100 employees or more. Large firms typically belong to the firm-size class of between 15 and 30 in financial statistics that employ between 135 and 275 workers (the average size is 921). The firms larger in size than this are overrepresented in financial statistics, covering over 60 percent of the workforce. Table A.1 shows that, given the large weight on the 10 – 30 firm-size class, firm-level variables for large firms do not extensively differ from those for small firms. The background variables - borrowing ratio, quasi rent and profits per capita - receive approximately the same value. One distinction is that large firms have twice higher capital intensity and lower return on equity. Another is that in large firms the dispersion in wages and return on equity is significantly lower, while the variation in job turnover is larger than in small firms.

The estimation of dividing the person effect into unobserved human capital and education/sex effect is shown in Table A.3 in the Appendix. It is seen that the person effect is 32 percentage points higher in males than in females. This is roughly equal to the difference in the person effect between those with a master's degree and upper secondary education. Firms are divided into four groups depending on R&D intensity:

Table 2. R&D Intensity

Firm	Average R&D / Sales	Firms		Workers
No R&D	0%	4,290	3,294*	416,497
Low R&D-intensity	0.01%-0.99%	448	451*	200,004
Medium R&D-intensity	1% - 4%	385	385*	137,266
High R&D-intensity	4.01% -	238	229*	147,763
All		5,361	4,359*	901,530

* Firms recorded in Financial Statements Data. Total R&Ds are measured relative to total sales of the firm in the period that the firm enters the data.

Table 1 in Section 2 and Table A.1 in the Appendix indicate that wages are higher in R&D firms. In R&D firms annual wages are 123 000 (in 1990FIM), exceeding the average 113 000 by around ten percent. Hence, a substantial part of the firm-size premium is related to large R&D incentive firms. In the largest firm-size category consisting of 30 percent of the workforce the wage gap between firms with no R&D and non-zero R&D is around 30 000 (in 1990 FIM). This relates to the higher share of educated employees (see Table 1). It is noted before that there is no firm size premium in the technology firms with high R&D intensity above 4%. Hence, the firm-size effect is concentrated in firms where R&D intensity is non-zero but below 4 percent.

Following table shows compensations for education and firm-level payments in firms with zero, non-zero and high R&D intensity:

One can notice that there is no marked difference in educational payments in firms with zero and positive R&D investment. There is some positive wage premium in firms with higher R&D but it is always less than 5 000. However, as noted earlier, R&D-intensive firms have a higher share of educated and this explains most of the higher wages. This shows that compensations for education are transferable and should, therefore, earn the same return irrespective of firm size.

Figure 10. Compensations on Education and R&D Intensity

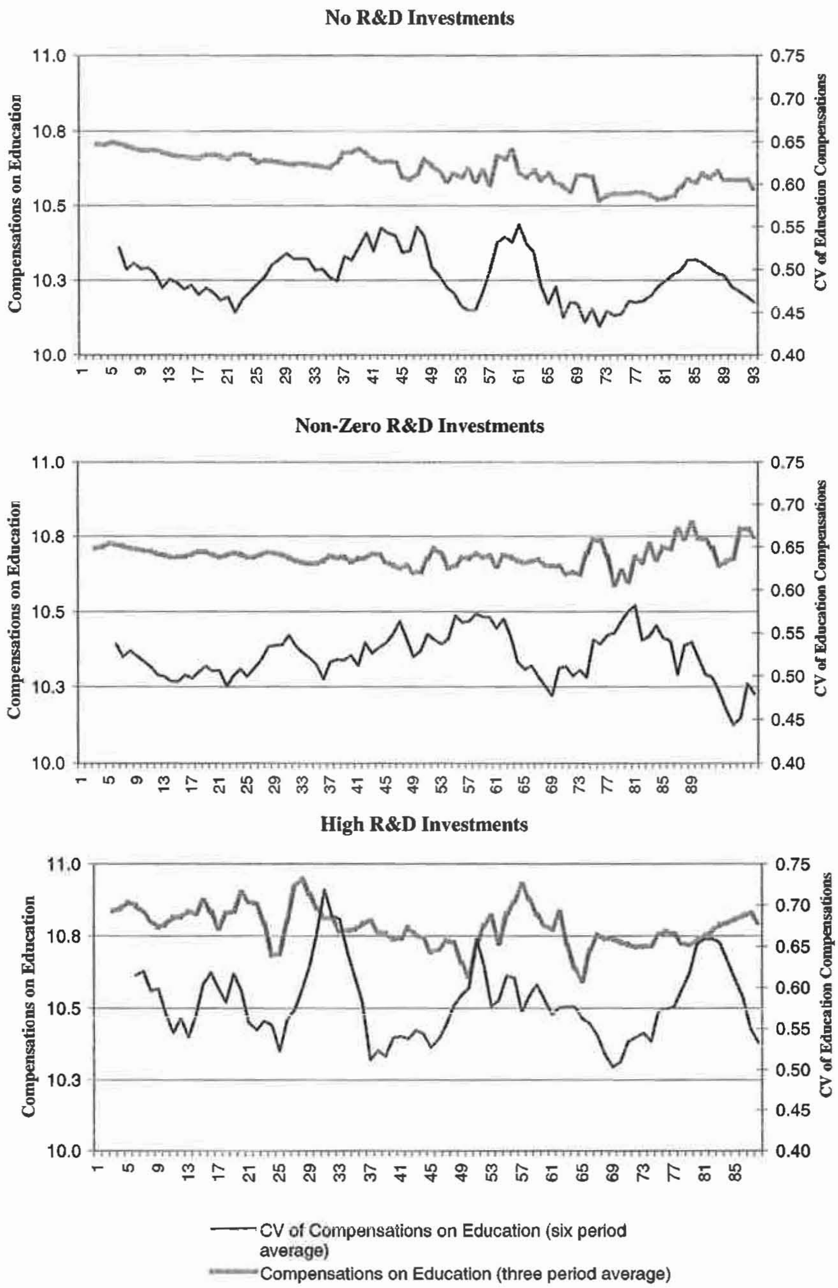
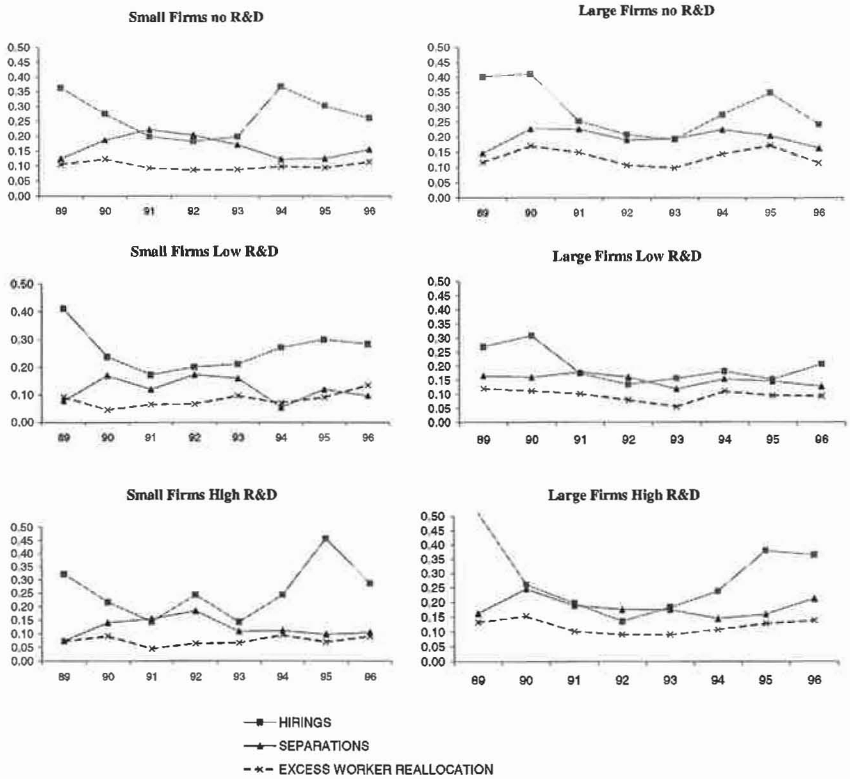


Figure 11. Hirings, Separations and Excess Worker Reallocation and Firm Size

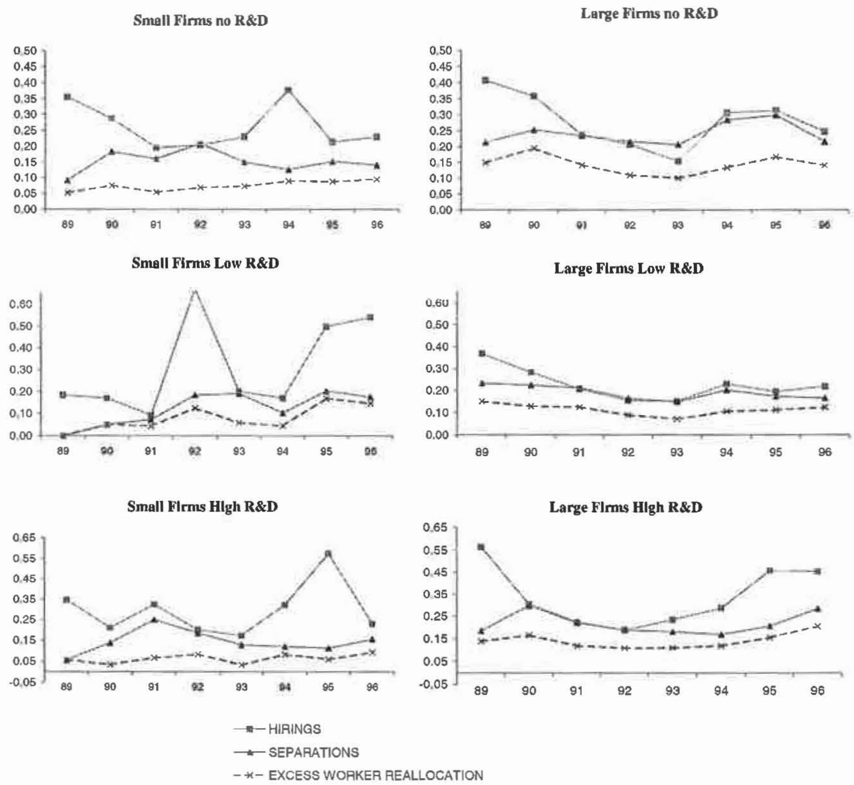


Let us next consider the role of R&D intensity in worker flows: hirings, separations and excess worker reallocation. The following figures 11 and 12 show these depending both on firm size and R&D intensity for all (fig. 11) and highly educated (fig. 12).

The figures show that cyclical variation in hirings has been as high in high R&D-intensive firms as in others and in small and large firms. Small firms have grown somewhat more extensively after a recession, as hirings have exceeded separations. One explanation for this can be that large firms have grown more abroad that is not recorded here.

Figure 12 shows that for the higher educated the cyclical variation is much the same as for all. In the large firms with non-zero but moderate R&D intensity the cyclical variation is lowest. For higher

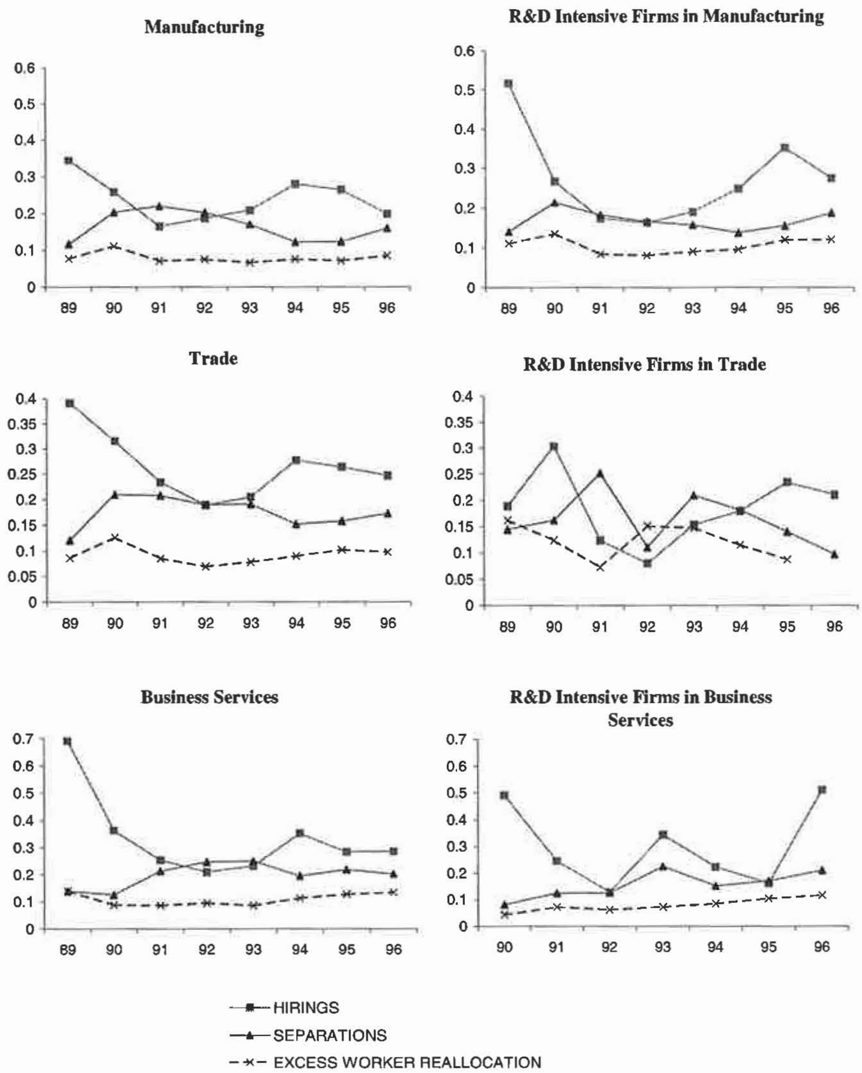
Figure 12. Hirings, Separations and Excess Worker Reallocation of Highly Educated and Firm Size



educated, excess worker reallocation is increasing over time. The following figure 13 shows employment in manufacturing, trade and business services in all and high R&D-intensive firms.

One can see that the employment patterns in R&D-intensive firms differ depending on the industry. Later, no direct positive relationship between R&D and employment is found for large firms. There is a decrease in hirings during recession in R&D-intensive firms in manufacturing. In trade there is a systematic trend downwards in employment. The firms have relied on internal growth as excess worker reallocation is also lower. In business services, hirings and worker reallocation have, on the other hand, increased considerably.

Figure 13. Hirings, Separations and Excess Worker Reallocation in Selected Industries



It was earlier argued that skill intensive firms might increase employment either through higher segregation of workers or through internal growth and low excess worker reallocation. It appears that firms with no R&D investment or high R&D intensity exercise, to a greater degree, the segregation of workers. Hirings and excess worker reallocation are extensive. Lazear's (1995) model of the recruitment of risky workers with option value applies (more evidence for this is given in the following section). Large firms with non-zero but low R&D intensity are, on the other hand, behind the firm-size premium that is explained by unobserved human capital. These firms can have a good reputation as being good wage payers. This decreases unwanted job seeking.

6 WAGE COMPENSATIONS AND MUTUAL DEPENDENCIES

Table 3 shows the means, standard deviation and correlation and Table 4 some correlations in four educational classes, using equations (8) and (9). The unobserved person and education/sex effects are weighted by the corresponding variance of the person effect.

From Tables 3 and 4 the total firm effect ψ_j correlates rather weakly with wages. From Table 4 the most positive correlation 0.11 exists between the firm effect of the uneducated and wages. From Table 3 it appears that fixed-term payment, the firm intercept ϕ (with mean value –0.061), has a large variance with a standard deviation of 0.1361. It correlates negatively with the short run seniority effect. This relates to the endogeneity of worker mobility and rent hopping. The new employer after a job switch pays high starting wages with low seniority payments from the first years in service (for discussion of rent hopping, see Teulings and Hartog, 1998). It is evident from Table 4 that the negative correlation is stronger for the higher educated workers, -0.34, indicating the importance of rent hopping.

Table 4 is based on estimations that include all employees and the correlations are calculated separately for the four education groups. Estimations included education dummies and Table 4 shows the correlations to the dummies (firm intercepts) of the education groups (employees with vocational certificates are the reference group). The important correlations are highlighted in Table 4.

One can see from Table 4 that the firm effect ψ_j and the firm intercept of those with basic education are strongly correlated, 0.49. For higher educated the corresponding correlation is very low around 0.13. The correlation of the firm effect ψ_j with short-run seniority payments is also high for lower educated, 0.35, as compared to higher educated, 0.15. All in all, the large compensations for the higher educated are rather independent of compensations paid to the rest of the workforce. They are based on longer run seniority payments. If higher educated are recruited, high starting wages associate with very moderate short-run seniority payments. Less educated have lower firm-level payments, which are mostly explained by high firm intercept.

Table 3. Summary Statistics and Correlations

Variable	Mean	Std. D.	lnw	$x\beta$	α	$u\eta$	ψ	ϕ	γ* Seniority	γ_2* Seniority^2	ρ * Hirings	ρ Hirings slope	R&D intensity
Log wages (1990 FIM)	11.5878	0.4894	1.0000	0.2828	0.6129	0.2607	0.0759	0.0052	-0.0250	0.0948	-0.0011	-0.0039	0.0241
$x\beta$	0.8117	0.2511	0.2828	1.0000	-0.0073	-0.2140	0.0115	-0.0250	-0.1677	0.2574	0.0002	0.0029	0.0063
α, Unobserved Human Capital	-0.0005	0.1227	0.6129	-0.0073	1.0000	0.0000	-0.0739	0.0342	-0.0356	-0.0185	-0.0304	-0.0248	0.0066
$u\eta$, Education/Sex Compensations	10.6866	0.0586	0.2607	-0.2140	0.0000	1.0000	0.0986	0.0036	0.0757	-0.0305	-0.0024	-0.0040	0.0397
ψ, Firm-Level Payments	-0.0655	0.0781	0.0759	0.0115	-0.0739	0.0986	1.0000	0.1006	0.3524	0.2862	0.0349	0.0024	0.0763
ϕ, Firm Intercept	-0.0606	0.1361	0.0052	-0.0250	0.0342	0.0036	0.1006	1.0000	-0.1852	0.0520	-0.9101	-0.6681	0.1147
γ * Seniority	-0.0345	0.1027	-0.0250	-0.1677	-0.0356	0.0757	0.3524	-0.1852	1.0000	-0.6447	0.0308	0.0375	0.0181
γ_2* Seniority^2	0.0288	0.0835	0.0948	0.2574	-0.0185	-0.0305	0.2862	0.0520	-0.6447	1.0000	-0.0160	-0.0243	-0.0350
ρ * Hirings	0.0008	0.1247	-0.0011	0.0002	-0.0304	-0.0024	0.0349	-0.9101	0.0308	-0.0160	1.0000	0.7157	-0.0152
ρ Hirings slope	0.0084	1.2430	-0.0039	0.0029	-0.0248	-0.0040	0.0024	-0.6681	0.0375	-0.0243	0.7157	1.0000	-0.0067
R&D Intensity	129.3451	444.4267	0.0241	0.0063	0.0066	0.0397	0.0763	0.1147	0.0181	-0.0350	-0.0152	-0.0067	1.0000

Correlations of α and η corrected for the sampling variance of the estimated effect.

Table 4. Summary Statistics and Correlations by Education Class

Variable	Mean	Std. D.	lnw	x β	α	$u\eta$	ψ	ϕ	ϕ Basic Education Dummy	ϕ Lower University Dummy	ϕ Higher University Dummy	γ · Seniority	γ_2 · Seniority^2	R&D intensity
x β Basic Education	**0.9481**	0.1837	**0.25**	1.00	-0.0830	**0.0235**	0.04	-0.02	0.00	0.00	0.01	-0.12	0.21	**0.014**
x β Vocational Certificates	**0.7651**	0.2428	**0.42**	1.00	-0.0174	**-0.0207**	0.05	-0.03	0.07	0.00	0.00	-0.12	0.24	**0.016**
x β Lower University	**0.6955**	0.2683	**0.57**	1.00	0.0745	**0.1184**	-0.01	-0.04	0.07	-0.08	-0.01	-0.12	0.20	**0.005**
x β Higher University	**0.5855**	0.0767	**0.61**	1.00	0.0982	**0.2421**	-0.01	-0.02	0.06	0.00	-0.05	-0.10	0.17	**0.023**
α Basic Education	**0.1261**	0.3222	0.64	-0.08	1.0000	0.0000	-0.13	0.02	-0.02	-0.01	-0.01	-0.04	-0.05	-0.001
α Vocational Certificates	**0.1631**	0.3268	0.62	-0.02	1.0000	0.0000	-0.05	0.04	0.02	-0.01	0.01	-0.02	-0.01	0.011
α Lower University	**0.2369**	0.3802	0.63	0.07	1.0000	0.0000	-0.05	0.03	0.02	-0.02	0.00	-0.05	0.04	0.013
α Higher University	**0.2715**	0.4097	0.61	0.10	1.0000	1.0000	0.01	0.01	-0.01	0.00	0.03	0.03	-0.04	0.008
$u\eta$ Basic Education	**10.52**	0.1589	**0.21**	0.02	0.0000	1.0000	0.19	0.02	0.13	-0.06	-0.05	0.07	0.01	0.043
$u\eta$ Vocational Certificates	**10.68**	0.1661	**0.62**	-0.02	0.0000	1.0000	-0.05	0.04	0.02	-0.01	0.01	-0.02	-0.01	0.011
$u\eta$ Lower University	**10.94**	0.1477	**0.19**	0.12	0.0000	1.0000	0.02	-0.07	0.07	-0.01	0.00	0.04	0.01	-0.003
$u\eta$ Higher University	**11.22**	0.1581	**0.19**	0.24	0.0000	1.0000	0.02	-0.04	0.04	0.00	0.01	0.04	-0.01	0.038
ψ Basic Education	-0.0834	0.1006	**0.11**	0.04	-0.1330	0.1897	1.00	0.18	**0.49**	**-0.11**	**-0.10**	**0.35**	0.34	0.072
ψ Vocational Certificates	-0.0581	0.0681	**0.07**	0.05	-0.0529	0.1251	1.00	0.09	**0.33**	**-0.11**	**-0.10**	**0.27**	0.27	0.082
ψ Lower University	-0.0531	0.0589	**0.03**	-0.01	-0.0503	0.0204	1.00	0.16	**0.20**	**0.18**	**-0.06**	**0.20**	0.19	0.056
ψ Higher University	-0.0491	0.0566	**0.06**	-0.01	0.0096	0.0228	1.00	0.15	**0.13**	**-0.01**	**0.21**	**0.15**	0.17	0.079
ϕ Basic Education	**-0.0852**	0.1248	0.02	-0.02	0.0227	0.0163	0.18	1.00	**1.00**	**-0.10**	**-0.13**	**-0.17**	0.02	0.137
Basic Education Dummy	-0.0248	0.0275	0.10	0.00	-0.0237	0.1327	0.49	0.30	1.00	-0.10	-0.12	0.11	-0.03	0.098
Lower University Dummy	0.0086	0.0332	-0.05	0.00	-0.0134	-0.0606	-0.11	-0.10	-0.10	1.00	0.15	-0.01	0.02	-0.094
Higher University Dummy	0.0158	0.0545	-0.03	0.01	-0.0125	-0.0544	-0.10	-0.13	-0.12	0.15	1.00	-0.02	0.01	-0.069
ϕ Vocational Certificates	**-0.0578**	0.1527	-0.01	-0.03	0.0227	0.0163	0.09	1.00	**0.12**	**-0.05**	**-0.05**	**-0.21**	**0.07**	0.115
Basic Education Dummy	-0.0235	0.0292	0.10	0.07	0.0177	0.0932	0.33	0.12	1.00	-0.06	-0.10	0.14	-0.02	0.085
Lower University Dummy	0.0079	0.0333	-0.04	0.00	-0.0145	-0.0588	-0.11	-0.05	-0.06	1.00	0.13	0.02	0.00	-0.092
Higher University Dummy	0.0151	0.0594	-0.03	0.00	0.0125	-0.0455	-0.10	-0.05	-0.10	0.13	1.00	-0.01	0.00	-0.061
ϕ Lower University	**-0.0504**	0.1157	-0.01	-0.04	0.0227	0.0163	0.16	1.00	**0.06**	**0.13**	**-0.05**	**-0.25**	**0.09**	0.062
Basic Education Dummy	-0.0217	0.0349	0.07	0.07	0.0239	0.0715	0.20	0.06	1.00	0.02	-0.07	0.08	-0.02	0.032
Lower University Dummy	0.0076	0.0285	-0.04	-0.08	-0.0232	-0.0121	0.18	0.13	0.02	1.00	**0.24**	0.03	-0.09	-0.047
Higher University Dummy	0.0159	0.0442	-0.01	-0.01	0.0037	0.0004	-0.06	-0.05	-0.07	**0.24**	1.00	0.06	-0.05	-0.040
ϕ Higher University	**-0.0437**	0.1311	-0.01	-0.02	0.0227	0.0163	0.15	1.00	**0.11**	**-0.01**	**0.27**	**-0.34**	**0.19**	0.097
Basic Education Dummy	-0.0227	0.0401	0.05	0.06	-0.0105	0.0409	0.13	0.11	1.00	0.05	-0.06	0.03	-0.01	0.041
Lower University Dummy	0.0064	0.0371	-0.01	0.00	0.0007	-0.0037	-0.01	-0.01	0.05	1.00	**0.19**	0.05	-0.03	-0.051
Higher University Dummy	0.0161	0.0404	0.00	-0.05	0.0285	0.0092	0.21	0.27	-0.06	**0.19**	1.00	**-0.25**	**0.11**	-0.069

First column shows correlations in each education groups: only basic education, vocational certificates, lower university and non-university degrees, and higher university degrees. In each estimation there is a intercept dummy for each education group (vocational certificates group is the reference). Correlations of α and η corrected for the sampling variance of the estimated effect.

One can also see from Table 4 that compensations for general experience are instead lower for the higher educated on average. However, it is evident that the correlation between compensations for experience and total wages is strongest for the higher educated.

Tables 5 through 10 show correlations for small and large firms in zero, low and high R&D-intensive firms.

One can first note that the firm effect ψ_j and the firm intercept ϕ and, especially, seniority effects are increasing in R&D intensity. Hence, the seniority profile deepens as R&D intensity goes up. From Table 9 the compensations for unobserved human capital are highest for large firms with non-zero but a moderate level of R&D. R&D intensity and unobserved human capital are also positively correlated in these large firms, 0.19.

In technology firms (R&D intensity above 4%) R&D intensity correlates positively with firm-level payments but not with unobserved human capital. The relatively large worker mobility associates not with high compensations for unobserved human capital, but with high firm-level payments. This finding gives support to the claim that fixed-term contracts and rent sharing are more important in high R&D-intensive large firms than in other large firms. The correlation between R&D and starting wages (firm intercept) is also high, 0.42. The technology firms use an educated workforce. The diffusion of human capital is large and the firm has an incentive to invest in general human capital and to share rents with employees.

The other possible factors explaining seniority payments are on-the-job training and the back loading of pay to give incentives to stay in the firm, see Lazear (1981). The last explanation is unconvincing, given the relatively large worker mobility. Excess worker reallocation of the higher educated, especially, is high and increasing over the period (see Figure 12). The rent sharing in large R&D-intensive firms aims at attracting new workers with large starting wages, whereas rent sharing in small firms lowers excess worker reallocation. The rent sharing in very R&D-intensive firms also takes place irrespective of firm size, since firm-size premium is low.

Table 5. Summary Statistics and Correlations in Small Firms Less Than 50 Employees Firms with No R&D

Variable	Mean	Std. D.	lnw	x β	α	uη	ψ	φ	γ*	γ_2*	ρ *	ρ
Log wages (1990 FIM)	11.5228	0.5359	1.0000	0.2604	0.6318	0.2406	0.1221	0.0298	-0.0012	-0.0032	-0.0058	-0.0127
x β	0.7894	0.2501	0.2604	1.0000	-0.0369	-0.1723	-0.1433	-0.0130	-0.0424	0.0186	0.0043	0.0104
α, Unobserved Human Capital	-0.0418	0.1219	0.6555	-0.0300	1.0000	0.0000	-0.0028	0.1162	-0.0213	-0.0284	-0.0971	-0.0813
uη, Education/Sex Compensations	10.7733	0.0605	0.2317	-0.2068	0.0000	1.0000	0.1109	0.0108	0.0366	-0.0138	-0.0085	-0.0170
ψ, Firm-Level Payments	-0.0713	0.0838	0.1221	-0.1433	-0.0856	-0.0119	1.0000	0.0533	0.1310	0.0354	0.0403	-0.0086
φ, Firm Intercept	-0.0543	0.4593	0.0298	-0.0130	0.0402	-0.0372	0.0533	1.0000	-0.2247	0.1641	-0.9641	-0.7342
γ * Seniority	-0.0165	0.2676	-0.0012	-0.0424	-0.0706	0.0170	0.1310	-0.2247	1.0000	-0.9212	0.0356	0.0468
γ_2* Seniority^2	-0.0005	0.1836	-0.0032	0.0186	-0.0042	-0.0149	0.0354	0.1641	-0.9212	1.0000	-0.0215	-0.0328
ρ * Hirings	0.0000	0.4406	-0.0058	0.0043	-0.0459	0.0290	0.0403	-0.9641	0.0356	-0.0215	1.0000	0.7489
ρ Hirings slope	-0.0289	3.6834	-0.0127	0.0104	-0.0136	-0.0013	-0.0086	-0.7342	0.0468	-0.0328	0.7489	1.0000
R&D Intensity	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 6. Summary Statistics and Correlations in Small Firms Less Than 50 Employees Low R&D Intensity

Variable	Mean	Std. D.	lnw	x β	α	uη	ψ	φ	γ*	γ_2*	ρ *	ρ
Log wages (1990 FIM)	11.6016	0.4710	1.0000	0.2743	0.6318	0.2406	0.0085	0.0253	-0.0809	0.0776	-0.0165	-0.0054
x β	0.8349	0.2314	0.2743	1.0000	-0.0369	-0.1723	0.0470	-0.0092	-0.1375	0.2330	-0.0045	-0.0016
α, Unobserved Human Capital	-0.0139	0.1197	0.6318	-0.0369	1.0000	0.0000	-0.0856	0.0402	-0.0706	-0.0042	-0.0459	-0.0136
uη, Education/Sex Compensations	10.7003	0.0512	0.2406	-0.1723	0.0000	1.0000	-0.0119	-0.0372	0.0170	-0.0149	0.0290	-0.0013
ψ, Firm-Level Payments	-0.0523	0.0803	0.0085	0.0470	-0.0856	-0.0119	1.0000	0.0997	0.4331	0.4427	0.0450	0.0065
φ, Firm Intercept	-0.0518	0.1380	0.0253	-0.0092	0.0402	-0.0372	0.0997	1.0000	-0.1291	0.0472	-0.9399	-0.8237
γ * Seniority	-0.0209	0.0719	-0.0809	-0.1375	-0.0706	0.0170	0.4331	-0.1291	1.0000	-0.4271	0.0697	0.1174
γ_2* Seniority^2	0.0216	0.0666	0.0776	0.2330	-0.0042	-0.0149	0.4427	0.0472	-0.4271	1.0000	-0.0523	-0.0848
ρ * Hirings	-0.0012	0.1318	-0.0165	-0.0045	-0.0459	0.0290	0.0450	-0.9399	0.0697	-0.0523	1.0000	0.8453
ρ Hirings slope	-0.0539	3.1345	-0.0054	-0.0016	-0.0136	-0.0013	0.0065	-0.8237	0.1174	-0.0848	0.8453	1.0000
R&D Intensity	5.4001	10.5093	0.1359	0.0220	0.1173	0.0692	-0.0124	-0.0381	-0.0344	0.1196	-0.0054	0.0047

Table 7. Summary Statistics and Correlations in Small Firms Less Than 50 Employees High R&D Intensity

Variable	Mean	Std. D.	lnw	x β	α	uη	ψ	φ	γ*	γ_2*	ρ *	ρ
Log wages (1990 FIM)	11.6088	0.5070	1.0000	0.3282	0.6407	0.1340	0.1906	0.0103	-0.0532	0.1388	0.0197	0.0091
x β	0.8156	0.2425	0.3282	1.0000	0.2070	-0.3750	0.2745	-0.0211	-0.0578	0.2747	0.0152	0.0118
α, Unobserved Human Capital	-0.0053	0.1245	0.6407	0.2070	1.0000	0.0000	0.0402	0.0373	-0.0649	0.0696	-0.0125	0.0023
uη, Education/Sex Compensations	10.7554	0.0602	0.1340	-0.3750	0.0000	1.0000	0.0326	0.0606	0.0088	-0.0416	-0.0183	-0.0040
ψ, Firm-Level Payments	-0.0430	0.0554	0.1906	0.2745	0.0402	0.0326	1.0000	0.0682	0.1269	0.3169	0.0587	0.0216
φ, Firm Intercept	-0.0647	0.1547	0.0103	-0.0211	0.0373	0.0606	0.0682	1.0000	-0.1611	0.0675	-0.9479	-0.7733
γ * Seniority	-0.0103	0.0899	-0.0532	-0.0578	-0.0649	0.0088	0.1269	-0.1611	1.0000	-0.7696	0.0137	-0.0057
γ_2* Seniority^2	0.0275	0.0779	0.1388	0.2747	0.0696	-0.0416	0.3169	0.0675	-0.7696	1.0000	-0.0107	-0.0016
ρ * Hirings	0.0045	0.1495	0.0197	0.0152	-0.0125	-0.0183	0.0587	-0.9479	0.0137	-0.0107	1.0000	0.8125
ρ Hirings slope	0.0623	1.9301	0.0000	0.0000	0.0023	-0.0040	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R&D Intensity	140.9128	346.5019	0.0692	0.0421	0.0744	0.0628	0.0614	0.0611	-0.0819	0.0295	-0.0154	-0.0135

Correlations of α and η corrected for the sampling variance of the estimated effect.

Table 8. Summary Statistics and Correlations in Large Firms Over 100 Employees No R&D

Variable	Mean	Std. D.	lnw	$x\beta$	α	$u\eta$	ψ	ϕ	γ_*	γ_{2*}	ρ^*	ρ
Log wages (1990 FIM)	11.4363	0.5370	1.0000	0.3566	0.6483	0.2139	0.0140	0.0674	-0.0702	0.0639	0.0251	0.0229
$x\beta$	0.7794	0.2862	0.3566	1.0000	0.0312	-0.2535	-0.2626	-0.0395	-0.3822	0.2918	0.0017	0.0160
α, Unobserved Human Capital	0.0372	0.1106	0.6483	0.0312	1.0000	0.0000	-0.0205	0.0390	-0.0622	0.0081	0.0232	0.0140
$u\eta$, Education/Sex Compensations	10.7276	0.0585	0.2139	-0.2535	0.0000	1.0000	0.1963	0.0346	0.2133	-0.1201	0.0193	0.0368
ψ, Firm-Level Payments	-0.0895	0.0735	0.0140	-0.2626	-0.0205	0.1963	1.0000	0.2274	0.7443	-0.0152	0.1112	0.0643
ϕ, Firm Intercept	-0.0470	0.0440	0.0674	-0.0395	0.0390	0.0346	0.2274	1.0000	-0.0507	-0.0414	-0.6509	-0.5543
γ * Seniority	-0.0605	0.0813	-0.0702	-0.3822	-0.0622	0.2133	0.7443	-0.0507	1.0000	-0.5617	0.0467	0.0638
γ_{2*} Seniority^2	0.0170	0.0461	0.0639	0.2918	0.0081	-0.1201	-0.0152	-0.0414	-0.5617	1.0000	0.0071	0.0168
ρ * Hirings	0.0011	0.0327	0.0251	0.0017	0.0232	0.0193	0.1112	-0.6509	0.0467	0.0071	1.0000	0.7084
ρ Hirings slope	0.0114	0.1881	0.0229	0.0160	0.0140	0.0368	0.0643	-0.5543	0.0638	0.0168	0.7084	1.0000
R&D Intensity	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 9. Summary Statistics and Correlations in Large Firms Over 100 Employees Low R&D Intensity

Variable	Mean	Std. D.	lnw	$x\beta$	α	$u\eta$	ψ	ϕ	γ_*	γ_{2*}	ρ^*	ρ
Log wages (1990 FIM)	11.6785	0.4411	1.0000	0.2318	0.6042	0.2519	-0.0523	-0.0540	-0.1916	0.1356	-0.0177	-0.0684
$x\beta$	0.8417	0.2316	0.2318	1.0000	-0.0679	-0.2203	0.0306	-0.0791	-0.2950	0.3277	0.0080	-0.0074
α, Unobserved Human Capital	0.0889	0.1093	0.6042	-0.0679	1.0000	0.0000	-0.2333	-0.0292	-0.1414	-0.1317	-0.0131	-0.0546
$u\eta$, Education/Sex Compensations	10.7064	0.0535	0.2519	-0.2203	0.0000	1.0000	0.0092	0.0242	0.0492	-0.0359	-0.0326	-0.0388
ψ, Firm-Level Payments	-0.0741	0.0961	-0.0523	0.0306	-0.2333	0.0092	1.0000	0.2352	0.5467	0.5261	0.1619	0.1232
ϕ, Firm Intercept	-0.0742	0.0506	-0.0540	-0.0791	-0.0292	0.0242	0.2352	1.0000	0.0218	-0.3316	-0.1147	-0.0806
γ * Seniority	-0.0404	0.0690	-0.1916	-0.2950	-0.1414	0.0492	0.5467	0.0218	1.0000	-0.2247	0.0590	0.1127
γ_{2*} Seniority^2	0.0405	0.0829	0.1356	0.3277	-0.1317	-0.0359	0.5261	-0.3316	-0.2247	1.0000	-0.0029	-0.0349
ρ * Hirings	0.0000	0.0175	-0.0177	0.0080	-0.0131	-0.0326	0.1619	-0.1147	0.0590	-0.0029	1.0000	0.6286
ρ Hirings slope	0.0033	0.0918	-0.0684	-0.0074	-0.0546	-0.0388	0.1232	-0.0806	0.1127	-0.0349	0.6286	1.0000
R&D Intensity	12.0929	17.7868	0.1745	-0.0008	0.0587	0.1968	0.1105	-0.0553	-0.0077	0.1971	-0.1081	-0.1168

Table 10. Summary Statistics and Correlations in Large Firms Over 100 Employees High R&D Intensity

Variable	Mean	Std. D.	lnw	$x\beta$	α	$u\eta$	ψ	ϕ	γ_*	γ_{2*}	ρ^*	ρ
Log wages (1990 FIM)	11.6979	0.4233	1.0000	0.1908	0.4943	0.2484	0.0995	0.0222	-0.0474	0.0902	0.0313	0.0002
$x\beta$	0.8110	0.2383	0.1908	1.0000	-0.0557	-0.3120	0.3348	-0.0737	-0.2899	0.5204	0.0057	0.0136
α, Unobserved Human Capital	0.0645	0.1012	0.4943	-0.0557	1.0000	0.0000	-0.1076	-0.0558	0.0167	-0.0788	0.0259	-0.0008
$u\eta$, Education/Sex Compensations	10.7806	0.0660	0.2484	-0.3120	0.0000	1.0000	-0.0592	0.0738	0.0949	-0.1781	0.0101	-0.0003
ψ, Firm-Level Payments	-0.0508	0.0644	0.0995	0.3348	-0.1076	-0.0592	1.0000	0.4166	0.0096	0.5467	0.1111	0.0553
ϕ, Firm Intercept	-0.0772	0.0531	0.0222	-0.0737	-0.0558	0.0738	0.4166	1.0000	0.0155	-0.2492	-0.3949	-0.3774
γ * Seniority	-0.0255	0.0416	-0.0474	-0.2899	0.0167	0.0949	0.0096	0.0155	1.0000	-0.5925	0.0324	0.0618
γ_{2*} Seniority^2	0.0507	0.0718	0.0902	0.5204	-0.0788	-0.1781	0.5467	-0.2492	-0.5925	1.0000	0.0539	0.0654
ρ * Hirings	0.0012	0.0229	0.0313	0.0057	0.0259	0.0101	0.1111	-0.3949	0.0324	0.0539	1.0000	0.7135
ρ Hirings slope	0.0109	0.1099	0.0000	0.0000	-0.0008	-0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R&D Intensity	375.6406	734.2850	0.0392	0.0480	0.0428	-0.0215	0.2254	0.4191	0.0969	-0.1540	-0.0864	-0.1582

Correlations of α and η corrected for the sampling variance of the estimated effect.

It is argued in Piekkola (2000) that in large firms with over 250 employees high wages and the firm effect are due to compensations for longer seniority, since the correlation between the firm effect and long run seniority is larger than in small firms. One can see from Tables 8 through 10 that the firm effect strongly correlates with long run seniority payments in large technology firms with high R&D intensity. This positive relation also holds for small firms that have R&D. It is evident that Lazear's model of recruiting risky workers with an option value is valid.

It is finally seen from Tables 5-10 that seniority effects squared (γ_{2*} Seniority^2) correlates with experience payments $x\beta_j$ and relatively more so in large firms and R&D-intensive firms. This gives evidence that the wage profile is steep for experienced personnel and not only for new workers. Experienced personnel have a substantially steeper wage profile, which is reinforced by the negative correlation between experience and short run seniority payments. It also appears that firm-level payments are higher for the experienced in R&D-intensive firms. Hence, young workers may not only have to accept a flatter wage profile but the wage level is also lower than for experienced workers.

From the positive hirings effect, it is seen that compensations are higher when the firm recruits more people. But the recruiting costs appear to be lower in large firms, irrespective of R&D intensity. This is seen from the comparison of the means of the hirings effect in small and large firms. Hence, the size of the available labour pool does not limit the amount recruited by large firms, as Weiss and Landau (1984) claim. Extensive recruitment lowers the fixed hiring costs per worker, which can be behind the large recruitment of risky workers. One can also see that in small firms there is strong negative correlation between starting wages and the hirings effect. Small firms that recruit a lot of personnel have to pay substantially higher wages.

7 WORKER MOBILITY EFFECTS

Table 11 depicts hirings, employment and excess worker reallocation effects, which are shown in Tables 12 and 13 separately for small and large firms.

One can see from Table 11 that average hirings effects (last column) are fairly similar to the employment effects (second column). This is in line with the argument that firms adjust the size of personnel primarily through recruitment. Compensations for education/sex, $u\eta$, have a stronger effect on employment than on hirings. Employment also improves because separations go down. A 60 percent rise in compensations on education (a difference between employees having a master's degree and upper secondary education) implies an increase in the employment rate by 20 percentage points. The strong effect is in line with our argument that educational abilities are transferable. It can be seen from Table 13 that educational compensations also raise excess worker reallocation in large firms. This may explain the less favourable employment performance in large firms. An educated workforce switches jobs relatively frequently and much of the payments are paid to lower this.

Large payments on unobserved human capital, α, have a negative effect on employment if the firm is small in size. In large firms, there is no strong or positive relation between high wages and employment. One can see that unobserved human capital is less transferable and explains employment changes less than compensations for education. As seen, the opposite is true for compensations for education that are paid to attract new workers. This also implies that wage elasticity with respect to employment is positive rather than negative.

Table 11 shows that the share of the educated workforce has a positive effect on employment. From Table 12 the positive effect in small firms is limited to those that practise R&D. Hence, the spillover effect of the share of the educated to total employment is most evident in large firms.

Maliranta (2000) has shown that employment creation has been higher in R&D-intensive firms. We can see from Table 11 that R&D intensity has a positive effect on employment.

Table 11. R&D and Excess Worker Reallocation, Employment and Compensation Policies

Dependent Variable	Excess Worker Reallocation		Employment Rate		Excess Worker Reallocation in Small Firms (< 20)		Excess Worker Reallocation in Large Firms (> 100)		Hirings	
Variable	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**
R&D Intensity	0.040	(1.5)	0.485	**(4.4)**	0.051	(1.6)	0.348	**(3.0)**	0.514	**(2.0)**
Average Predicted Effect of Time Varying Variables (xβ)	-0.252	**(21.1)**	-0.317	**(6.4)**	-0.228	**(15.4)**	-0.291	**(10.5)**	-0.524	**(5.3)**
Average Unobserved Human Capital (α)	-0.015	**(2.4)**	0.095	**(3.7)**	-0.003	(0.4)	-0.036	**(2.1)**	0.067	**(4.3)**
Average (α), R&D Intensity	0.000	(0.3)	-0.009	(1.4)	-0.004	**(2.1)**	0.008	**(1.9)**	-0.009	**(1.8)**
Average Education Effect (uη)	0.036	**(2.0)**	0.304	**(4.2)**	0.036	**(1.6)**	0.096	**(2.5)**	0.338	(1.0)
Average Education Effect (uη), R&D	-0.004	(1.5)	-0.046	**(4.4)**	-0.005	(1.6)	-0.033	**(3.0)**	-0.048	(0.7)
Average Firm Effect Intercept (ϕ)	-0.021	**(3.5)**	-0.018	(0.8)	-0.023	**(4.0)**	-0.021	(0.4)	-0.042	(0.1)
Average Hirings Effect	-0.019	**(2.0)**	-0.040	(1.0)	-0.028	**(2.8)**	0.124	**(2.2)**	-0.062	**(2.1)**
Average Seniority Effect	0.025	**(4.2)**	0.001	(0.1)	0.031	**(5.0)**	0.020	(0.7)	0.028	(1.2)
Average Seniority Effect, R&D	0.001	(1.3)	0.002	(1.1)	0.001	**(2.8)**	-0.007	(1.3)	0.003	**(1.8)**
Higher Educated/Employees	-0.030	**(2.8)**	0.089	**(2.0)**	-0.015	(1.1)	-0.074	**(3.1)**	0.050	(1.6)
Higher Educated/Employees, R&D	0.003	(1.5)	0.026	**(3.7)**	0.005	**(2.1)**	0.017	**(2.8)**	0.028	**(2.1)**
Log(Capital/L)	0.000	(0.2)	-0.027	**(7.3)**	0.000	(0.2)	0.007	**(3.4)**	-0.025	**(2.0)**
Quasi-Rent/L/100	0.000	**(2.5)**	0.000	(1.1)	0.000	**(2.0)**	0.000	**(2.8)**	0.000	**(3.0)**
Borrowing ratio	0.001	(0.4)	-0.006	(0.5)	0.002	(0.6)	-0.004	(0.7)	0.012	(1.3)
Market Share	0.000	(1.5)	-0.001	(1.3)	0.000	(0.2)	0.001	(3.4)	-0.001	(0.1)
Average employees < 7	-0.011	**(2.7)**	0.030	**(1.8)**					0.033	(0.6)
Average employees 7-19	-0.004	**(2.1)**	0.000	(0.0)					-0.001	**(2.2)**
Average employees 50-99	0.002	(1.7)	0.002	(0.4)					0.004	**(1.8)**
Average employees 100-499	0.001	(1.6)	0.015	**(5.5)**					0.017	**(2.5)**
Average employees > 500	0.003	**(4.6)**	0.027	**(10.9)**					0.031	**(7.5)**
Sample size	4082		4082		2536		870		4082	
Coefficient Degrees of Freedom	48		48		43		41		48	
Root Mean Squared Error	0.8953		3.7011		0.8720		1.0228		3.6355	
R2	0.2032		0.1385		0.1654		0.3515		0.1882	

The dummies include 28 industry dummies. The logarithmic difference in employment is between the last and first year the firm is observed. All estimations are ordinary least squares using appropriate firm employment weights, see section 2.

Table 12. R&D, Hirings and Excess Worker Reallocation in Small Firms, personnel <=50

Dependent Variable	Hirings		Excess Worker Reallocation		Employment Rate	
Variable	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**
R&D Intensity	0.569	**(6.0)**	0.051	(1.6)	0.508	**(5.2)**
Average Predicted Effect of Time Varying Variables (xβ)	-0.540	**(12.3)**	-0.228	**(15.4)**	-0.340	**(7.5)**
Average Unobserved Human Capital Effect (α)	-0.017	(0.8)	-0.003	(0.4)	0.002	(0.1)
Average (α), R&D Intensity	-0.012	**(2.3)**	-0.004	**(2.1)**	-0.009	(1.7)
Average Education Effect (uη)	0.164	**(2.5)**	0.036	(1.6)	0.167	**(2.5)**
Average Education Effect (uη), R&D	-0.053	**(5.9)**	-0.005	(1.6)	-0.047	**(5.1)**
Average Firm Effect Intercept (ϕ)	-0.049	**(2.8)**	-0.023	**(4.0)**	-0.024	(1.4)
Average Hirings Effect	-0.061	**(2.1)**	-0.028	**(2.8)**	-0.034	(1.2)
Average Seniority Effect (γ+2*seniority*γ^2)	0.038	**(2.1)**	0.031	**(5.0)**	0.013	(0.7)
Average Seniority Effect, R&D	0.000	(0.1)	0.001	**(2.8)**	-0.002	(1.1)
Higher Educated/Employees	-0.046	(1.2)	-0.015	(1.1)	-0.055	(1.4)
Higher Educated/Employees, R&D	0.016	**(2.4)**	0.005	**(2.1)**	0.010	(1.5)
Log(Capital/L)	-0.004	(1.1)	0.000	(0.2)	-0.005	(1.5)
Quasi-Rent/L/100	0.000	(0.5)	0.000	**(2.0)**	0.000	(0.8)
Borrowing ratio	-0.012	(1.0)	0.002	(0.6)	-0.029	**(2.4)**
Market Share	0.004	**(2.0)**	0.000	(0.2)	0.004	**(2.1)**
Sample size	2536		2536		2536	
Coefficient Degrees of Freedom	43		43		45	
Root Mean Squared Error	2.5747		0.8720		2.6381	
R^2	0.1533		0.1654		0.0818	

The dummies include 28 industry dummies. The logarithmic difference in employment is between the last and first year the firm is observed. All estimations are weighted ordinary least squares.

Table 13. R&D, Hirings and Excess Worker Reallocation in Large Firms, personnel >=100

Dependent Variable	Hirings		Excess Worker Reallocation		Employment Rate	
Variable	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**
R&D Intensity	-0.033	(0.1)	0.348	**(3.0)**	-0.236	(0.4)
Average Predicted Effect of Time Varying Variables (xβ)	-0.363	**(2.3)**	-0.291	**(10.5)**	-0.151	(1.0)
Average Unobserved Human Capital Effect (α)	0.142	(1.4)	-0.036	**(2.1)**	0.213	**(2.2)**
Average (α), R&D Intensity	-0.006	(0.3)	0.008	**(1.9)**	-0.022	(0.9)
Average Education Effect (uη)	0.458	**(2.0)**	0.096	**(2.5)**	0.346	(1.6)
Average Education Effect (uη), R&D	0.002	(0.0)	-0.033	**(3.0)**	0.021	(0.3)
Average Firm Effect Intercept (ϕ)	0.568	**(2.1)**	-0.021	(0.4)	0.645	**(2.4)**
Average Hirings Effect	0.055	(0.2)	0.124	**(2.2)**	-0.026	(0.1)
Average Seniority Effect (γ+2*seniority*γ^2)	-0.396	**(2.6)**	0.020	(0.7)	-0.409	**(2.7)**
Average Seniority Effect, R&D	0.038	(1.3)	-0.007	(1.3)	0.036	(1.2)
Higher Educated/Employees	0.349	**(2.5)**	-0.074	**(3.1)**	0.403	**(2.9)**
Higher Educated/Employees, R&D	0.006	(0.2)	0.017	**(2.8)**	0.003	(0.1)
Log(Capital/L)	-0.054	**(4.8)**	0.007	**(3.4)**	-0.069	**(6.2)**
Quasi-Rent/L/100	0.001	(0.7)	0.000	**(2.8)**	0.001	(1.7)
Borrowing ratio	0.028	(0.9)	-0.004	(0.7)	0.017	(0.5)
Market Share	0.001	(0.9)	0.001	**(3.4)**	-0.001	(1.1)
Sample size	870		870		870	
Coefficient Degrees of Freedom	41		41		42	
Root Mean Squared Error	5.8821		1.0228		5.8309	
R^2	0.2531		0.3515		0.2518	

The dummies include 28 industry dummies. The logarithmic difference in employment is between the last and first year the firm is observed. All estimations are weighted ordinary least squares.

The earlier figures 11 and 12 in Chapter 5 show rather moderate differences in hirings and separation rates depending on R&D. However, it turns out from Table 12 that the R&D investment raises hirings and employment in small firms. But the interaction terms of R&D with human capital compensations for education and unobserved human capital are negative. From Table 13 in large firms R&D has no positive effect on employment and the interaction terms of R&D with human capital compensations are insignificant.

One reason for the moderate effect in large firms can be that those skill intensive large firms with a lot of R&D and human capital practise segregation of workers. Firms recruit a more skilled workforce at the expense of an unskilled which leads to lower overall employment. Another reason is that it takes time before R&D results in an increase in production and employment. Large firms with low R&D intensity also rely more on international growth. This was most evident in trade, where restructuring of the industry has been extensive.

Finally, Table 13 for large firms shows that firm-level payments, firm intercept, work in the direction of raising employment. In Table 12 for small firms there is a negative effect on hirings, but the lower separations leave the employment change insignificant. One can see that firm-level payments in small firms relate to fixed-term payments that aim at reducing excess worker reallocation of workers. In large firms fixed-term payments more clearly relate to rent sharing to attract new workers. High firm-level wages works as an incentive for new employees to enter and not for old workers not to leave (see also the deeper seniority profile in table 9). This is most evident for firms with high R&D intensity.

One can next consider the higher educated workers in Tables 14 through 15. R&D is presumably used by educated personnel in particular. Tables 14 through 16 show the figures for the higher educated.

Tables 15 and 16 show that the employment of the higher educated is increased by R&D investment in small firms. In large firms R&D has no positive effect on the demand for the higher educated. Remember that in Table 13 in large firms the interaction of R&D with the share of educated labour, anyhow, had a positive effect on the total employment. The following table summarizes all our main findings.

Table 14. R&D and Excess Worker Reallocation, Employment and Compensation Policies for Highly Educated

Dependent Variable	Excess Worker Reallocation of Highly Educated		Employment Rate of Highly Educated		Excess Worker Reallocation in Small Firms (< 20)		Excess Worker Reallocation in Large Firms (> 100)		Hirings of Highly Educated	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
R&D Intensity	0.000	(0.4)	0.002	(1.3)	-0.002	(0.9)	-0.002	(1.0)	0.004	**(2.0)**
Average Predicted Effect of Time Varying Variables ($x\beta$)	-0.169	**(3.6)**	-0.042	(1.2)	-0.023	(0.3)	-0.213	**(2.9)**	-0.428	**(5.3)**
Average Unobserved Human Capital (α)	-0.009	(0.3)	0.073	**(3.7)**	-0.014	(0.3)	-0.008	(0.2)	0.207	**(4.3)**
Average (α), R&D Intensity	-0.093	(1.0)	0.087	(1.0)	-0.128	(1.3)	0.009	(0.0)	-0.296	**(1.8)**
Average Education Effect ($u\eta$)	0.043	(0.6)	0.055	(1.0)	0.279	**(2.1)**	-0.169	(1.6)	0.128	(1.0)
A. Education Effect ($u\eta$) of Educated	0.030	(0.1)	0.561	**(2.3)**	-0.135	(1.6)	0.415	**(5.3)**	0.046	(0.7)
Average Firm Effect Intercept (ϕ)	0.062	(0.8)	-0.013	(0.8)	0.000	(0.0)	0.019	(0.1)	-0.007	(0.1)
Average Hirings Effect	0.360	**(1.8)**	0.101	(0.8)	-0.020	(0.1)	2.767	**(3.7)**	0.540	**(2.1)**
Average Seniority Effect	0.017	(0.2)	-0.037	(1.3)	0.046	(0.5)	-0.372	(1.5)	-0.112	(1.2)
A. Seniority Effect of Educated	-0.041	(0.8)	0.039	**(2.2)**	-0.009	(0.2)	0.001	(0.0)	0.093	**(1.8)**
Higher Educated/Employees	0.410	(0.2)	6.075	**(2.3)**	0.059	(0.8)	0.032	(0.3)	-0.161	(1.6)
Higher Educated/Employees, R&D	-0.056	(1.2)	0.176	**(4.8)**	-0.213	**(3.1)**	0.004	(0.0)	0.164	**(2.1)**
Log(Capital/L)	0.001	(0.4)	-0.003	(1.5)	0.003	(0.9)	0.006	(1.4)	-0.007	**(2.0)**
Quasi-Rent/L/100	-0.001	(0.2)	-0.012	**(4.4)**	-0.005	(0.6)	0.003	(0.6)	-0.018	**(3.0)**
Borrowing ratio	0.000	**(1.8)**	0.000	(1.4)	0.000	(0.9)	0.000	(1.2)	0.000	(1.3)
Market Share	-0.013	(1.2)	-0.003	(0.4)	0.010	(0.5)	-0.028	**(2.0)**	-0.002	(0.1)
Average employees < 7	0.000	(0.3)	-0.001	**(2.6)**					0.000	(0.6)
Average employees 7-19	0.047	**(1.9)**	-0.005	(0.5)					-0.072	**(2.2)**
Average employees 50-99	0.017	(1.7)	-0.002	(0.4)					-0.025	**(1.8)**
Average employees 100-499	-0.003	(0.8)	0.004	(1.6)					0.015	**(2.5)**
Average employees > 500	-0.011	**(3.7)**	0.012	(6.3)					0.031	**(7.5)**
Sample size	1035		4082		297		548		2304	
Coefficient Degrees of Freedom	48		49		38		41		49	
Root Mean Squared Error	1.7885		2.6305		1.3136		2.0417		4.3890	
Adjusted R^2	0.2300		0.2445		0.3621		0.2847		0.2259	

The dummies include 28 industry dummies. The logarithmic difference in employment is between the last and first year the firm is observed. All estimations are ordinary least squares using appropriate firm employment weights.

Table 15. R&D, Hirings and Excess Worker Reallocation in Small Firms, personnel <=50

Dependent Variable	Hirings of Highly Educated		Excess Worker Reallocation of Highly Educated		Employment Rate of Highly Educated	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
R&D Intensity	0.569	**(6.0)**	-0.002	(0.9)	0.010	**(9.8)**
Average Predicted Effect of Time Varying Variables (xβ)	-0.540	**(12.3)**	-0.023	(0.3)	-0.060	**(2.3)**
Average Unobserved Human Capital	-0.017	(0.8)	-0.014	(0.3)	0.028	**(2.1)**
Average (α), R&D Intensity	-0.012	**(2.3)**	-0.128	(1.3)	0.038	(0.7)
Average Education Effect (uη)	0.164	**(2.5)**	0.279	**(2.1)**	-0.031	(0.8)
A. Education Effect (uη) of Educated	-0.053	**(5.9)**	-0.135	(1.6)	0.150	(1.0)
Average Firm Effect Intercept (ϕ)	-0.049	**(2.8)**	0.000	(0.0)	-0.005	(0.5)
Average Hirings Effect	-0.061	**(2.1)**	-0.020	(0.1)	0.233	**(3.3)**
Average Seniority Effect	0.038	**(2.1)**	0.046	(0.5)	-0.023	(1.3)
A. Seniority Effect of Educated	0.000	(0.1)	-0.009	(0.2)	0.014	(1.3)
Higher Educated/Employees	-0.046	(1.2)	0.059	(0.8)	1.415	(0.8)
Higher Educated/Employees, R&D	0.016	**(2.4)**	-0.213	**(3.1)**	-0.005	(0.2)
Log(Capital/L)	-0.004	(1.1)	0.003	(0.9)	-0.016	**(9.7)**
Quasi-Rent/L/100	0.000	(0.5)	-0.005	(0.6)	0.005	**(2.3)**
Borrowing ratio	-0.012	(1.0)	0.000	(0.9)	0.000	(0.2)
Market Share	0.004	**(2.0)**	0.010	(0.5)	-0.006	(0.8)
Sample size	2536		297		2536	
Coefficient Degrees of Freedom	43		38		46	
Root Mean Squared Error	2.5747		1.3136		1.4931	
R^2	0.1533		0.3621		0.1358	

The dummies include 28 industry dummies. The logarithmic difference in employment is between the last and first year the firm is observed. All estimations are weighted ordinary least squares.

Table 16. R&D, Hirings and Excess Worker Reallocation in Large Firms, personnel >=100

Dependent Variable	Hirings of Highly Educated		Excess Worker Reallocation of Highly Educated		Employment Rate of Highly Educated	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
R&D Intensity	-0.033	(0.1)	-0.002	(1.0)	-0.003	(0.9)
Average Predicted Effect of Time Varying Variables (xβ)	-0.363	**(2.3)**	-0.213	**(2.9)**	-0.017	(0.1)
Average Unobserved Human Capital	0.142	(1.4)	-0.008	(0.2)	0.166	**(2.1)**
Average (α), R&D Intensity	-0.006	(0.3)	0.009	(0.0)	0.114	(0.2)
Average Education Effect (uη)	0.458	**(2.0)**	-0.169	(1.6)	0.104	(0.6)
A. Education Effect (uη) of Educated	0.002	(0.0)	0.415	**(5.3)**	2.887	**(2.4)**
Average Firm Effect Intercept (ϕ)	0.568	**(2.1)**	0.019	(0.1)	0.089	(0.4)
Average Hirings Effect	0.055	(0.2)	2.767	**(3.7)**	-1.026	(0.9)
Average Seniority Effect	-0.396	**(2.6)**	-0.372	(1.5)	-0.131	(0.4)
A. Seniority Effect of Educated	0.038	(1.3)	0.001	(0.0)	0.172	(1.5)
Higher Educated/Employees	0.349	**(2.5)**	0.032	(0.3)	32.537	**(2.4)**
Higher Educated/Employees, R&D	0.006	(0.2)	0.004	(0.0)	0.621	**(4.4)**
Log(Capital/L)	-0.054	**(4.8)**	0.006	(1.4)	0.005	(0.6)
Quasi-Rent/L/100	0.001	(0.7)	0.003	(0.6)	-0.043	**(5.0)**
Borrowing ratio	0.028	(0.9)	0.000	(1.2)	0.002	**(2.8)**
Market Share	0.001	(0.9)	-0.028	**(2.0)**	0.007	(0.3)
Sample size	793		548		870	
Coefficient Degrees of Freedom	42		41		43	
Root Mean Squared Error	6.0481		2.0417		4.4531	
R^2	0.2031		0.2847		0.3332	

The dummies include 28 industry dummies. The logarithmic difference in employment is between the last and first year the firm is observed. All estimations are weighted ordinary least squares.

Employment			
	Small Firms	Large Firms	Non-Zero R&D Firms
R&D	+ (+)	? (?)	0 (+)
Compensations for Education (η)	+ (?)	? (+)	-
Compensations for Unobserved Human Capital (α)	-	+	+ technol. firm
Share of the Educated	?	+	+
Firm-Level Payments	-	+	+
Capital Intensity	? (-)	- (+)	-

+ indicates positive, - negative and ? ambiguous effect on employment in tables 11-13, in parenthesis for the higher educated in tables 14-16.

Skill intensity can take various forms: R&D, physical capital, the share of the educated workforce, or the unobserved human capital. All of these may include elements that lead to an excess demand for a skilled workforce at the expense of an unskilled. R&D has no clear negative effect on total employment. On the contrary, it is shown that in small firms the use of R&D investment raises total employment. In large firms this is less clear. Large firms with low R&D intensity may rely more on internal growth. The higher share of educated of the total workforce and the interaction of it with R&D still has a positive effect on employment. Overall, R&Ds have not led to a lower absolute demand for an unskilled workforce. An exception is low R&D intensity large firms, where restructuring, e.g. in trade, has been extensive.

The share of the educated has a positive effect on employment in large firms and a rather moderate effect on wage levels. What then explains the good employment rates of the skilled and the high unemployment rates of the aged and the unskilled? This may be best explained by firm differences. The good employment in R&D-intensive firms with a high share of the educated has not taken place at the expense of the unskilled in those firms, but possibly at the expense of the unskilled in other firms, which is not considered here. Hence, there might have been an increasing gap in employment performance in firms using a skilled and an unskilled workforce or only an unskilled workforce.

There is still one factor that has led to a greater use of skilled labour. Namely, physical capital intensity is negatively related to employment demand in large firms. In other words, physical capital and a skilled workforce can be complements and physical capital and an unskilled workforce substitutes. In small firms physical capital has, instead, lowered the use of an educated workforce.

Let us next consider more deeply excess worker reallocation. The following table summarizes the main findings.

Excess Worker Reallocation			
	Small Firms	Large Firms	Non-Zero R&D
R&D	? (?)	+ (?)	+ (?)
Interaction to Education		+	
Interaction to Unobserved Human Capital	-	-	
Labour Market Experience	-	-	- -
Compensations for Education (η)	? (+)	? (+)	- (+)
Compensations for Unobserved Human Capital (α)	?	-	+
Firm-Level Payments	-	?	
Capital Intensity	-	-	-

+ indicates positive, - negative and ? ambiguous effect on employment in tables 11-13, in parenthesis for the higher educated in tables 14-16.

One can see from Table 11 that labour market experience has the most negative effect on excess worker reallocation. Older workers change jobs less regularly, especially those with high wages. An increase in wages by 10 percentage points, generated by an increase of the average experience level of employees by 6 years, from the average of 21 years, lowers excess separations by around 2.5 percentage points. The second column from Table 11 also shows that the employment performance of aged workers is bad. The six year increase in the average age lowers the employment rate by 3 percentage points. In Table 12 this is especially apparent in small firms.

One can see from Table 16 for the higher educated in large firms that both the compensations for education and the hirings effect raise excess worker reallocation. This hints at the shortage of the educated workforce and suggests that the fixed costs in hirings are large. As discussed above, firm-level payments are, particularly, paid in large firms to attract a higher educated workforce.

Compensations for unobserved human capital, on the other hand, reduces excess worker reallocation in large firms (see Table 13). Given the initial log wage regression, the effects of unobserved human capital should be interpreted relative to the expected wage. An increase in unobserved human capital by 10 percentage points decreases excess worker reallocation on average by only 0.2 percentage points (see Table 11), but the effect is 0.4 percentage points in large firms (see Table 13). This is, however, not very substantial given the average excess separation rate of 9 percent.

Small firms use firm-level payments more intensively and the payments on unobserved human capital are lower. In Table 12 unobserved human capital compensations reduce excess worker reallocation, particularly, in R&D-intensive small firms, since the interaction term between R&D and unobserved human capital is negative. Labour market experience lowers excess worker reallocation, as expected. Besides this, firm-level payments are used in small firms to lower excess job mobility. An exception consists of firms with high levels of R&D investment.

Finally, the firm size dummies in the first column in Table 11 show that the unexplained excess worker reallocation increases in firm size. According to the size dummies, the unexplained excess worker reallocation is 4 percent higher in the largest than in the smallest firms. The reason for the lower actual difference in overall excess worker reallocation in Figure 3 is the higher payments on human capital and experience in large firms. Both work in the direction of lowering excess worker reallocation. Hence, despite a more experienced workforce, some large firms employ risky workers with large worker turnover, following Lazear (1995). The unexplained excess worker reallocation remains high as employees with bad performance can be fired or quit when not promoted. Table 14 for the higher educated shows no similar firm-size effect. This may relate to educational competencies being more easily diffused between small and large firms. It is also evident that firms with non-zero but moderate R&D intensity pay high wages that lower this excess worker reallocation. Risky workers are concentrated in firms with non R&D or very high R&D intensity.

The following table shows consistency of the results with alternative wage models:

Wage Formation	
Non-Technology Firms	Technology Firms
	High R&D Intensity
Small Firms:	
Fixed-Term Contracts	Additional features:
Rent Sharing	Rent Sharing and/or High
Large Firms:	Starting Wages to Attract New Workers
Recruitment of Risky Workers	
Reputation Wages (moderate R&D intensity)	Steep Seniority Profile because of Human Capital Accumulation

Fixed-term wages (firm intercept) are used to lower excess worker reallocation in small firms. Technology firms also use rent sharing. Rent sharing and fixed-term contracts are substitutes but the former may be preferred when the outside options of employees or employers are known. There is also support for Hall and Lazear (1984) that in small firms fixed payments, the firm intercept, lower excess separations. Excess separations are too high, especially when the firm behaves as a monopsony and sets wages at too low a level where unwanted job seeking of employees is too high. Table 13, though, shows that the market share has an insignificant effect in small firms. Fixed-term wages are done on mutual agreement rather than employers having monopsony power in labour market.

In large firms, uncertainty about employers' outside options may not be resolved by wage negotiations. Following Nickell (1999), high monopoly rents may not signal profitability but may signal that workers are not receiving their share of the firm's success. Large firms prefer to retain their option to fire risky employees if they turn out to be bad performers. This is the case for firms with no R&Ds or in technology firms with high R&Ds. High R&D-intensive firms also pay firm-level compensations to recruit more personnel. On the other hand, the large firms with moderate R&D intensity explain the firm-size premium, pay high wages and rely more on internal growth. Those firms rely on their good reputation in the labour market and would also suffer least from any additional firings costs imposed on employers. The opposite holds for small firms that already face difficulty in keeping good quality workers in service. Firings costs would further make it difficult to fill vacant jobs due to excess quits of high wage workers.

The evidence of fixed-term contracts is much the same for the higher educated in Tables 16 through 18. In small firms fixed term wages (firm intercept) lower hirings and separations and seniority payments raise hirings. The opposite holds for large firms. Firm-level wages are used in small firms to lower quits and in large firms to recruit the higher educated. In large firms compensations for education also raise excess worker reallocation since the educated workforce is mobile. This is also indicated by large experience payments that give an indication of rent hopping. The higher educated can raise their earnings by switching jobs frequently.

One can also argue that the wage structure in R&D-intensive firms partly support Moen (2000) and Pakes and Nitzan (1983) that predict a steep seniority profile with low starting wages (see also Tables 8-10). They argue that if workers in R&D-intensive firms get access to valuable knowledge in the firm, they can expect high wages in the future. They accept low starting wages in return for high seniority payments. Employees can accumulate general knowledge in R&D-intensive firms and accept low wages earlier in the career compensated for high experience payments. But starting wages are also high in technology firms. This indicates a shortage of labour.

Correlation Tables 5 through 10 in Chapter 6 indicated that long run seniority payments are higher in large firms, while the short run seniority payments are higher in small firms. The differences in firm intercept are not large, depending on R&D intensity. It is suggested that the fact that seniority payments are postponed in large firms follows from the option value of risky workers. The average seniority of workers in large firms is higher, but seniority payments are postponed to longer seniority and excess worker reallocation of new workers is high. In large firms there is more promotion opportunities. But high R&D-intensive firms also pay high starting wages. This relates to a shortage of skilled labour. Firms have then a clear incentive to reduce excess worker reallocation. Still, high wages and job mobility are positively related. R&D-intensive firms pay higher wages (1) to attract an educated workforce, (2) because of an accumulation of general human capital raising the seniority profile, (3) in technology firms to attract new workers using rent sharing and high starting wages.

8 THE PERFORMANCE OF THE FIRM

The job search of employees may have a different effect on total factor productivity and profitability per person. In the job search model by Acemoglu and Shimer (2000) higher wages associate with a higher level of irreversible investment in complementary inputs such as capital. This raises total factor productivity, while free entry of firms imply that profits are not higher. Burdet and Mortensen (1999) even implies the same total profits for all firms. This implies a decrease in profits per labour as the firm size increases. It is clear that reputation wages or the recruitment of risky workers with an option value can be associated with higher profitability.

In Table 17 the average total factor productivity, the average log of value added and the average net profits per person measure firm performance. Tables 18 and 19 show these for small and large firms respectively. The log of net profits is obtained for a reduced number of firms since profitability was negative in many firms in the severe recession period of 1992-1994.

Unobserved human capital, α, has a significant positive effect on the total factor productivity, value added per labour and profitability. In Tables 18 and 19 the positive effect is particularly strong in small firms. Small firms recruit fewer high wage workers but they have a more positive effect on firm performance. Overall, a 14 percentage point rise in wages due to unobserved human capital, roughly the difference in unobserved human capital between the smallest and largest firms, see Figures 2 and 3, is associated with a similar rise in profitability. The effect is equally strong for large firms in Table 19. The implications are equally strong both for total factor productivity and profits per capita. This suggests that much of the "skill-biased technical changes" associates with a better use of both human and physical existing capital rather than a large share of educated employees. Firms that recruit high-wage earners also perform better.

The unobserved human capital of the educated has a less clear effect on the total factor productivity and profitability. Compensations for education, in turn, improve the total factor productivity irrespective of firm size and have no clear relation to profitability. The effects of educational compensations on profitability turn out to be positive only when dropping industry dummies in the last column. One can see

Table 17. Total Factor Productivity, Valued Added and Net Profits Per Capita As a Function of Compensation Policies

Dependent Variable:	log(TFP) Level		Log of Valued Added/L/100		Log of Net Profits/L/100		Log of Net Profits/L/100 No Industry Dummies	
Variable	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**
R&D Intensity	0.044	**(0.1)**	-0.615	(1.5)	-0.270	(0.3)	-0.350	(0.5)
Average Predicted Effect of Time Varying Variables (xβ)	0.079	(0.6)	0.234	**(1.7)**	0.148	(0.5)	0.082	(0.3)
Average Unobserved Human Capital (α)	1.013	**(13.8)**	1.035	**(14.6)**	1.011	**(6.1)**	0.836	**(5.5)**
Average (α), R&D Intensity	-0.004	(0.2)	0.023	(1.2)	-0.060	(1.3)	-0.090	**(2.0)**
Average Education Effect (uη)	0.781	**(3.8)**	1.190	**(5.9)**	0.717	(1.6)	1.439	**(4.0)**
Education Effect (uη) of Educated	-0.005	(0.2)	0.058	**(1.5)**	0.030	(0.4)	0.038	(0.5)
Average Firm Intercept	-0.074	(1.3)	-0.057	(1.7)	0.039	(0.5)	0.027	(0.3)
Average Seniority Effect	0.098	(1.4)	0.118	(1.9)	0.367	**(2.6)**	0.466	**(3.3)**
Seniority Effect of Educated	0.012	(1.0)	0.015	(1.3)	0.006	(0.5)	0.014	(1.1)
Higher Educated/Employees	-0.225	**(1.8)**	-0.261	(2.1)	0.898	**(3.2)**	0.415	(1.7)
Higher Educated/Employees, R&D	0.014	(0.7)	-0.053	(2.5)	-0.079	(1.6)	-0.088	**(1.8)**
Log(Capital/L)					0.286	**(12.2)**	0.236	**(11.8)**
Quasi-Rent/L/100	0.016	**(31.4)**	0.018	**(35.2)**	0.006	**(6.3)**	0.007	**(7.5)**
Borrowing ratio	0.011	(0.3)	0.105	**(3.2)**	-0.518	**(4.7)**	-0.348	**(3.5)**
Market Share	0.015	**(8.0)**	0.016	**(8.6)**	0.010	**(2.5)**	0.011	**(2.8)**
Return on Capital	0.015	**(1.9)**	0.010	**(1.3)**	0.106	**(5.4)**	0.102	**(5.1)**
Exports/Employees	3.444	**(2.1)**	4.833	**(3.0)**	-0.406	(0.1)	3.242	(0.8)
Average employees < 7	0.000	(0.0)	0.077	**(1.7)**	0.409	**(3.7)**	0.333	**(3.2)**
Average employees 7-19	-0.024	(1.1)	-0.009	**(0.5)**	-0.002	(0.0)	-0.015	(0.3)
Average employees 50-99	0.001	(0.1)	0.008	**(0.8)**	-0.014	(0.6)	-0.008	(0.3)
Average employees 100-499	0.007	(1.0)	0.029	**(3.9)**	-0.014	(0.8)	-0.007	(0.4)
Average employees > 500	0.015	**(2.2)**	0.043	**(6.4)**	0.023	**(1.5)**	0.035	**(2.4)**
Sample size	3818		4104		2627		2627	
Coefficient Degrees of Freedom	48		48		49		22	
Root Mean Squared Error	10.2667		10.1907		19.1402		19.4513	
R^2	0.3544		0.5608		0.2285		0.1949	

The dummies include 35 industry dummies. The quadratic quasi rent per labour is the product of quasi-rent and the deviation of it from its mean. The last column excludes industry dummies.

Table 18. Total Factor Productivity, Valued Added and Net Profits Per Capita As a Function of Compensation Policies in Small Firms <50

Dependent Variable:	log(TFP) Level		Log of Valued Added/L/100		Log of Net Profits/L/100	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
R&D Intensity	0.598	(1.4)	0.024	(0.1)	0.897	(1.1)
Average Predicted Effect of Time Varying Variables (xβ)	0.006	(0.0)	-0.046	(0.3)	-0.291	(0.8)
Average Unobserved Human Capital Effect (α)	1.153	**(13.7)**	1.157	**(14.3)**	0.829	**(4.8)**
Average (α), R&D Intensity	0.011	(0.4)	0.027	(1.2)	0.036	(0.7)
Average Education Effect (uη)	0.902	**(3.4)**	1.092	**(4.3)**	1.103	**(2.1)**
Education Effect (uη), R&D	-0.056	(1.4)	-0.002	(0.0)	-0.082	(1.0)
Average Firm Intercept	-0.040	(0.7)	-0.055	(1.6)	0.017	(0.3)
Average Firm Seniority Effect	0.064	(0.9)	0.067	(1.1)	0.362	**(2.7)**
Firm Seniority Effect of Educated	-0.003	(0.2)	0.003	(0.2)	0.002	(0.2)
Higher Educated/Employees	-0.188	(1.2)	-0.088	(0.6)	0.488	(1.5)
Higher Educated/Employees, R&D	0.013	(0.5)	-0.031	(1.2)	-0.011	(0.2)
Log(Capital/L)					0.187	**(7.0)**
Quasi-Rent/L/100	0.013	**(24.4)**	0.014	**(25.3)**	0.006	**(6.7)**
Borrowing ratio	-0.024	(0.5)	0.070	(1.6)	-1.131	**(7.7)**
Market Share	0.017	**(2.1)**	0.028	**(3.5)**	-0.008	(0.6)
Return on Capital	0.008	(1.0)	0.005	(0.6)	0.060	**(3.4)**
Exports/Employees	2.183	(1.3)	4.023	**(2.5)**	2.011	(0.6)
Average employees < 7	0.431	(1.2)	0.423	(1.3)	-0.725	(1.2)
Average employees 7-19	-0.141	(0.4)	0.752	**(2.7)**	-0.581	(1.1)
Average employees 50-99	0.416	(1.3)	-0.049	(0.2)	-1.171	**(2.1)**
Average employees 100-499	0.597	**(1.8)**	-0.090	(0.3)	-0.931	(1.7)
Average employees > 500	0.493	(1.5)	0.630	**(2.3)**	-0.713	(1.4)
Sample size	2326		2523		1618	
Coefficient Degrees of Freedom	43		43		44	
Root Mean Squared Error	10.0003		9.8662		16.4698	
R^2	0.3206		0.4827		0.2019	

The dummies include 35 industry dummies. The quadratic quasi rent per labour is the product of quasi-rent and the deviation of it from its mean. The last column excludes industry dummies.

Table 19. Total Factor Productivity, Valued Added and Net Profits Per Capita As a Function of Compensation Policies in Large Firms >100

Dependent Variable:	log(TFP) Level		Log of Valued Added/L/100		Log of Net Profits/L/100	
Variable	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**
R&D Intensity	0.044	(0.1)	-0.615	(1.5)	-0.270	(0.3)
Average Predicted Effect of Time Varying Variables (xβ)	0.079	(0.6)	0.234	(1.7)	0.148	(0.5)
Average Unobserved Human Capital Effect (α)	1.013	**(13.8)**	1.035	**(14.6)**	1.011	**(6.1)**
Average (α), R&D Intensity	-0.004	(0.2)	0.023	(1.2)	-0.060	(1.3)
Average Education Effect (uη)	0.781	**(3.8)**	1.190	**(5.9)**	0.717	(1.6)
Education Effect (uη) of Educated	-0.005	(0.2)	0.058	(1.5)	0.030	(0.4)
Average Firm Intercept	-0.074	(1.3)	-0.057	(1.7)	0.039	(0.5)
Average Firm Seniority Effect	0.098	(1.4)	0.118	**(1.9)**	0.367	**(2.6)**
Firm Seniority Effect of Educated	0.012	(1.0)	0.015	(1.3)	0.006	(0.5)
Higher Educated/Employees	-0.225	**(1.8)**	-0.261	**(2.1)**	0.898	**(3.2)**
Higher Educated/Employees, R&D	0.014	(0.7)	-0.053	**(2.5)**	-0.079	(1.6)
Log(Capital/L)					0.286	**(12.2)**
Quasi-Rent/L/100	0.016	**(31.4)**	0.018	**(35.2)**	0.006	**(6.3)**
Borrowing ratio	0.011	(0.3)	0.105	**(3.2)**	-0.518	**(4.7)**
Market Share	0.015	**(8.0)**	0.016	**(8.6)**	0.010	**(2.5)**
Return on Capital	0.015	**(1.9)**	0.010	(1.3)	0.106	**(5.4)**
Exports/Employees	3.444	**(2.1)**	4.833	**(3.0)**	-0.406	(0.1)
Average employees < 7	0.000	(0.0)	0.077	(1.7)	0.409	**(3.7)**
Average employees 7-19	-0.024	(1.1)	-0.009	(0.5)	-0.002	(0.0)
Average employees 50-99	0.001	(0.1)	0.008	(0.8)	-0.014	(0.6)
Average employees 100-499	0.007	(1.0)	0.029	**(3.9)**	-0.014	(0.8)
Average employees > 500	0.015	**(2.2)**	0.043	**(6.4)**	0.023	(1.5)
Sample size	854		864		585	
Coefficient Degrees of Freedom	41		41		41	
Root Mean Squared Error	11.0049		9.6919		25.9494	
R2	0.5181		0.7757		0.3464	

The dummies include 35 industry dummies. The quadratic quasi rent per labour is the product of quasi-rent and the deviation of it from its mean. The last column excludes industry dummies.

that educational compensations reflect transferable human capital raising the wage level rather than the firm's profitability.

Seniority payments associate with positive effects only on profitability. A 10 percent increase in wages generated by seniority payments raises net profits by 3 percentage points. The coefficient for the largest firms is insignificant in Table 19, confirming the minor role that incentive payments play in improving efficiency. One should also bear in mind that seniority compensations in large firms are concentrated on longer tenures and possibly less related to firm performance. The payments on unobserved skills improve profitability in all firms and incentive-based schemes only in small firms.

Time-varying compensations, experience payments, have a neutral effect on firm performance. The compensations do not relate very strongly to higher value added per person either. In large firms an increase in wages by 10 percent, when the average experience of employees increases six years from the average, increases valued added per person by around 2 percentage points, but the coefficient is insignificant. One can also interpret the results to show that the low job reallocation and employment with high payments for experience have resulted in no deterioration of firm performance. But experienced personnel are located in high valued added and quasi rent. High quasi rent industries include energy and water, consumer-goods manufacturing (food, textiles, clothing), trade and construction in decreasing order. Given the strong positive effect of quasi rent, experienced personnel are valued in firms, where wage expenses form a low share of all valued added and where the share of experienced personnel is relatively large. Otherwise, the strong effect of the level of quasi rent per person also follows from general demand effects.

A high borrowing ratio, especially in small firms, associates with lower profitability. The earlier tables 11 through 16 indicate no strong link between wage policy and liquidity constraints. Finally, since a large share of small firms is focused on services, it is worthwhile to consider whether the firm-size effects are industry specific. Comparing the third and fourth columns in Table 6 one can notice that the exclusion of industry dummies does not substantially change the results, except for educational payments.

We have also considered employment and firm performance in some manufacturing industries, ICT and business services and trade. In the trade sector the results differ from those obtained for typical small firms. Seniority payments have a weaker positive effect on profitability than in manufacturing and in the ICT sector. Compensations for experience deteriorate profitability. In ICT and business services unobserved human capital is relatively unimportant in profitability but clearly plays an important role in the total factor productivity. One possible reason can be the keener relation between unobserved human and physical capital (largely buildings) in these industries. The workforce is highly educated and compensating for it also has a very strong positive effect on employment and total factor productivity. Given that ICT industries are growing fast the profitability implications are also fairly unimportant relative to future prospects in firm performance. This can also explain why the borrowing ratio lowers profitability but raises productivity. From all this one concludes that the firm size differences, especially with respect to unobserved human capital, are not explained by the location of small firms in trade and large firms in manufacturing. Small firm results are not typical of trade and service sectors, where the share of small firms is large.

9 R&D AND PRODUCTIVITY

It can be seen from Table A.1 in the Appendix that high R&D intensive firms have an average higher total factor productivity. This is clearest for firms with middle-level R&D intensity or higher, but not for firms with low R&D intensity. Tables 17 through 19 show that after controlling for other factors R&D investment does not directly raise productivity or profitability. This shows that R&D investment is essentially human capital investment that may not alone be sufficient to assess the efficiency of intellectual capital. Other essential ingredients of firm performance are compensations for unobserved human capital and education.

In small R&D-intensive firms firm-specific payments strongly raise productivity (not shown), especially in small firms where high R&D requires rent sharing between employers and employees, shown as the positive interaction between R&D and firm effect. This is in line with our earlier results of the importance of incentive payments. Small R&D-intensive firms use fixed payments. But small firms do not use a deep seniority profile. In large R&D-intensive firms firm-specific payments are similarly important but seniority payments are also. They ensure that new high wage workers can be hired and stay in the firm. The difference to Moen (2000) is, however, that the starting wages may have to be attractive.

10 CONCLUSIONS

Firms recruiting personnel with unobserved human capital perform better. It is, though, clear that in some case the causality can be reversed: well performing firms can afford to pay high wages. This is an area of our future research. Here, it is argued that it pays to recruit high wage earners, whether in terms of paying reputation wages or employing risky workers. Small firms, however, have difficulty in recruiting high wage workers, one reason being greater productivity and performance uncertainty. There are large fixed costs in recruitment. Small firms use their better monitoring of employees and incentive-based payments to reduce excess separations. Large firms are more willing to maintain large job turnover or fire employees that turn out to perform badly or not promote them. Mobility costs are relatively higher for workers than for employers in large firms. The employee would lose the high compensations for unobserved human capital if he switched jobs. In small firms, the unobserved human capital potential is also profitable. The mobility costs for workers are, however, relatively lower and it is more difficult for small firms to inhibit excess quits.

It is apparent that the situation is somewhat different in high R&D-intensive firms. In these firms worker mobility is potentially large as well as the spillovers related to this. High wages are paid to attract new workers. In low R&D intensity firms the wage profile is, in contrast, characterised by low starting wages. The reason for postponement of pay is the accumulation of general human capital over time.

The relative share of unobserved human capital which explains the firm-size premium might also be important in the United States. Davis and Haltiwanger (1996) also provide evidence of incentive-based mechanisms being lower in the US as the firm size increases, since wage differentials between bottom and top earners decreases in firm size (the 10th least earner as compared to the 90th highest earner). As has been discussed, a large part of higher wages is also unexplained by observable characteristics. The bigger difference is that job turnover decreases in firm size, as evidenced in Brown and Medof (1994). One explanation is that the reputation wage effect and/or the direct size increasing effect of lower job search dominates in large firms, while in Finland the recruitment of risky workers with an option value is more important. The comparisons are also flawed with the different composition of short-time versus long-tenure workers. It is likely that short-time worker mobility, largely excluded here, is decreasing in firm size in Finland, too.

Another reason is the different labour market institution. Higher unionisation in Finland may lead to a more compressed wage structure in large firms. In Finland, with large wage compression, it is evident that the biggest decision in the wage level is made when the employee is recruited. Wages can be more easily adjusted upwards later in the flexible labour market in the US. Our results are indeed in line with wage compression in corporatist institutions, where worker mobility is comparable to the US level (see e.g. Böckerman and Piekkola, 2000).

Bertola and Rogerson (1997) argue that under wage compression a negative labour demand shock leads to intense labour shedding and hiring. Finland experienced a deep recession in the beginning of the 1990s. It appears that the level of hirings, in particular, adjusted, while wage policy and separations are less cyclical. Some of the worker mobility effects of wage policy may relate to the deep recession. It can be that under more favourable climate the separation effects of wage compensations are higher.

In any case, recession did not substantially change the wage structure. It is also true that large firms may have been more subject to shifts in profit margins and severe competition as an outcome of globalisation, and high worker reallocation may have strengthened the concentration of high wage earners in large firms.

The firm size effect can also emerge from other institutional factors. Under strong unions in large firms the inefficiency of seniority payments emerge from Kuhn and Robert's (1989) LIFO lay-off model, where the last employed is the first to be kicked out. The unions, possibly more powerful in large firms, set higher wages for intramarginal workers with longer tenure. General wage agreements can also be more binding in large firms, as being often the targets of unionization drives (Voos, 1983, Brown et al., 1990). In any case, higher-level wage negotiations in Europe are used as protection against aggregate shocks, but do not decrease job turnover, especially in large firms. Finally, the study includes many firm factors except firm age. This is expected to be of minor importance, as in Troske (1999), when worker characteristics such as experience and education are controlled for.

Appendix A.

The 5,361 observations are from the following industries: mining (nace 10-14) 23, consumer goods (nace 15, 17-19) 481, other manufacturing (nace 20-25) 605, non-metallic mineral products (nace 26, 36-37) 605, metals and machinery (nace 27-29) 807, energy and water (nace 40-43) 99, construction (nace 44-45) 670, trade (50-55) 1594, ICT and business services (nace 30, 71-72, 741-745, 642) 684, household services (nace 746-747, 93-99) 194. The transport (except telecommunications), educational and health sectors are ignored. The estimated equations include 35 industry dummies at the two digit level while the three-digit level is used in construction and services (see above).

In the final sample used in the estimations, there are 5,361 firms with 3,349 firms with one plant, 1107 firms with 2-3 plants and 900 firms with 4 plants or more. The plant level job and worker flows are calculated from the 8,021,902 person-year observations (438,247 plant-year observations) in the period 1987-1996 of persons who worked for at least one year in the sample firms during the period 1989-1996. The employee data on personnel in selected firms cover 3,099,342 observations and 791,437 persons after deleting (i) 55,406 observations of persons to whom wages in one year deviate more than five standard deviations from the estimated value (the OLS regression was similar to Abowd, Kramarz and Margolis, 1999, p. 326, with explanatory variables: sex, year, 8 education classes and work experience up to the fourth power, see Table A2 in Appendix A), (ii) 6,582 observations where the hirings coefficient was not estimable (hirings or separation rate not obtainable) and (iii) 24 empty observations. It is important to note that the time span of 8 years is sufficiently long to separate person and firm effects, requiring at least one person in every firm to experience a job switch.

535,258 observations out of 4,770,543 had a missing seniority starting date in the firm. For these observations, the observed firm switches are used to calculate seniority from the beginning of January. The problem is that there is no job switch for 26% of the 108,452 individuals who had a missing starting date in 1989, and for 29% of the 94,624 individuals in 1990, etc. For those individuals seniority is calculated from the beginning of the personnel data period (1987). Finally, in the calculation of the seniority and hirings effects, 1,259 firms that have less than 10 observations are pooled (5,717 observations) into a single firm in the 5 main industries.

Table A.1 Summary Statistics: Mean, Standard Deviation

	All Firms		No R&D Investment		Low R&D Intensity		Middle R&D Intensity		High R&D Intensity	
Variable	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Number of Firms	4359		3294		451		385		229	
Firm Size	420	12710	127	4532	998	26500	718	17298	847	18442
Real Wages	112989	421174	110537	410638	114945	445606	115462	433293	122852	438027
Excess Separations	0.09	1.00	0.09	1.00	0.09	1.19	0.08	0.76	0.09	0.88
Separation Rate	0.16	1.47	0.17	1.45	0.17	1.79	0.14	1.23	0.15	1.25
Hirings Rate	0.32	3.99	0.30	3.24	0.40	6.58	0.31	4.57	0.36	4.57
Experience	20.86	60.08	20.65	58.60	21.89	55.92	21.51	54.88	18.62	73.87
Seniority	8.97	64.63	7.85	55.42	10.72	83.72	11.14	66.96	9.26	74.20
$Seniority^2$	8.70	144.34	7.89	160.80	9.79	81.22	10.49	64.55	8.96	72.78
Average Predicted Effect of x Variables ($x\beta$)	0.77	2.70	0.74	2.96	0.82	1.19	0.82	1.15	0.76	1.63
Average Individual Effect (α)	0.15	2.78	0.14	2.83	0.16	2.93	0.14	2.33	0.19	2.33
Average Education Effect ($u\eta$)	10.71	1.76	10.70	1.55	10.70	2.08	10.72	2.12	10.81	2.18
Average Firm Effect	-0.06	3.07	-0.06	3.29	-0.05	2.62	-0.05	0.77	-0.06	2.99
Average Firm Intercept (ϕ)	-0.06	5.22	-0.06	5.58	-0.06	3.54	-0.07	3.74	-0.08	4.82
Average Hirings Effect	0.01	2.80	0.01	2.99	0.01	2.11	0.00	0.89	0.01	3.23
Average Seniority Effect (γ+2*seniority*γ^2)	-0.03	4.11	-0.08	4.46	0.05	2.03	0.04	2.09	0.04	2.40
Skilled Workers/Employees	0.17	2.74	0.15	2.42	0.15	2.82	0.20	3.28	0.34	3.78
Log(Capital/L)	6.88	20.58	6.51	18.40	7.53	22.25	7.43	21.37	7.36	23.49
Quasi-Rent/L/100	6.84	321.53	7.41	356.89	7.53	203.92	5.05	155.40	3.22	84.52
Market Share	2.80	104.24	0.90	48.59	6.48	221.71	5.82	162.13	3.83	90.58
Borrowing ratio	0.22	5.76	0.26	5.88	0.19	5.84	0.13	3.98	0.13	5.67
Return on Equity	0.30	21.44	0.34	24.11	0.20	11.07	0.23	4.84	0.37	10.14
R&D Intensity	1.41	163.81	0.00	0.00	0.42	5.60	2.08	13.85	15.02	673.92
log Total Factor Productivity	-0.28	12.77	-0.40	12.33	-0.06	12.68	-0.09	13.21	-0.22	14.59
Value Added/Employees/100	0.01	0.32	0.01	0.36	0.01	0.21	0.01	0.16	0.01	0.08
Profits/Employees/100	0.29	67.08	0.30	35.24	-0.55	159.03	1.21	91.82	0.83	55.97
Average Individual Effect (α) R&D	0.27	32.49	0.00	0.00	0.07	1.72	0.31	5.88	2.90	130.34
Average Education Effect ($u\eta$), R&D	15.98	1836.29	0.00	0.00	4.49	59.97	22.28	149.25	162.95	7383.66
Skilled Workers/Employees, R&D	0.54	99.19	0.00	0.00	0.07	1.74	0.44	8.92	6.36	410.53
Firm Effect, R&D	-0.08	14.10	0.00	0.00	-0.02	0.72	-0.10	1.81	-0.92	59.78
Exports/Employees/100	0.0018	0.1057	0.0019	0.1087	0.0009	0.0527	0.0018	0.0814	0.0034	0.1577

Calculations use as weights the sample weight times the average number of employees, as regressions. Wages, opportunity income, valued added, net profits and exports per labour and quasi rent in thousands of 1990FIM.

Table A.2 Estimates of the Effects of Experience, Year, Individuals and Firms on the Log of Wages for 1989 to 1996

Variable	Mean	Coefficient	t-value	Variable	Mean	Coefficient	t-value
Number of job switches	2.8804E-18	0.00384	(2.1)				
Experience/10	3.133E-18	0.29321	(9.4)				
Experience/10^2	-1.59263E-15	-0.00550	(45.6)				
Experience^3 / 100	-3.8304E-17	0.01291	(33.2)				
Experience^4 / 1000	1.6175E-15	-0.00118	(28.0)				
Firm size X Experience	-7.55622E-15	0.00000	(5.6)				
Firm size squared X Experience	2.5564E-11	0.00000	(4.0)				
Firm size X Experience X Seniority	5.3679E-14	0.00000	(4.6)				
Firm size squared X Experience X Seniority	-1.69478E-11	0.00000	(1.7)				
Year 1989	5.5324E-18	1.12780	(5.1)				
Year 1990	7.3863E-18	1.02482	(5.4)				
Year 1991	7.5782E-18	0.85215	(5.4)				
Year 1992	6.2800E-18	0.63453	(5.1)				
Year 1993	5.5765E-18	0.44842	(4.8)				
Year 1994	5.8724E-18	0.28524	(4.5)				
Year 1995	5.2826E-18	0.15548	(4.9)				
Industry 10-14 X Experience	9.1508E-21	0.00123	(0.4)	Industry 10.14 X Experience^2	1.0249E-18	0.00002	(0.3)
Industry 15-16 X Experience	2.7910E-19	-0.00411	(1.4)	Industry 15.16 X Experience^2	4.5614E-18	0.00024	(8.8)
Industry 17 X Experience	2.7452E-20	-0.01220	(4.0)	Industry 17 X Experience^2	-3.42926E-18	0.00053	(9.1)
Industry 18 X Experience	-5.49048E-20	-0.00466	(1.5)	Industry 18 X Experience^2	3.73353E-18	0.00019	(3.6)
Industry 19 X Experience	3.088E-20	-0.00554	(0.8)	Industry 19 X Experience^2	-7.32065E-20	0.00015	(0.5)
Industry 20 X Experience	-1.83016E-20	-0.00382	(1.3)	Industry 20 X Experience^2	0	0.00023	(3.8)
Industry 21 X Experience	6.6801E-19	-0.00567	(2.0)	Industry 22 X Experience^2	6.03953E-19	0.00038	(13.8)
Industry 22 X Experience	-1.83016E-20	-0.00288	(1.0)	Industry 22 X Experience^2	-6.65721E-19	-0.00022	(5.8)
Industry 23 X Experience	-6.29118E-20	-0.00330	(1.1)	Industry 23 X Experience^2	-6.4742E-19	0.00032	(5.8)
Industry 24 X Experience	-7.79248E-20	-0.00524	(1.8)	Industry 24 X Experience^2	3.10913E-18	0.00045	(12.1)
Industry 26 X Experience	-2.72393E-09	-0.00407	(1.4)	Industry 26 X Experience^2	1.24623E-10	0.00018	(3.8)
Industry 27 X Experience	-1.14385E-21	-0.00064	(0.2)	Industry 27 X Experience^2	-3.22223E-18	-0.00004	(11.9)
Industry 28 X Experience	1.71578E-21	-0.00111	(0.4)	Industry 28 X Experience^2	-19.44736422	0.00000	(0.3)
Industry 29 X Experience	-1.96599E-19	-0.00637	(2.3)	Industry 29 X Experience^2	1.766720191	0.00039	(16.4)
Industry 30 X Experience	-3.94629E-19	0.00743	(0.9)	Industry 30 X Experience^2	1.19608E-17	-0.00243	(1.2)
Industry 31 X Experience	-1.14385E-21	-0.00471	(1.7)	Industry 32 X Experience^2	1.14385E-20	0.00036	(11.8)
Industry 32 X Experience	-1.25824E-20	0.00421	(1.3)	Industry 32 X Experience^2	3.3675E-18	0.00038	(1.4)
Industry 33 X Experience	-9.43677E-21	-0.00547	(1.3)	Industry 33 X Experience^2	-4.34663E-20	0.00000	
Industry 34 X Experience	-8.00696E-21	-0.00538	(0.7)	Industry 34 X Experience^2	-9.15081E-21	0.00074	(0.5)
Industry 35 X Experience	-1.04662E-19	-0.00394	(1.3)	Industry 35 X Experience^2	1.82559E-18	0.00018	(3.0)
Industry 36 X Experience	-4.48961E-20	-0.00585	(1.9)	Industry 36 X Experience^2	4.5754E-19	0.00023	(3.0)
Industry 40 X Experience	-4.46102E-20	-0.01035	(3.5)	Industry 40 X Experience^2	-1.5911E-18	0.00030	(6.8)
Industry 451 X Experience	4.6898E-20	-0.00349	(1.1)	Industry 452 X Experience^2	-6.2683E-19	0.00031	(3.2)
Industry 452 X Experience	-2.71665E-20	-0.00171	(0.6)	Industry 452 X Experience^2	-2.03605E-19	-0.00026	(6.0)
Industry 453 X Experience	-1.77297E-20	-0.00677	(2.2)	Industry 453 X Experience^2	6.74872E-20	0.00020	(2.2)
Industry 50 X Experience	7.2920E-20	-0.00344	(1.2)	Industry 50 X Experience^2	-3.01748E-18	0.00012	(2.3)
Industry 51 X Experience	-7.16337E-20	-0.00496	(1.8)	Industry 52 X Experience^2	7.069E-18	0.00017	(7.3)
Industry 52 X Experience	1.9274E-19	-0.00505	(1.8)	Industry 52 X Experience^2	-4.55524E-18	0.00006	(2.4)
Industry 55 X Experience	-4.63974E-20	-0.00498	(1.7)	Industry 55 X Experience^2	2.83904E-18	0.00015	(3.1)
Industry 71 X Experience	-4.5754E-21	0.00349	(0.4)	Industry 72 X Experience^2	0	0.00116	(1.0)
Industry 72 X Experience	-8.60748E-20	-0.00131	(0.4)	Industry 72 X Experience^2	6.74872E-19	0.00025	(3.1)
Industry 741 X Experience	-2.75096E-19	-0.00404	(1.4)	Industry 742 X Experience^2	3.01062E-18	0.00009	(2.1)
Industry 746 X Experience	-2.03034E-20	-0.00630	(1.8)	Industry 746 X Experience^2	-2.56223E-19	-0.00006	(0.4)
Industry 747 X Experience	6.2912E-21	-0.01048	(3.6)	Industry 747 X Experience^2	-2.42496E-19	0.00026	(2.6)
Industry 93 X Experience	6.8917E-20	-0.01467	(4.7)	Industry 93 X Experience^2	1.54992E-19	0.00052	(4.8)
Coefficient Degrees of Freedom		85					
Sample Size		3161329					
Root Mean Squared Error		0.71643					
R^2		0.011					

Table A.3 Education Effect

Variable	Coefficient	t-value
Intercept	10.57	(12074.8)
Primary Education	-0.22	(203.1)
Upper Secondary Education 10-11 years	-0.15	(141.1)
Vocational Education 13-14 years	0.12	(74.2)
Bachelor's Degree 15 years	0.23	(99.1)
Master's Degree 16 years	0.40	(247.8)
Post-Graduate Degree	0.67	(104.5)
Sex	0.32	(402.9)
Sample size	1 834 655	
Coefficient Degrees of Freedom	7	
Root Mean Squared Error	0.159	
R^2	0.1865	

The benchmark education class is upper secondary education of about 12.

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