Gender differences in job assignment and promotion in a complexity ladder of jobs*

Tuomas Pekkarinen†& Juhana Vartiainen

January 2002

Abstract

The paper studies gender differences in the allocation of workers to tasks of different complexity using panel data from a representative sample of Finnish metalworkers during 1990-1995. Finnish metal industry data provide a continious measure of the complexity of the worker's tasks. Using this measure we estimate gender differences in the initial task assignments, promotion rates, and promotion wage growth. We find that women are allocated to less complex tasks than men in this industry. This difference is already visible at the initial task assignments but is strengthned by the differential promotion rates of men and women. Women are less likely to be promoted than men with equivalent characteristics on the same tasks. Female promotion wage growth is higher than that of men. The results also suggest that promotion premium - the difference between promotion wage growth and non-promotion wage growth - is higher for women.

1 Introduction

The gender wage gap is a persistent phenonemon. Even in economies where participation rates of women have been at considerably high levels for decades and where the experience on anti-discriminatory legislation is long, women still tend to earn lower wages than men. An important component of the gender wage gap is explained by the different allocation of men and women across industries and occupations. It is common to find that when one controls for sufficiently narrowly defined industrial and occupational categories the gender wage gap is considerably reduced. Thus, one of the key elements in understanding the gender wage differentials is the allocation of men and women to different tasks.

This paper studies gender differences in the allocation of workers to tasks of different complexity using panel data from a representative sample of workers in the Finnish metal industry during 1990-1995. We analyse gender differences in the initial task assignments, promotion rates, and the wage growth upon promotion and without.

Finnish metal industry data are exceptional because they provide a continious measure of the complexity of the tasks of an individual worker that is valid for both within and between firm comparisons. In the wage determination process all the jobs in this industry are evaluated by an outside party according to their complexity. Based on this evaluation a minimum wage is attached to each job. These task-specific minimum wages can be observed in our data and we argue that they can be used as both ordinal and cardinal measure of the complexity of individual's tasks.

*First preliminary version.

†European University Institute, Department of Economics, Via dei Rocettini 9, I-50016 San Domenico di Fiesole, Italy. Email: tuomas.pekkarinen@iue.it.

Men are clearly over-represented in this industry and the gender wage differential is considerable. On average men earn 18 % higher hourly wages than women. However, when complexity of the tasks is controlled for the gender wage gap is reduced to 9 %. Even though there are no definite "male or female tasks" in this industry - both men and women are observed in all the levels of complexity - it is clear from the observation of the allocation of tasks that men tend to work on more complex tasks while women are concentrated on the low end of the complexity axis.

We are interested in the mechanisms behind this observation. More precisely, we study to what extent this difference in task allocation is due to different initial task assignments and to the differential treatment of men and women in the promotion process. That is to say, are women allocated to jobs with different career prospects to begin with or do they also progress slower than men with similar characteristics that are assigned to same jobs? Furthermore, we study the wage implications of differences in career patterns. By estimating gender differences in promotion premiums we try to find out whether women gain more or less from promotions than men.

There exists an extensive theoretical and empirical literature that is related to the subject. In the theoretical work gender differences in outside opportunities are the driving force behind the differences in promotion rates and returns to promotion. Perhaps the most cited model is the one by Lazear and Rosen [4]. In this model the only thing that distinguishes women from men is their comparative advanatge in non-market activties. More favourable outside opportunities make the promotion of women more costly because of increased risk of quitting. Consequently in order to be promoted women have to be more productive than men. Women are promoted less often but they also gain more than men once promoted.[1]

Empirical studies tend to give varying results. Winter-Ebmer and Zweimüller [6] find that the Austrian census data seem to support the promotion rate implications of the Lazear and Rosen [4] model. Women are promoted less often according to their results. However, Winter-Ebmer and Zweimüller have no wage data and are thus unable to study the implications of promotion patterns for wages. McCue [5] finds similar kind of results with PSID data but only for married women. On the other hand, Booth et al [2] arrive at completely opposite results when testing their own model with data from British Household Panel Survey. Booth et al have also access to wage data and they find that women gain less from promotions than men.

What is common to all of the empirical studies mentioned above is the fact that the authors can't distuinguish assignments and promotions in a credible way. In cross-sectional studies, like in Winter-Ebmer and Zweimüller [6], the only way to seperate promotions from assignments is to define mismatches of education and job categories as promotions and matches as assignments. Even in the cases where authors use longitudinal data, as is done in Booth et al [2], the information on the exact task assignment of individuals at the beginning of their careers is usually not available.

In our view information on initial task assignment is valuable because it allows one to disentangle whether gender differences in career patterns are due to differences in the promotion process or the starting level of the workers. It is often argued that different career patterns of men and women are a result of self-selection of women to tasks with particularily bad career prospects. Thus for a meaningful empirical analysis one would ideally need a setting where observationally identical men and women start their careers in same kind of tasks. We claim that in our cases we have data from multiple firms, although in a single industry, where the initial task assignment and subsequent promotions and demotions can be observed. We believe that analysis of these data can provide interesting

[1] These implications are reversed if one adopts the assumption that the outside opportunties of women are worse. This assumption is adapted in a recent study by Booth et al [2].

results on the mechanisms behind the gender wage differentials.

The rest of the paper is organized as follows. In the following section we provide an overview of the theoretical background that relies heavily on the model by Lazear and Rosen [4]. The third section presents the data and descriptive analysis of task assignments, promotion probabilities, and wage differentials. In the fourth section we provide a detailed analysis of the promotion rates while the fifth section concentrates on the analysis of the returns to promotion. The sixth section concludes.

2 Theoretical background

A classical framework in which to think about gender differences in promotion outcomes is the model by Lazear and Rosen [4]. It is a model of optimal promotion decisions where promoted workers undergo costly training in order to learn the tasks which they are promoted to. Training costs play an important role in this model because workers cannot commit on staying in the firm. After the promotion decision has been taken workers weight the wage paid by the employer and their outside options. If the value of outside option exceeds the going wage, the worker leaves the firm and the training invested on him or her is lost.

Men and women are assumed to differ in their outside options. Because women have a comparative advantage in non-market activities their outside options are better than those of men. Hence, women are more likely leave the firm and the risk of losing the training invested is higher when promoting a woman than when promoting men. Thus women have to be more productive in order to be promoted.

Here we will briefly present the basic features of the Lazear and Rosen model in a slightly modified form. In a general analysis of promotion and wage dynamics Gibbons and Waldman [3] show that models that incorporate both task assignments and human capital acquisition can yield a number of implications that seem to fit the empirical findings.[2] In the context of Lazear and Rosen model this modification yields additional implications for gender differences in time it takes to get promoted.

2.1 Efficient promotions

We assume that workers enter the labour market with some level of innate ability that is publicly known. While working they gradually acquire labour market experience that adds to their effective ability. Denote the innate ability of a worker i with δ_i and the labour-market experience prior to period t with x_{it}. Following Gibbons and Waldman [3] we assume that the effective ability of the worker is a function of innate ability and labour market experience: $\eta_{it} = \delta_i f(x_{it})$, where $f' > 0, f'' < 0$.

Like Lazear and Rosen we abstract from initial task assignment by assuming that it is done solely on the basis of innate ability and there is no training costs involved. After the initial task assignment workers cumulate labour-market experience and increase their effective ability. The employer can now promote some of these workers to more skill sensitive tasks but this is assumed to involve training costs.

Consider two tasks A and B and assume that task A is more sensitive to workers effective ability. We focus on the workers that have been assigned to task B and assume a 3-period long working life. At period t all the workers are performing task B. At the end of the period the employer observes the effective ability of the workers and decides to choose some workers for promotion to task A. In period $t + 1$ all the workers remain

[2]Gibbons and Waldman [3] also incorporate symmetric learning about abilities of the workers in their model. This yields additional implications regarding demotions and real wage decreases. In order to keep the analysis simple we disregard this feature here.

in task B but the ones that are chosen to be promoted undergo costly training. In period $t+2$ the promoted workers are assigned to task A while the rest of the workers stay in task B.

The output per worker at period t is $\eta_t = \delta f(x_t)$. At period $t+1$ the output of the workers chosen for training is reduced to $\gamma_1 \eta_{t+1} = \gamma_1 \delta f(x_t+1)$, where $\gamma_1 < 1$, while the rest of the workers produce $\eta_{t+1} = \delta f(x_t+1)$. Finally, in period $t+2$ the promoted workers are assigned to the more productive task A where they produce $\gamma_2 \eta_{t+2} = \gamma_2 \delta f(x_t+2)$ with $\gamma_2 > 1$. The workers who remain in task B in period $t+2$ produce $\eta_{t+2} = \delta f(x_t+2)$.

We assume that workers are sure to remain in the firm in periods t and $t+1$. However, in period $t+2$ the workers are free to leave and they weight the value of non-market time against the value of working. We denote the value of non-market time with ω and assume that it has a cumulative distribution function $F(\omega)$.

The employers task is now to design an efficient promotion rule. Such a rule should induce workers to remain in the firm if the market value of their output exceeds that of the non-market time. As there are no externailties in this setting the firm will choose a socially optimal promotion rule that chooses only those workers for promotion whose lifetime output is higher if promoted to more demanding tasks.

Social output for the workers who are chosen to be promoted to task A is equal to:

$$\delta f(x_t) + \gamma_1 \delta f(x_t+1) + \gamma_2 \delta f(x_t+2) \int_0^{\gamma_2 \delta f(x_t+2)} dF + \int_{\gamma_2 \delta f(x_t+2)}^{\infty} \omega dF \tag{1}$$

Correspondingly the social output for workers who remain on task B is:

$$\delta f(x_t) + \delta f(x_t+1) + \delta f(x_t+2) \int_0^{\delta f(x_t+2)} dF + \int_{\delta f(x_t+2)}^{\infty} \omega dF \tag{2}$$

The difference between 1 and 2 can be written as:

$$D(\delta, x_t) = -\delta f(x_t+1)(1-\gamma_1) + \int_{\delta f(x_t+2)}^{\gamma_2 \delta f(x_t+2)} F(\omega) d\omega \tag{3}$$

Workers are promoted to the task A if $D(\delta, x_t) > 0$ and they remain on task B if $D(\delta, x_t) < 0$. Hence, there is a promotion threshold than can be written as:

$$\delta f(x_t+1)(1-\gamma_1) = \int_{\delta f(x_t+2)}^{\gamma_2 \delta f(x_t+2)} F(\omega) d\omega \tag{4}$$

It can be shown that for any x_t there exists a δ^* and conversely for any δ there exists a x_t^* such that 4 holds. Thus there are both innate ability and labour market experience threshold values for promotion.

2.2 Wages

Consider now a wage sturcture that would induce both efficient separation at $t+2$ and efficient selection of workers to tasks A and B. In order to induce efficient separation such a wage structure should pay wage equal to observed output at $t+2$: $w_{t+2}^A = \gamma_2 \delta f(x_t+2)$ and $w_{t+2}^B = \delta f(x_t+2)$. In order to induce efficient selection of workers for promotion the wages should differ between the workers that choose training at $t+1$, w_{t+1}^A, and the workers who choose not to go to training, w_{t+1}^B.

The expected liftetime income of a worker who chooses to train to task A is:

$$w_{t+1}^A + \gamma_2 \delta f(x_t+2) + \int_{\gamma_2 \delta f(x_t+2)}^{\infty} \omega f(\omega) d\omega \tag{5}$$

and the expected lifetime income of a worker who chooses to remain in task B is:

$$w_{t+1}^{B} + \delta f(x_t + 2) + \int_{\delta f(x_t+2)}^{\infty} \omega f(\omega) d\omega \tag{6}$$

The difference between 5 and 6 is $w_{t+1}^{B} - w_{t+1}^{A} = \int_{\delta f(x_t+2)}^{\gamma_2 \delta f(x_t+2)} F(\omega) d\omega$. Using the efficient promotion threshold condition 4 this can be written as:

$$w_{t+1}^{B} - w_{t+1}^{A} = \delta f(x_t + 1)(1 - \gamma_1) \tag{7}$$

Thus in order to induce efficient selection of workers to task A the wages must be lower in period $t+1$ for the workers that go into the training. This wage differential is higher the higher the promotion threshold.

2.3 Gender differences in outside options

Lazear and Rosen assume that workers differ in their outside options according to their gender. Women are assumed to have a comparative advantage in non-market activities which means that the female distribution of the value of non-market time, $F_f(\omega)$, stochastically dominates that of men, $F_m(\omega)$. Write the distribution of the value of non-market time as $F(\omega; \alpha)$ where α is a shifter such that $\partial F/\partial \alpha > 0$. Define $F_f(\omega) \equiv F(\omega; \alpha_f)$ and $F_m(\omega) \equiv F(\omega; \alpha_m)$ and assume that $\alpha_m > \alpha_f$ which implies that $F_m(\omega) > F_f(\omega)$.

The first thing to notice is that as we assumed that the initial task assignment does not include any training, the differences in outside opportunities do not play any role there. This means that there are no gender differences in the effective ability among the workers in the same task immediatly after the initial task assignment.

However, the promotion decisions are affected by different distributions of outside options because the trainig invested on a worker who leaves is lost. Differentiating 4 with respect to α at δ^* yields:

$$\frac{d\delta^*}{d\alpha} = \frac{\int_{\delta^* f(x_t+2)}^{\gamma_2 \delta^* f(x_t+2)} \frac{\partial F(\omega;\alpha)}{\partial \alpha} d\omega}{-\partial D(\delta^*, x_t)/\partial \delta}$$

which is negative since $\partial D(\delta^*, x_t)/\partial \delta > 0$. Thus α decreases the promotion threshold value of innate ability δ^* and because $\alpha_m > \alpha_f$ we have that $\delta_m^* < \delta_f^*$. So women need to have a higher level of innate ability than men in order to be promoted.

Similarily differentiating with respect to α at x_t^* yields:

$$\frac{dx_t^*}{d\alpha} = \frac{\int_{\delta f(x_t^*+2)}^{\gamma_2 \delta f(x_t^*+2)} \frac{\partial F(\omega;\alpha)}{\partial \alpha} d\omega}{-\partial D(\delta, x_t^*)/\partial x_t}$$

which is also negative since $\partial D(\delta, x_t^*)/\partial x_t > 0$. Thus we have that $x_m^* < x_f^*$. Women also need a longer labour-market experience than men in order to be promoted. Thus as the distributions of innate ability and labour-market experience are the same for both men and women we should expect to see less women promoted

Since men and women have different promotion thresholds they have different wage differentials 7 that induce efficient selection to task A in period $t+1$. Namely, the wage spread for women should be higher. Thus, a one way to induce efficient promotions would be to pay gender specific wages in period $t+1$ and let workers choose jobs freely. However, in any kind of realistic setting gender specific wages are not feasible because of anti-discriminatroy legislation and the employer is forced to use the same wage spread for all the workers. Assignment of workers to jobs and use of different promotion criteria for men and women by the employer.offers a way around this problem. Hence, as women have to meet a higher productivity criterion than men in order to be promoted the wage increase is on average higher for promoted women than for promoted men.

To summarize, in a model where men and women are otherwise identical when it comes to their porductive characteristics but women have a comparative advantage in non-market activities women have to meet a higher productivity criterion in order to be promoted to more complex tasks. Consequently we should observe less women than men promoted and promoted women should gain higher wage increases upon promotions than men. In the following sections we will analyze promotion rates and wage growth with data from Finnish metal industry.

3 The data

The data come from the wage records of the Confederation of Finnish Industry and Employers (*Teollisuus ja työnantajat*). Each year a survey is conducted among the member employers of the confederation and the information is gathered in the wage records. The wage records contain detailed information on the wages and working hours of all the workers who are employed in a firm affiliated with the confederation. In the case of metal industry in Finland this covers practically all the firms in the industry.

We will work with a sample drawn from the wage records that has been used in a number of studies on Finnish wage structure. In the original sampling the year 1990 was chosen as the base year and the 1990 wage records were ordered randomly by firms. Within each firm the workers were ordered according to their mean pay and every 15th worker was then picked for the sample. A longitudinal data set was created from 1990 onwards and backwards all the way to the year 1980 by using the personal codes in the data to identify the workers who were present in the base year 1990 sample. A supplementary drawing was conducted for each year from the population of new and leaving workers so that the relative sizes of the yearly samples were the same as those of the original wage records and the probability of a worker drawn from the each yearly sample being a newcomer or a leaver was the same as in the yearly population. This resulted in an unbalanced panel that is supposed to represent the structure and dynamics of the Finnish manufacturing sector worker population.

The wage records' data on wages and working hours can be considered as exceptionally reliable since in principle the information comes directly from the firms' wage accounts. However, the information on the individual characteristics is rather scarce. Basically only age and gender can be identified from the raw data. Perhaps the most disturbing piece of missing information are the family backgournd variables.

In this paper we use a subsample of the data that consists of all the blue-collar metal industry workers in the sample during years 1990-95. We restirict the analysis on workers who were present in the industry for at least two years in order to have a sample of workers with a reasonably strong commitment to the labour market. After ruling out some workers because of missing or high probability of false information or because they were present only for less than two periods we end up with a panel that has 23 711 employee/year observations containing information on 5 489 different individual workers of whom 1 258 (22%) are women. Workers were distributed in 477 different firms. For a good part of the empirical analysis we restrict the sample to include only workers who enter the industry for the first time during 1990-1995. This is because for these workers we observe the initial task assignment. This sample had 5 421 employee/year observations containing information on 1 692 workers of whom 409 (23%) were women. Workers in this subsample were distributed in 323 firms.

3.1 Wage determination in the Finnish metal industry

We restricted the sample to include only the metal industry workers in 1990-95 because the data on metal industry provide particularily interesting information on the complexity of the tasks of an individual worker. The reason for this is the peculiar wage determination mechanism in the Finnish metal industry. The employers and the trade union of the industry have established a procedure that provides information on the complexity of each job and productivity of each worker. This procedure was introduced gradually so that it was applied in all the firms in the industry by 1990.

In the Finnish metal industry the general guidelines of the wage determination are set in the national level *collective agreement* that is negotiated between the central employer organisation and the trade union. According to the collective agreement wages should be determined by the complexity of the job, individual performance of the worker given the requirements of the job, and by various individual and firm-specific arrangements. The same rules should be applied in all the firms.

The complexity of the job specifies a job-specific minimum wage for each worker. This minimum level is called the *occupation-related wage*. Worker's individual performance on the job affects the wage outcome through a *personal bonus* of 2 to 17% on top of the occupation-related wage. Occupation-related wage and the personal bonus form the minimum level that the worker can expect to be paid. The determination of the final wage outcome takes place at the firm level. An individual firm has considerable scope to choose its wage levels as long as it stays above the minimum levels set by the collective agreement. The firm has two methods of payment available. It can pay either a fixed hourly rate or a piece rate according to the output produced by the worker.

3.2 Job complexity

The complexity of the tasks is evaluated with a grading system that is similar to the ones used in large establishments in the US. The evaluation of the tasks is carried out by a group of specialists who consider various aspects of the jobs and assign them points according to their complexity. The complexity level is based on three criteria: 1) how long does it take to learn the tasks involved with the job, 2) what is the degree of responsibility involved with the job, and 3) what are the working conditions. The outcome of the evaluation should be independent of the characteristics of the workers performing the job and does not therefore change when the individual on the job changes.

What is special to the grading system used in the Finnish metal industry is the fact that this system is used in order to make the jobs comparable across firms. This is fundamental for the wage determination process since the same rules should be applied in all the firms in the industry. Thus, the outcome of the evaluation is a complexity metric that is universal for the industry.

Based on the evaluation of jobs an occupation-related wage is determined for each job in the collective agreement. More demanding the job, that is more complexity points it gets, the higher is the corresponding occupation-related wage. It is this feature of the data that we shall use in the analysis. Basically there should be a one-to-one mapping from the occupation-related wages to the complexity points. The occupation-related wages can therefore be interpreted as a continuous variable measuring the complexity of the job. Thus, for each individual the occupation-related wage should measure the complexity of the tasks he or she is performing.

It is crucial for our analysis that the scale with which the complexity is measured does not change from year to year. We tried to check for this by looking at the workers who were present for the whole sample period, who did note change their firm or job, and whose occupation-related wages behaved in the same way for the whole sample period.

There were 936 workers of this kind.[3] It is reasonable to argue that the tasks of these workers remained constant during the whole sample period. However, examination of the data on these workers revealed that there were increases in occupation-related wages in certain years. Apparently the scale of the occupation-related wages was adjusted from time to time even though the complexity of the tasks did not change. In order to have the same complexity measure for the whole period we used these observed increases and substracted them from the occupation-related wage levels that were observed in the subsample of workers whose tasks did not change during the sample period. There were some occupation-related wage levels that were not represented in this subsample and for whom we could thus not observe the exact occupation-related wage increases. From these workers' occupation-related wages we substracted the median increases observed in the sample of workers whose tasks did not change for the corresponding years. After this correction the occupation-related wages should correspond to real complexity in all the years.

3.3 Descriptive analysis

Occupation-related wages order the jobs into a ladder according to their complexity. In figure 1 we have plotted the distributions of men and women across different complexity levels in the pooled data. Complexity levels where defined by grouping the occupation-related wages into integers.

Figure 1 gives an idea on how the whole worker population is allocated across different tasks. It also reveals some interesting things about the gender differences. First of all, it is obvious that this is a male-dominated industry. Women are clearly under-represented. This is hardly surprising but it has to be kept in mind when interpreting the results. Second, the difference between female and male distributions of complexity is striking: women are concentrated on the low end of complexity axis while men are dominant in the more complex tasks. One obvious explanation for this difference could be the existence of "male and female tasks". If women were altogether excluded from the more complex tasks there would be nothing surprising in this figure. However, tasks are not gender specific in this industry. There are both men and women employed in all the levels of complexity.

As figure 1 is based on the pooled data it is naturally a result of both movements along the complexity ladder as well as of initial task assignments. In order to separate these two factors we plotted the distributions of the first observations on workers along the complexity axis. We interpert these observations as the initial task assignments of workers.

Figure 2 plots the distributions of men and women across the tasks of different complexity at the initial task assignment. If anything the difference between men and women is even more striking in this figure. Hence, it appears that men and women are assigned to different kinds of tasks to begin with. If one takes the theory discussed in the previous section seriously the distribution of tasks at the initial assignment can be seen as the distribution of the workers' innate "metal ability". According to this interpretation the figure 2 reveals that less able women select themselves to the metal industry than men.

However, figures 1 and 2 do not tell us whether we can interpret the complexity levels as a real job ladder. After all complexity can be a completely arbitrary attribute of the job and workers may move between tasks of different complexity almost randomly. This is why it is important to look at the patterns of job-to-job transitions. If complexity levels

[3]There were a total of 1 456 workers who did not change their firm or occupation during the whole sample period. However, examination of workers within the original occupation-related wage levels revealed that some these workers experienced changes in the complexity of their tasks.

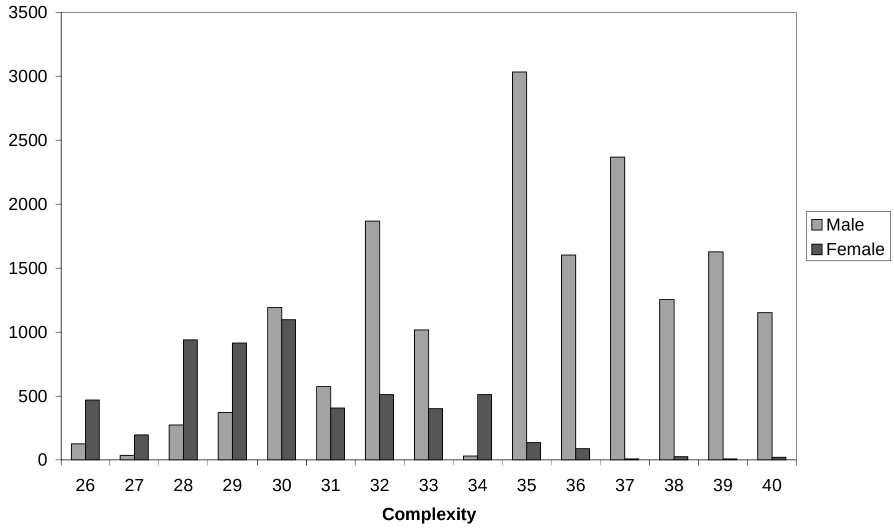

Figure 1: Allocation of workers across tasks, the pooled data

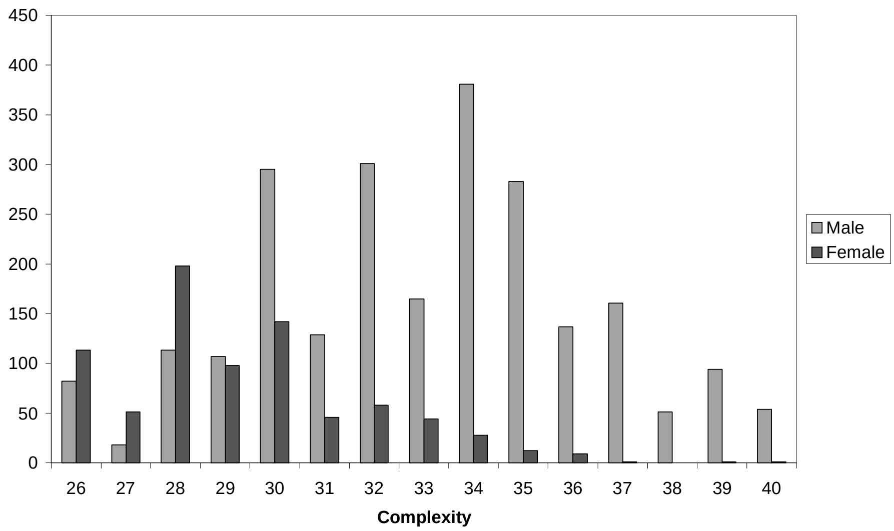

Figure 2: Allocation of workers across tasks at the initial assignment

really are a true job ladder the movements up and down this ladder should correspond more or less to the stylized facts concerning promotions and demotions. Basically we should see clearly more promotions than demotions and promotions should not to skip many levels.

Table 1 is a job-to-job transition matrix similar to the one in Baker, Gibbs, and Holmström [1]. It shows all the transitions between complexity levels including the entries, exits, and stays as percentages of movements from a complexity level to another. Shaded areas indicate levels that were the most frequent destination of the complexity level movers. It is clear that most of the workers stay within the level they were assigned to. This is especially true at the higher end of the complexity axis. However, there are a considerable number of upward movements and these rarely leap over many levels. On the other hand downward movement is rare. All in all, the information in table 1 seems to correspond more or less to the stylised facts regarding promotions and demotions. Thus, it seems appropriate to interpret the complexity axis as a job ladder.

So far we have looked at aggregated complexity levels but in reality occupation-related wage is a continious variable that is not only ordinal but also cardinal. This is a very convenient feature since it allows us to summarize all the information on promotions and demotions in the changes in complexity. Cardinal nature of our complexity variable also make it possible to measure the extent of promotions. Thus, we are able to discriminate between promotions where worker moves to completely different tasks and promotions where tasks change only marginally which is not typically possible in studies that rely on survey data where promotion is a binary variable.

Table 2 presents the sample means of changes in complexity of men and women as well as the differences between the two groups in the yearly cross-sections and the whole sample. There does not seem to be any clear difference between men and women in the change in complexity. Actually the change in complexity is sometimes higher for women. According to these numbers men and women move up the complexity ladder in a more or less equal way.

However, when one looks at differences between means within complexity levels, the gender differences are clear. Table 3 gives the differences in sample means within complexity groups. Groups were constructed by grouping to integers as in figure 1 and 2. It is clear from table 3 that the change in complexity is significantly lower for women in almost all the complexity groups. Thus, the high sample mean of change in complexity for women seems to be caused by the fact that women are assigned to the tasks where positive changes in complexity, ie promotions, are more frequent. Within complexity levels however, the women are promoted less frequently than men.

What does the raw data then tell about the effect of promotion on wages? In table 4 we present some descriptive statistics on wage growth of promoted and non-promoted men and women. Promotion is defined here as a dummy variable that takes value one if the change in complexity is positive. For both men and women wage growth is clearly faster among promoted workrers. "Promotion premium" - the difference between wage growths of promoted and not-promoted workers - is clearly positive and significant in all the cross-sections as well as in the whole sample for both sexes. The numbers also seem to suggest that women gain somewhat more from promotions than men. Wage growth of promoted females is consistently faster than that of promoted men. The difference - 0.02 - is also significant in the whole sample. Also, the difference in the promotion premium is significant in the cross-section of 1992. The difference in promotion premiums in the whole sample also indicates that women gain more from promotions but this difference is not highly significant.

The descriptive analysis seems to indicate that on average there are no differences in promotion rates between men and women. If anything women seem to be promoted slightly more often than men. However, within task levels women experience clearly smaller changes in complexity, which implies that women are assigned to tasks where promotions are more frequent but that women are promoted less often than men on the same tasks. Women seem to gain somewhat more in wages from promotions but it is unclear whether there is any difference in promotion premiums between two sexes.

4 Gender differences in promotions

The descrpitive statistics presented in tables 2 and 3 already revealed how sensitive gender differences in changes in complexity are to control variables. It is thus important to control for individual characteristics as well as the characteristics of the tasks in order to understand the real gender differences. For example, the theoretical arguments discussed above suggest that the age and tenure of the worker might have significant effects on the changes in complexity.

In table 5 we present results from OLS regression of changes in complexity on female dummy and controls. Of individual characteristics we were able to control for age and tenure as well as for whether the worker was a newcomer in the industry. In order to control for the effort exerted by the worker we also included in the regression the personal bonus earned by the worker as well as the share of piece rate and over-time hours in the total hours worked. Finally, of firm characteristics we also included the firm-size measured as number of employees.

In the first column we regress the change in complexity on female dummy and these controls. Whereas the raw correlation of change in complexity and female dummy was roughly zero, controlling for these characteristics makes it slightly positive (0.004). Thus even when for controling for the individual characteristics and effort proxies there do not seem to be any significant genser differences in promotion rates.

However, table 3 suggested that within complexity levels there are clear differences. Thus what we really want to control for is the initial task assignment of the worker. We measure the initial task assignment of the worker with the complexity of the tasks where he or she is observed for the first time. We preferred this task variable to the complexity of the current tasks since the worker might have been promoted to the current tasks. The complexity of the tasks where the worker is observed for the first time is unambigously a result of the initial task assignment

Inclusion of the complexity of the initial task assignment changes results considerably. The estimated coefficient of the female dummy is now negative and clearly significant. The size of the coefficient (-0.011) is also considerable if one bears in mind that the sample mean of the change in complexity is 0.01.

We interpret this result as implying that women are initially assigned to tasks where promotions are more frequent but that compared to the men that have been assigned to those same tasks they have clearly worse possibilities of advancing to more complex tasks. This result also highlights how important it is to control for the worker's tasks. Aggregate comparisons, even when controlling for indvidual charcteristics and effort, would not have revealed this difference.

5 Gender differences in promotion premium

Descriptive statistics in table 4 suggested that gender differences in wage growth correspond to theoretical implications discussed at the outset. Wage growth upon promotion seemed to be higher for women than for men. There were also differences in promotion premiums but because the wage growth was higher for women also without promotions the differences were not as strong. In this section we explore these questions more fully by regressing the wage growth on promotion and gender dummies as well as their interaction controlling for individual characteristics and the complexity of the worker's tasks.

The first column of table 6 summarizes the information already given in table 4. When wage growth is regressed only on female and promotion dummies as well as their interaction only promotion dummy gets a significant coefficient. Workers earn on average 4.9% higher wage incerases when promoted than otherwise. The coefficent of the interaction term is positive but not highly significant.

When controls for individual characteristics and the complexity of the tasks are included in the regression, the coefficient of the interaction term is positive and significant. According to this result promotion premium is 1.8% higher for women than men. Thus, when we control for the initial task assignment of the workers women seem to gain more from promotions. In the final column we estimate this equation allowing for individual-specific fixed effects. The results do not change much. The coefficient of the intercation term is almost exactly the same as in the OLS equation but the standard error are increased somwhat.

The evidence presented here does suggest that there are gender differences in promotion premiums although the coefficients are at best just above reasonable levels of significance. The coefficents of the interaction term of gender and promotion dummies are more or less of same size. If these results truly reflect gender differences in promotion premiums they can be interpreted as considerable. Combined with the results obtained above on changes in complexity this evidence on gender differences in wage growth seems to fit quite well with Lazear and Rosen story. Not only are women in this industry promoted less often than men but they also seem to gain more when they are promoted.

6 Conclusions and suggestions for future research

Theories that seek to explain gender differences in job assignments and promotion patterns usually part from assumptions about different outside option of sexes and yield implications for promotion rates and promotion premiums. The model by Lazear and Rosen [4] discussed in the second section implied that women should be promoted less often than men and they should gain more from promotions.

The Finnish metal industry data are exceptionally suitable for the analysis of promotions. They provide a task metric that is valid for both within and between firm comparisons and that is linked to the actual task containts. What we have is actually a personell dataset that includes various firms. The major weakness of the data is the lack of some demographic variables such as marriage status or number of children that could be important in the analysis of gender differences.

We find that women are allocated in less complex tasks than men. This difference is clearly visible already at the initial task assignment. Furthermore, women are promoted less frequently to more complex tasks than men in the same tasks. The promotion process therefore increases the gender differences in task allocation. However, those few women that are promoted gain more from promotions than men with same individual characteristics on the same task. This difference in is particularily clear in the wage growth upon promotion butit is also visibile in promotion premium even though women expereince somewhat faster wage growth also without promotions.

All in all, these results seem to more or less correspond to the implications of the Lazear and Rosen model. What the results also highlight is the importance of the initial task assignments. On average, the gender differences are not at all clear in these data. It is only when the initial task assignments are controlled for that gender differences arise. Typically job outcomes are a results of both initial assignments and subsequent promotions. We believe that the ability to distinguish between these two phenomena is important when studying gender differences in promotion patterns.

At the time of writing this version years 1996-2000 of data have become available. In the future research we will add these years to our panel and the extent to analysis on gender differences in time it takes to get promoted.

References

[1]Baker, G.P. & M. Gibbs & B. Holmström, (1994): "The internal economics of the firm: Evidence from personell data", *Quarterly Journal of Economics,* 109: 921-955.

[2]Booth, A.L. & M. Francesconi & J. Frank, (2001): "A sticky floors model of promotion, pay, and gender", forthcoming *European Economic Review.*

[3]Gibbons, R. & M. Waldman, (1999): "A theory of wage and promotion dynamics inside firms", *Quarterly Journal of Economics*

[4]Lazear, E.P. & E. Rosen, (1990): "Male-female wage differentials in job ladders", *Journal of Labor Economics,* 13 (3), 426-471.

[5]McCue, K. (1996): "Promotions and wage growth", *Journal of Labor Economics,* 14 (2), 175-209.

[6]Winter-Ebmer, R. & J. Zweimüller, (1997): "Unequal assignment and unequal promotion in job ladders", *Journal of Labor Economics*, 15:1, 43-71.

Table 1 Transition matrix between jobs for newcomers in the metal industry, 1990-1995

	Exit	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	Total	N
Entry		3.8	1.9	9.5	5.3	13.0	4.6	11.5	6.2	15.0	10.1	5.2	6.3	2.1	3.2	2.5	100	1705
26	8.3	55.6	.	13.0	6.5	7.4	.	8.3	.	.	0.9	.	.	.	.	.	100	108
27	11.3	1.6	64.5	9.7	.	.	6.5	.	1.6	4.8	.	.	.	.	.	.	100	62
28	12.5	2.1	1.4	53.3	11.5	9.8	1.4	4.2	0.7	3.1	.	.	.	.	.	.	100	287
29	15.2	0.4	0.4	1.3	64.6	8.1	0.4	5.4	0.4	2.2	1.3	.	.	.	.	.	100	223
30	13.5	0.2	0.4	0.4	1.8	62.0	3.2	9.5	2.4	4.2	1.4	.	0.8	0.2	.	.	100	497
31	8.0	.	1.1	.	.	1.1	68.2	2.8	12.5	3.4	.	2.3	.	0.6	.	.	100	176
32	11.4	.	.	0.2	0.2	3.3	1.7	64.8	0.7	10.5	5.0	0.5	1.7	.	.	.	100	421
33	9.9	.	.	.	.	0.4	1.7	1.3	63.1	14.2	.	5.6	.	2.6	.	1.3	100	233
34	9.9	.	.	0.1	0.1	1.0	0.4	0.9	1.6	69.4	7.3	5.3	2.0	1.0	0.6	0.3	100	695
35	9.8	.	.	0.2	.	0.2	0.2	1.5	.	3.5	70.9	.	11.6	0.4	1.5	.	100	457
36	10.9	.	.	.	.	0.4	.	.	0.8	5.0	.	73.1	0.4	6.3	.	2.9	100	238
37	10.4	.	.	.	.	0.6	.	0.6	0.3	2.2	5.7	0.6	75.3	0.3	3.2	0.6	100	316
38	5.6	.	.	.	.	.	.	.	.	2.1	.	1.4	.	80.3	3.5	7.0	100	142
39	10.6	.	.	.	.	.	.	.	.	1.4	1.4	0.7	3.5	.	82.4	.	100	142
40	7.5	.	.	.	.	.	.	.	.	0.6	.	1.3	.	1.3	.	89.4	100	160
Total	7.6	2.3	1.4	5.9	4.9	10.4	4.1	9.8	5.2	15.4	10.2	5.6	7.3	3.1	3.4	3.6	100	5862

Shows all transitions between complexity levels, including entry, exit, and stays from 1990 to 1995, as percentage of movements from a complexity level to another. Complexity levels are created by aggregating occupation-related wages into integers. Shaded cells indicate the level that was the most frequent destination of the complexity level moves. Numbers in boxed cells indicate stays within a complexity level. Zeros denote nonempty cells that round up to zero and "."s denote empty cells.

Table 2 Change in complexity. Gender differences in yearly cross-sections and the whole sample.

Year	1990	1991	1992	1993	1994	All
Men	0.013	0.004	0.007	0.014	0.011	0.010
Women	0.013	0.007	0.011	0.016	0.011	0.012
Difference	0.000	-0.003	-0.004	-0.002	0.000	-0.002
	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.002)

Numbers in cells are changes in log occupation-related wages from current to the next year. Numbers in parenthesis are estimated standard errors.

Table 3 Change in complexity. Gender differences within complexity groups.

Group	Men	Women	Difference
26	0.070	0.033	0.037* (0.015)
27	0.112	0.020	0.091* (0.025)
28	0.052	0.021	0.031* (0.007)
29	0.027	0.010	0.018* (0.006)
30	0.026	0.008	0.018* (0.004
31	0.019	0.004	0.015* (0.006)
32	0.013	0.001	0.013* (0.005)
33	0.020	0.016	0.004 (0.007)
34	0.009	-0.003	0.012* (0.005)
35	0.004	-0.008	0.012 (0.007)
36	0.002	0.019	-0.018 (0.014)
37	-0.006	-0.016	0.010 (0.018)
38	0.002	-0.000	0.002 (0.010)
39	-0.016	.	.
40	-0.002	-0.020	0.017* (0.008)

Numbers in cells are changes in log occupation-related wages from current to the next year. Numbers in parenthesis are estimated standard errors. Star indicates significance at 5%-level.

Table 4 Changes in wages. Gender differences in yearly cross-sections and the whole sample.

	1990	1991	1992	1993	1994	All
A. Men						
Wage growth						
- promoted	0.011	0.002	0.042	0.051	0.058	0.041
- non promoted	-0.021	-0.018	-0.003	-0.002	-0.004	-0.007
Promotion premium	0.032*	0.021*	0.045*	0.053*	0.061*	0.049*
	(0.009)	(0.009)	(0.009)	(0.008)	(0.007)	(0.00)
B. Women						
Wage growth						
- promoted	0.027	0.048	0.085	0.066	0.063	0.060
- non promoted	-0.019	-0.032	0.017	0.002	0.006	-0.002
Promotion premium	0.046*	0.080*	0.068*	0.061*	0.056*	0.062*
	(0.008)	(0.032)	(0.014)	(0.011)	(0.011)	(0.006)
C. Male-female differential						
Wage growth						
- promoted	-0.015	-0.046*	-0.043*	-0.011	-0.005	-0.019*
	(0.019)	(0.020)	(0.019)	(0.017)	(0.013)	(0.008)
- non promoted	-0.002	0.014	-0.020*	-0.003	-0.010	-0.005
	(0.010)	(0.007)	(0.007)	(0.007)	(0.007)	(0.003)
Promotion premium	-0.013	-0.060*	-0.022	-0.008	-0.005	-0.013
	(0.021)	(0.019)	(0.017)	(0.016)	(0.013)	(0.007)

Numbers in cells are changes in log real wages. Promoted workers experience a positive change in their occupation-related wages. Non-promoted workers experience no change or a negative change in their occupation-related wages. Promotion premium is the difference between the wage growth of promoted and not-promoted workers. Numbers in parenthesis are estimated standard errors. Star indicates significance at 5%-level.

Table 5 Change in complexity – regression results

	(1)	(2)
Female	.004*	-.011*
	(.002)	(.002)
Age	-.055*	-.033*
	(.007)	(.001)
Tenure	-.000	-.000
	(.000)	(000)
Newcomer	.010*	.010*
	(.002)	(.002)
Personal bonus	-.075*	-.037*
	(.018)	(.017)
Piece rate share	-.000	-.000
	(.000)	(.000)
Overtime share	.023*	.030*
	(.010)	(.011)
Firm-size	.000	.000
	(.000)	(.000)
Initial task complexity	-	-.103*
		(.010)
Constant	.029*	.383*
	(.004)	(.032)
R^2	.061	.105
N	3 710	3 710

Dependent variable is the difference between log of the occupation-related wage in the next period and the log of the occupation-related wage at the current period. Tenure measured as number of years that individual has been present in the panel. Newcomer is a dummy that takes value one at the first observation on individual. Personal bonus is measured as a proportion of occupation-related wage. Piece-rate share is measure as a ratio of hours worked on piece rate. Overtime share is the ratio of hours worked on overtime. Initial task complexity is the log of the occupation-related wage at the initial task assignment. Numbers in parenthesis are robust standard errors.

Table 6 Wage growth – regression results

	(1)	(2)	(3)
Female	.005	-.006	-
	(.003)	(.004)	
Promotion	.049*	.033*	.010
	(.004)	(.004)	(.005)
Female * Promotion	.013	.018*	.018
	(.009)	(.008)	(.010)
Individual characteristics	No	Yes	Yes
Complexity	No	Yes	Yes
Fixed-effects	No	No	Yes
R^2	.070	.105	.020

Dependent variable is the difference in the log of real. Female is a dummy for being a female. Promotion is a dummy for change in tasks. Female*promotion is the interaction term between the two. Individual characteristics include: age, age squared, tenure, share of overtime, share of piece rate, region. Complexity refers to the log of occupation-related wage. Fixed effects refers to the deviation of individual-specific means transformation.