Boundaries of Internal Labor Markets: The Relative Importance of Firms and Occupations

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Abstract

This paper studies the relative importance of firm and occupation in hiring, career choice, and wages. The analysis is based on an extensive Swedish dataset that includes employee and occupation characteristics and wage information for over 180,000 workers each year. Contrary to conventional assumptions, we find no firm-based "ports of entry" through low level jobs. Instead, we find occupation-based ports of entry. At higher ranks, firms prefer to hire workers with relevant occupational experience, even if that requires hiring from outside the firm. Wage regressions reinforce the message, showing that overall experience and tenure in occupation have significant effects on wages but that tenure within a firm does not. We also study heterogeneity between occupations and find that, where the occupation-based port of entry is more pronounced, occupation tenure has a larger effect on wages. These results shed new light on the boundaries of internal labor markets suggesting that firm-specific aspects (such as firm-specific human capital or firm-worker contracts) may be less important than previously thought and that occupation-specific aspects (such as occupation-specific human capital) deserve closer attention.

1. Introduction

The worker-firm relationship is at the heart of modern labor economics. Theories to explain that relationship introduce the concepts of firm-specific human capital, worker-firm matching, and long-term labor contracts.

It remains a subject of debate, however, whether these firm-specific aspects are relatively important determinants of a worker's career, specifically, his wage and rank. Some basic predictions of contract models often go unsupported in empirical analyses (e.g. see Prendergast 2002) and growing numbers of economists are expressing skepticism about the importance of firm-specific human capital (e.g. see Lazear 2003). Sociologists (DiPrete and McManus 1993) have emphasized that occupation is an important determinant of a worker's career and, indeed, of the way firm tenure affects the worker's career[1]. Still, most empirical studies do not have access to the data needed to tease out the different possible determinants of a worker's career, such as occupation.

This lack of control for occupation not only biases the analysis of firm-specific career determinants (e.g. the returns to firm tenure in wages), but also misleads the theoretical literature. It is no coincidence, for example, that there are only a few theoretical models based on occupation-specific human capital but many based on firm-specific human capital or firm-worker contracts.

In this paper we study the effects of both firm- and occupation-specific variables on wages, and also on hiring and promotion practices. We study whether firms tend to fill positions from within or seek candidates outside the organization. Thus, we provide a standard for assessing the effect on wage of firm-specific aspects of a worker's career, and conclude that these aspects are far less important than occupation-specific aspects. In particular, we find that, at higher ranks, firms become more likely to hire someone with the same occupation at a different firm than someone with a different occupation at the same firm, and that the returns to occupation tenure are much higher than those to firm tenure in wage regressions.

The absence of controls for occupation in earlier studies arises partly because available datasets have been limited in scope. For example, when Kambourov and

[1] See e.g. Rosenbaum (1979a,b), Spilerman (1986), Spilerman and Lunde (1991), and Weeden (2002) for the relative importance of occupation.

Manovskii (2002) attempt to control for occupation tenure as well as firm tenure in wage regressions using PSID, Panel Study of Income Dynamics, they are left with less than one thousand workers for a whole decade. Our analysis is based on an extensive Swedish employer-employee matched dataset (described in section 3) that is essentially a collection of personnel records from almost every private sector firm in Sweden. A unique feature of the Swedish dataset is that it contains extremely detailed occupation codes which enable us to measure the effect of occupation consistently across different firms. We focus on the set of white-collar workers in large firms during 1986-1989. This sample contains more than 180,000 workers per year.

Our hiring analysis (section 4) provides new insights on the internal labor market (ILM) literature: controlling for occupation reveals a new account of the boundaries of a worker's career and of an internal labor market. Even though Doeringer and Piore's (1985) original concept of ILM is based on a social group process, including occupation, the literature often assumes that the boundary of an internal labor market is determined by the firm. Thus, the literature has focused on whether a firm hires from outside or promotes from within, and whether the wages of workers within a firm are independent of external labor market conditions (see e.g. Baker, Gibbs, and Holmstrom 1994a,b). To explain empirical findings, the literature has relied on theoretical models based on firm-specific aspects such as firm-specific human capital or firm-worker contracts[2].

However, the results of our hiring analysis strongly suggest that, to the extent that labor markets can be described as segmented into various ILM's, the boundaries of these labor markets are more accurately described by occupations (even across firms) than by firms (across occupations). We obtain the same conclusion in our analysis of worker mobility in section 5.

Our wage analysis in section 6 helps to illuminate a series of studies testing theories about how wages depend on firm-specific variables (see e.g. Altonji and Shakotko 1987, Topel 1991, Altonji and Williams 1997). Altonji and Shakotko (1987) find the low returns to firm tenure, challenging some of the building blocks of modern labor economics and sparking a series of subsequent studies. These have focused mainly on separating the effect of firm-specific human capital from the effect of firm-specific

[2] See Gibbons and Waldman (1999) for a survey.

matching on wages, despite the fact that the models predict similar results and therefore make the exercise rather difficult[3].

By contrast, our wage analysis focuses on assessing the relative importance of firm tenure and occupation tenure, finding that occupation tenure yields much larger returns. This comparison is similar to that of Neal (1999), Parent (2002), and Kambourov and Manovskii (2002) who find that industry (or occupation)-tenure has much higher returns than firm tenure. However, these studies are based on a limited sample[4] and noisy tenure variables and lack an analysis of the role of industry (or occupation) in *hiring* and *mobility*. Furthermore, none of these studies combine their wage analysis with the analysis of hiring.

Other important questions have also been neglected. Few studies have analyzed the heterogeneity across occupations (or firms) of the relative importance of firm vs. occupation-specific aspects in terms of both hiring and wages. We find large heterogeneity across occupations in terms of both. For example, even though occupation tenure has larger returns than firm tenure in most occupations, firm tenure has larger returns than occupation tenure in a few occupations such as sales, technical service, and administration. This heterogeneity, as we discuss later, provides new implications and challenges for future research.

In section 7, we examine the interaction between the wage and hiring results to show that they present a consistent picture. Comparing different occupations, we find that the relative importance of occupation- and firm-specific aspects in hiring decisions is positively correlated with their relative importance in wage determination. As we illustrate in section 2, hiring (or mobility) decisions and wage policy are often determined by the same underlying parameters, though there is a paucity of studies that link an analysis of hiring (i.e. ports of entry) to an analysis of the returns to firm tenure in wages.

The majority of theories and empirical studies on workers' careers and ILMs have emphasized firm-specific aspects[5]. However, our study shows that occupation-specific

[3] See Kambourov and Manovskii (2002) for various reasons why it is difficult to separate these two effects. For example, it is difficult to control for the effects of firm tenure on both occupation-worker matching and on firm-worker matching.
[4] There are less than 3000 workers in a non-random sample of displaced workers in Neal (1999), less than 2,500 workers in Parent (2002), and less than 1,000 workers in Kambourov and Manovskii (2002).
[5] For an exception, see Shaw (1984).

aspects are far more important than firm-specific aspects in hiring, mobility, and wages. We also show the heterogeneity across specific occupations. These results provide new insights on the boundaries of workers' careers and of ILMs and point to the importance of revising theoretical and empirical approaches to capture these new findings.[6]

As always, these new results open up new questions. What drives the heterogeneity across occupations? What does this heterogeneity imply for the employer's freedom to negotiate/set wages and for the organizational structure of a firm? In section 8 we summarize our present findings and discuss some intriguing potential answers to these questions.

2. Simple Model

In this section we present a simple model of mobility, hiring, and wages in order to identify the economic factors that determine the careers of workers and the boundaries of ILM's.

2.1 Mobility and Boundary of Career

Consider a worker with the following four career options: (i) staying in the same occupation at the same firm, (ii) changing firms within the same occupation, (iii) changing occupations within the same firm, and (iv) changing both occupation and firm.

If a worker i stays at the same occupation o in the same firm f, suppose that the expected *continuation* payoffs are given as follows:

$$w_1 = \lambda_g Exp_i + \lambda_f \tau_{if} + \lambda_o \tau_{io} + x_i'\beta + \mu_i + \varepsilon_{ifo} \qquad (1)$$

Here, Exp_i is worker i's general labor market experience, τ_{if} is the firm tenure, and τ_{io} is the occupation tenure. Also, x_i is a vector of the worker's observed characteristics, and μ_i represents the worker's unobserved characteristics. Finally, ε_{ifo} represents the worker's matching quality with firm f and occupation o.

[6] For recent promising works that incorporate the concept of occupation (job or task) – specific human capital, see Kwon (1999), Gibbons and Waldman (2003), and Lazear (2003).

Firm-specific aspects, such as firm-specific human capital the worker has accumulated, or an implicit long-term contract, will determine the size of λ_f, while occupation-specific aspects, such as occupation-specific human capital, will determine the size of λ_o. However, we can not directly estimate λ_f and λ_o from (1) because the expected continuation payoffs are not observable. Thus, we construct a simple model which will allow us to isolate these variables using the observed career choices of workers.

Suppose that if worker *i* changes firms within the same occupation, the expected continuation payoffs become:

$$w_2 = \lambda_g Exp_i + \lambda_f(0) + \lambda_o \tau_{io} + x_i^{'}\beta + \mu_i - m_f \tau_{if} - k_f + \varepsilon_{if'o} \tag{2}$$

Here $m_f \tau_{if}$ measures the expected change in firm matching quality, expressed as a function of firm tenure[7]. Note that if $m_f > 0$, a worker with a longer firm tenure would be less likely to find a better firm match, possibly because long tenure correlates with a good match[8]. The worker loses value when $\lambda_f \tau_{if}$ is reset to zero either because the firm-specific human capital accumulated in the old firm becomes useless or because the worker cannot receive the tenure premium promised by a long-term contract with the old firm. We also denote the direct cost of changing firms (e.g. cost of moving) by k_f.

Similarly, if the worker changes occupations within the same firm, the continuation payoffs become:

$$w_3 = \lambda_g Exp_i + \lambda_f \tau_{if} + \lambda_o(0) + x_i^{'}\beta + \mu_i - m_o \tau_{io} - k_o + \varepsilon_{ifo'} \tag{3}$$

where m_o and k_o are defined similarly to m_f and k_f above.

If the worker changes both his/her firm and his/her occupation, then the continuation payoffs are:

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[7] This change in the firm-match quality may also depend on labor market experience, occupation tenure, or other worker characteristics. We will discuss this possibility in Section 6.

[8] We may also have $m_f > 0$ if the cost of changing firm increases with firm tenure, perhaps because the worker has many friends at work or has become accustomed to the current firm.

$$w_4 = \lambda_g Exp_i + \lambda_f(0) + \lambda_o(0) + x_i'\beta + \mu_i - m_f\tau_{if} - k_f - m_o\tau_{io} - k_o + \varepsilon_{if'o'} \quad (4)$$

Then, worker *i* would, for example, change firm within the same occupation if

$$w_2 = \max\{w_1, w_2, w_3, w_4\}$$

We assume that ε_{ifo} are i.i.d. with a type I extreme distribution. This is a well-known (multinomial) logit model. (See e.g. Maddala 1983) In particular, the relative probability of 'moving outside the firm within the same occupation' to 'staying within the same firm and the same occupation' becomes:

$$\begin{aligned} \frac{\Pr(\text{outside firm within occup})}{\Pr(\text{within firm within occup})} &= \frac{\exp\{\lambda_g Exp_i + \lambda_o\tau_{io} + x_i'\beta + \mu_i - m_f\tau_{if} - k_f\}}{\exp\{\lambda_g Exp_i + \lambda_f\tau_{if} + \lambda_o\tau_{io} + x_i'\beta + \mu_i\}} \\ &= \exp\{-(\lambda_f + m_f)\tau_{if} - k_f\} \\ &= \exp\{-\beta_f\tau_{if} - k_f\} \end{aligned} \quad (5)$$

where $\beta_f \equiv \lambda_f + m_f$. Therefore, if we can observe a worker's career choice regarding firms and occupations, we can identify β_f.

Note that if λ_f is large, then firm-specific aspects are valuable to the worker's career. If the cost of changing firms, m_f, is large, a worker is *less* likely to find a good firm-match as firm tenure increases. Therefore, even though we cannot separate λ_f and m_f, we can still argue that if $\beta_f (\equiv \lambda_f + m_f)$ is large, then firm-specific aspects (firm-specific human capital, firm-specific matching, or long-term contracts) are valuable to a worker's career. We can also argue that if β_f is large, workers' long-term careers will be largely restricted within the boundary of a firm because those with longer firm tenure will find it ever less profitable to switch.[9]

The relative probabilities of other choices can be also expressed as follows:

[9] If the cost of changing firm, k_f, (such as moving cost) is large, it would also restrict the workers' career choice even in the absence of firm-specific human capital or firm-specific matching. We regard this cost as a benchmark and focus mainly on the firm-specific aspects, β_f, in this study.

$$\frac{\Pr(\text{within firm outside occupation})}{\Pr(\text{within firm within occupation})} = \exp\{-(\lambda_o + m_o)\tau_{io} - k_o\} = \exp\{-\beta_o \tau_{io} - k_o\} \quad (6)$$

$$\frac{\Pr(\text{outside firm outside occupation})}{\Pr(\text{within firm within occupation})} = \exp\{-\beta_f \tau_{if} - \beta_o \tau_{io} - k_f - k_o\} \quad (7)$$

where $\beta_o \equiv \lambda_o + m_o$

Following the same logic as above we argue that, if β_o is large, occupation-specific aspects are important in a worker's career; that is, internal labor markets are largely defined by the boundary of occupation.

2.2 Hiring and Boundary of ILM

As we discussed in the beginning, the previous literature has implicitly assumed that an ILM exists within the boundary of a firm, and the theoretical literature hastily built models of ILMs based on ideas about the value of firm-specific human capital or long-term contracts. (See Baker and Holmstrom 1995, "Internal Labor Markets: Too Many Theories, Two Few Facts") However, many sociologists and some economists have suggested that an ILM may exist within the boundary of an occupation, even across firms. Clearly, an economics department would hire an economist from another university rather than a classics professor from the same university. If *most* ILMs are determined by the boundary of an occupation and not by the boundary of a firm, we need to revise existing theoretical models of ILM in more occupation-specific terms.

To study the boundaries of ILMs, we need to consider firms' hiring strategy, that is, how they choose to fill empty positions within the firm. According to current theory, an internal labor market does not hire new workers into all its ranks; this would expose all the workers to the external labor market. Rather, an ILM is supposed to hire new workers at the bottom ranks only (called *ports of entry*) and promote these workers to higher ranks according to its administration policy. (See Doeringer and Pirore 1985) This implies that, in practice, internal hiring (or promotion) ratio should increase with rank.

Consider the following simple model of hiring. Suppose that a firm *f* needs to fill a vacancy in rank r in occupation o. The firm has five options in hiring: (i) hiring from

within the firm and within the same occupation, (ii) hiring from outside the firm within the same occupation, (iii) hiring from outside the occupation within the firm, (iv) hiring from outside the firm and outside the occupation, and (v) hiring a worker who is new to the labor market.

We assume that higher ranks require higher skill levels, that is, more human capital. A worker's skills consist of general skills, firm-specific skills, and occupation-specific skills. Abusing the notation slightly, we denote the average general skills in rank *r* by $\lambda_g r$. Similarly, we denote the average firm- and occupation-specific skills in rank *r* by $\lambda_f r$ and $\lambda_o r$. Thus, if the firm hires from within the firm and within occupation, the expected productivity is given as follows:

$$h_1^r = \lambda_g r + \lambda_f r + \lambda_o r + \varepsilon_{fo} \tag{8}$$

where ε_{fo} is the worker's expected matching quality with firm and occupation.

Note that measuring skills (or human capital) by rank has a potential advantage over measuring them by experience and tenure. If workers have different learning speeds, labor market experience and firm and occupation tenure are inaccurate measures of individual human capital. However, if firms can observe workers' human capital (or resultant productivity) and promote them accordingly, rank will be a better measure of human capital than experience or tenure.

If the firm hires a worker from the same rank of the same occupation but from another firm[10], the expected productivity is as follows:

$$h_2^r = \lambda_g r + 0 + \lambda_o r + \varepsilon_{f'o} - m_f r - k_f \tag{9}$$

where $m_f r$ measures the differences in firm match quality, which may depend on rank. If $m_f > 0$, for example, at higher ranks, workers from outside the firm are less likely to have a good match than workers from within the firm. Note that the new worker lacks

[10] We assume that the firm hires from the same rank because a worker in another firm who occupies a higher rank wouldn't move, and one who occupied a lower rank wouldn't demonstrate sufficient productivity.

firm-specific skills.[11] Also k_f measures the cost of hiring from outside the firm (e.g. recruiting cost).

If the firm fills the job with a worker from another occupation but at the same rank within the same firm, the expected productivity is as follows:

$$h_3^r = \lambda_g r + \lambda_f r + 0 + \varepsilon_{fo'} - m_o r - k_o \tag{10}$$

where $m_o r$ and k_o are similarly defined as above.

If the firm fills the job with a worker in the same rank but from another firm and occupation, the expected productivity is:

$$h_4^r = \lambda_g r + 0 + 0 + \varepsilon_{f'o'} - m_f r - m_o r - k_f - k_o \tag{11}$$

Finally, if the firm hires a worker who is new to the labor market, the expected productivity is:

$$h_5^r = 0 + 0 + 0 + \varepsilon_{f'o'} - m_f r - m_o r - k_f - k_o - k_n \tag{12}$$

where k_n is the additional cost of hiring new entrants.

Therefore, firm *f* would fill the job in rank *r* in occupation *o* with someone from outside the firm but within the same occupation if:

$$h_2^r = \max\{h_1^r, h_2^r, h_3^r, h_4^r, h_5^r\}$$

If we assume that ε_{fo} is i.i.d. and follows a type I extreme distribution, then the relative probability of 'hiring outside the firm within the same occupation' to 'hiring from within the same firm and the same occupation' is

[11] We can also interpret the loss of firm-specific skills as the loss of incentives among workers at lower ranks. In a tournament system, hiring an outside worker for a high-rank job will reduce the incentives of internal workers competing for the high-rank job. See Chan (1996) for more details.

$$\frac{\Pr(\text{outside firm within occupation})}{\Pr(\text{within firm within occupation})} = \exp\{-(\lambda_f + m_f)r - k_f\} = \exp\{-\beta_f r - k_f\} \quad (13)$$

where $\beta_f \equiv \gamma_f + m_f$.

As λ_f increases, the opportunity cost of hiring a worker from outside the firm (i.e. loss of firm-specific skills or loss of incentives among lower-ranking workers) increases. Also, the larger m_f, the less likely that a worker from outside the firm will have a better match than a worker from inside the firm. As in the model of career choice, we cannot separately identify λ_f and m_f. However, if $\beta_f (\equiv \lambda_f + m_f)$ in (13) is large, it would imply that firm-specific factors (either λ_f or m_f) are important in firms' hiring decision. In other words, if β_f is large, firms will hire and promote mainly from within the boundary of the firm, especially at higher ranks, and new workers will enter firms only through the bottom ranks. This also implies that an ILM is determined by the boundary of a firm.

Similarly, the relative probability of 'hiring outside the occupation and within the firm' to 'hiring within firm and within occupation' is given as follows:

$$\frac{\Pr(\text{within firm outside occupation})}{\Pr(\text{within firm within occupation})} = \exp\{-(\lambda_o + m_o)r - k_o\} = \exp\{-\beta_o r - k_o\} \quad (14)$$

where $\beta_o \equiv \lambda_o + m_o$. By the same logic as above, if β_o in (14) is large, occupation-specific factors are important in firms' hiring decision, and firms should hire and promote mainly from within the boundary of an occupation, especially at higher ranks. This would also imply that an ILM is determined by the boundary of an occupation.

The relative probabilities of other hiring strategies can be also expressed as follows:

$$\frac{\Pr(\text{outside firm outside occupation})}{\Pr(\text{within firm within occupation})} = \exp\{-(\beta_f + \beta_o)r - (k_f + k_o)\} \quad (15)$$

$$\frac{\Pr(\text{hiring new entrant})}{\Pr(\text{within firm within occupation})} = \exp\{-(\lambda_g + \beta_f + \beta_o)r - (k_f + k_o + k_n)\} \quad (16)$$

2.3 Wage

Firm-specific human capital, long-term contracts, and firm-specific matching also affect a worker's current wages. In particular, these models all predict that wages will increase with firm tenure. Thus, many studies have focused on the size of the firm tenure coefficient in a wage regression. To illustrate what the firm tenure coefficient captures in a typical wage regression, with a slight abuse of notation, consider the following regression model.

$$w_{ifot} = \lambda_g Exp_{it} + \lambda_f \tau_{ift} + \lambda_o \tau_{iot} + \mu_i + \theta_{if} + \gamma_{io} \quad (17)$$

where θ_{if} is the worker-firm match quality and γ_{io} is the worker-occupation match quality. The other variables are similarly defined as in (1).

Estimation of a solution to this type of wage equation has been well discussed in the literature (see Topel 1991 and Kambourov and Manovskii 2002). Since μ_i, θ_{if}, and γ_{io} are unobservable, we must match the wage model using the following regression model:

$$w_{ifot} = \alpha_g Exp_{it} + \alpha_f \tau_{ift} + \alpha_o \tau_{iot} + e_{it} \quad (18)$$

Note that α_f and α_o are identified by comparing those workers who remain in a firm or occupation with those who leave. For example, consider two ex-ante identical workers (*i* and *j*) who have been in the labor market in the same occupation for *t* years. Suppose that worker *i* has remained in the same firm for *t* years, but worker *j* changed firms after the first year and has remained in the second firm ever since. Then, following (17), these workers' wages are determined as follows:

$$w_i = \lambda_g t + \lambda_f t + \lambda_o t + \mu + \theta_f + \gamma_o$$
$$w_j = \lambda_g t + \lambda_f (t-1) + \lambda_o t + \mu + \theta_{f'} + \gamma_o \quad (19)$$

Among observables, the two workers are differentiated only by firm tenure. Therefore, the difference in wages will indicate the returns to firm tenure as follows:

$$\alpha_f = w_i - w_j = \lambda_f + (\theta_f - \theta_{f'}) \quad (20)$$

That is, the coefficient of firm tenure in wage regression (18) measures not only the worker's firm-specific skills (λ_f), but also the change in firm matching quality.

Therefore, as in the models of career choice or hiring, we cannot separate the changes in firm-specific human capital from the changes in firm-worker matching quality. In particular, when a firm cannot fire workers (as in Sweden), workers will change firms only when the improvement in firm matching quality is large. Therefore, $\theta_f - \theta_{f'}$ will be negative. Then, even if λ_f is positive, the coefficient of firm- tenure in a wage regression (α_f) can be negative.

Note, however, that if λ_f or $\theta_f - \theta_{f'}$ is large, workers will not benefit much from changing firms. Therefore, as α_f increases, the worker's career becomes more restricted within the boundary of the firm.

Similarly, the coefficient of occupation tenure should measure the return to occupation-specific human capital and the change in occupation-worker matching quality. Then, by the same logic as above, as α_o increases, the worker's career becomes more restricted within the boundary of his/her occupation.

Many previous studies have attempted to measure the returns to firm-specific human capital and have focused on estimating λ_f separately. However, as illustrated above, it is difficult to identify λ_f and $\theta_f - \theta_{f'}$ separately, so these studies returned mixed results depending on the assumptions they made. Furthermore, most did not control for occupation tenure.

This lack of control for occupation tenure is a serious problem. Neal (1999), Parent (2002), and Kambourov and Manovskii (2002) show that firm tenure becomes insignificant when they control for industry (or occupation) tenure, undermining the importance of separating individual firm-specific aspects. However, these studies are based on limited samples with noisy tenure variables. Thus, in this paper, we focus on the relative size of α_f and α_o, properly controlling for both firm tenure and occupation-tenure and using a representative dataset.

3. The Data

The previous section illustrates that, in order to separate the firm- and occupation-specific aspects of ILM, one needs an unusual dataset: one that contains detailed information on the *history* of workers' past firms, occupations, and ranks as well as their wages.

The Swedish data are ideal in this respect. The data were collected and compiled by the Swedish Employers' Confederation (SAF) from their database on wage statistics, assembled from establishment-level personnel records. These data contain detailed information on occupation, firm, and wage for all blue- and white-collar workers in every industry (except the insurance and banking industries) in the private sector within the SAF domain from 1970 to 1990. We use the white collar data set from 1986-1989 in this study. These data are used in the yearly wage negotiations and are monitored not only by SAF but also by the labor unions. Hence, their quality is exceptionally high: they should be very reliable compared to standard sample surveys with personal reports of pay rates and hours worked.

3.1 Labor market conditions in Sweden

Sweden has strong egalitarian traditions, allowing much less inequality in pay than, for instance, the U.S. (see Fritzell 1991, Blau and Kahn 1996). Sweden has a low return to job tenure (Edin and Zetterberg 1992), a low return to schooling (Edin and Holmlund 1995; Edin and Topel 1997), small industry wage differentials (Edin and Zetterberg 1992), a small gender wage gap within occupation establishment levels (Meyersson-Milgrom, Petersen and Snartland 2001), a small gender productivity gap

(Petersen, Snartland and Meyersson Milgrom 2000), and a small gender reached-rank gap (Meyersson Milgrom and Petersen 2003, SOU 1998).

Employers are allowed to decide autonomously when it comes to hiring and promotion. But firing workers is strictly regulated by law and is monitored by the labor union. Very few workers are fired or laid off, except when the firm can claim that the jobs has become redundant. An employer cannot fire a worker and hire another for the same position. To lay a worker off, the employer must certify that her position is being eliminated due to lack of demand for that particular skill. Thus, when a worker in Sweden changes firms to accept a new position, it is generally because the new job is more attractive to the worker than the old.

Since our study focuses on the period 1986-1989, it is useful to review the conditions in Sweden then: the longitudinal data from Sweden present a valuable and rare glimpse of a period of institutional change within a country. Wages, unlike hiring decisions, were set largely through negotiations at the central, industry, or local level. Beginning in 1966, wage setting for most private sector white collar workers was determined through negotiations between SAF and PTK, the main cartel for the private sector white collar union. After 1983, the central wage bargaining system started to dissolve despite the government's attempts to save it. For the vast majority of all employees after 1988, wages were determined by industry- and plant-level bargaining (Calmfors and Forslund 1990), while local plant unions continued to represent workers. The period of 1986 to 1989 then encompassed the transition from pervasive centralized wage negotiation to locally-determined wage setting. Our choice of this period benefits our study, in that the findings will be more general to other countries where firm level bargaining takes place.

Sweden is also a good case study for a labor market with long-term labor contracts. Gibbs et al (2002) show that 80% of men and 86% of women in the SAF wage statistics sample remained at one firm while in the sample. However, Fox (2003), using the same sample, showed that employees are more likely to change firms at younger ages. Promotions are more common than firm changes, and being promoted upon changing firms is least common. Changing firm and receiving a promotion increases pay 7.3 %, promotion only 3.3 % (Gibbs et al 2002). Finally, research findings using the same data

also suggest that white-collar workers exhibit a downward rigidity in nominal wages (see Ekberg 2003). Sweden's system seems to suggest an important role for firm-based recruitment and wage setting, since there is so little movement of workers between firms, but still the period we have chosen to analyse has relatively decentralized wage bargaining compared to earlier periods. There are some major differences between Swedish the labor markets and other countries', but also some major similarities. And all in all we suggest that the characteristics of the Swedish data in the studied period are ideal for separating the effects of firm- and occupation-based aspects of ILM and also for studying the variation across occupation based variables.

3.2 The Occupation Coding (BNT) System

The Swedish centralized wage system has been covered extensively in the literature, but the BNT occupation coding system has seldom been described and there is a particular paucity of research on how the two systems complemented each other. The BNT system, used for classifying salaried occupations in the Swedish data, was developed jointly by SAF (Swedish Federation of the Employers), SIF (Swedish union of clerical and technical employees in industry), SALF (Swedish Union of Foremen and Supervisors), HTF (Swedish Commercial Salaried Employees) and CF (Swedish Association of Graduate Engineers CF-STF) to facilitate the enumeration of the salary levels for different types of salaried work. The first edition was published in 1955. [12]

The BNT system code was founded on two basic criteria. The first was work performed (types of tasks) and the second was degree of difficulty. Work performed was defined in terms of a variety of operations such as designing, manufacturing, buying, and selling, and degree of difficulty was defined as the sum total of the requirements for a given job such as knowledge, experience, creative effort, supervisory and financial responsibility, the nature and extent of contacts, and the diversity of the work performed. Salaried occupations were classified exclusively on the basis of the work performed by given salaried workers. The *manner* in which the salaried worker performs his duties, i.e.

[12] Since 1980 the statistics include members of companies of the SFO (the SFO Employer's Association), KFO (The Cooperative Employers' Association), K.A.B (the Negotiation Organization of the Cooperative and Public Utility Housing Corporations of Sweden), and TA (the Swedish Newspaper Employers Association).

the performance and skill exhibited by the salaried worker, were not to influence the classification, nor were formal merits such as education or period of employment. So the occupations were classified on the basis of objective and factual information. The parties claimed to be in full agreement that consultations should not take the form of negotiations, so the consultations took place at a different time from local salary negotiations.

Inspection of the implementation of the central wage negotiating system and the occupation coding system were carried out regularly in order to ensure that the salary statistics were as accurate as possible. Both the labor unions and the employer federation conducted random sample checks. Each year experts from the national headquarters of the SAF and the salaried worker unions attended many national consultation meetings at the instigation of the local level party. These meetings were held whenever companies and local union branches failed to agree on classification at local consultations.

The establishment characteristics include a 1-digit industry code, size (number of employees), region, and area within region. For each employee surveyed, information was obtained on method of wage payment (incentive- or time-rated), education, age, hours worked, part-time or full-time employment, union status and if unionized the name of the union, and a detailed description of job content, usually a four-digit code. We refer to this job content information as "occupational codes," although it might also be described as job titles. Altogether, the white-collar occupations include approximately 280 positions in each year.

The system includes ten occupation areas (for instance, construction and design), and 51 broad occupational groups (for instance, construction work), each with detailed information about task content. Each of the 51 groups is labelled by occupation family and each code consists of 3 digits (see appendix A). Within each group a further distinction is made with respect to the level of difficulty in the job, a code that runs from 2 (high) to 8 (low). For our present purposes we have recoded it as 7 (high) to 1 (low), which we refer to as ranks. Not all occupations span the entire 7 ranks: some start higher than rank 1 and some do not include ranks 5-7. The cross-classification of 51

occupational groups and 7 ranks yields 276-285 occupation-by-rank groups, which we refer to as occupations for short[13] (see appendix B for sample description).

The titles in the present data predominantly indicate content of work, but include aspects of the amount of responsibility involved, such as whether the worker is in a position of leadership or supervision. Within the restaurant business, for instance, there are 14 job titles, among them cook, cold buffet manager, cutter, and cook's assistant. It is naturally a question of judgment whether given titles are too fine or too coarse. The equal pay laws require that likes should be treated alike, but as long as the titles delineate differences in content of work and responsibilities, they are treated as unlike jobs.

3.3 Overview

In this study, we focus on full-time white-collar workers from 1986 to 1989 because the tenure variables are largely missing in earlier periods and because the centralized wage bargaining system has substantially weakened during this period. We also restrict the analysis to workers in firms with more than a hundred white-collar workers because it is difficult to discuss ports of entry in small firms which have only one or two ranks.[14]

This sample contains almost 190,000 workers in more than 570 firms in each year. Thus, our analysis is much more representative than earlier studies which are based on either a single firm or on less than a few thousand workers.

Each observation contains worker ID, year, plant ID, firm ID, industry code, occupation code, rank code, township code, gender, age, education code, and wage. Because each worker, plant, firm, and occupation is assigned a unique number, we can trace each individual worker cross firms and occupations. Furthermore, occupation and rank codes are comparable across firms. If two workers in different firms have the same occupation and rank code, we are certain that they are performing almost the same task. Thus, we can accurately construct each individual worker's labor market experience, firm

[13] The white-collar workers' code system for occupations, the BNT-code, was first developed in 1955 and has been revised several times since (SOU 1993, p. 204). Its main purpose was to aid in the collection of wage statistics, not for setting wages directly. It is not unlike the salary grade level structures in many large U.S. organizations (e.g., Spilerman 1986), where a salary grade level indicates such things as the level of responsibility and qualifications associated with the position. But that system lacks a strong tie between the grade level and the actual salary itself, though a clear correlation exists.

[14] However, including small firms does not change the qualitative results.

tenure, and occupation tenure. We exclude workers who entered the labor market before 1970 because we cannot construct these tenure variables for them.[15]

See Table 1 for summary statistics on selected variables. Firm size and occupation size are measured by the number of white-collar workers in the firm and in the occupation, respectively.[16] Wages are measured in Kronor by the total monthly payment including salary, bonus, and fringe benefits.

[Table 1 here]

Despite Sweden's centralized wage bargaining system, individual worker-firm wage bargaining has always played a significant role, especially since 1983. For example, Figure 1 shows large wage variations within occupations and within firms.

[Figure 1 here]

According to the spirit of centralized wage bargaining, workers are supposed to receive the same wages if they are in the same occupation and at the same rank. However, Figure 1 shows that, within a rank, there can be not only large wage variations, but also wage distribution overlaps. That is, some workers in a lower rank can receive larger wages than some workers in a higher rank.[17] These patterns bear a remarkable resemblance to those found in U.S. firms (see, for example, Baker, Gibbs and Holmstrom, 1994a and Kwon 1999).

The hiring patterns in the Swedish data are also similar to those found in U.S. firms. Table 2 shows the sources of hiring by rank.[18]

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[15] These workers constitute 18% of workers in 1986-1989. Including them in the analysis which does not require tenure variables (e.g. hiring analysis in section 5) does not change the results.

[16] Unfortunately, it is difficult to combine white-collar worker data and blue-collar worker data because they use different firm IDs. Fox (2003) and Ekberg (2003) have attempted to combine two datasets and measured the firm size by the sum of white-collar and blue-collar workers in the firm. In their wage regressions, the results did not change with this new measure of firm size.

[17] These patterns remain even if we use the wage residuals from a wage regression that control for age, tenure, gender, and education.

[18] Table 2 ignores the fact that ranks in different occupations are not comparable, but provides a nice overview of the patterns of hiring. We control for occupation more precisely in section 4.

[Table 2 here]

Column [1] shows the yearly average number of workers in each rank from 1986-1989[19], column [2] the number who have changed neither firm, occupation, nor rank compared with the previous year. Thus, column [3] represents the number of workers who changed ranks or occupations within firms or who changed firms to enter a higher rank. The ILM literature has largely focused on the proportion of workers in a particular rank who are promoted from within rather than hired from an outside firm (see e.g. Lazear and Oyer 2002). Column [4] shows the percentage of new workers in each rank who are from within the same firm. For example, in Table 2(a), among 409.25 new workers in rank 7, 68.8% of them are from within the same firm. Column [4] shows that at the lower ranks, most new entrants are from outside the firm, while most new entrants at high ranks are from within the firm. Therefore, even though ports of entry are not as well defined in reality as in textbooks, a significant portion of workers at high ranks come from within the firm. This pattern could imply the importance of firm-specific aspects such as firm-specific human capital or tournament-like long-term contracts, and thence that the relevant boundary of an ILM is determined by the firm. Baker, Gibbs and Holmstrom (1994a) also finds the same pattern in a US firm. Table 2 (b) shows that in larger firms the internal hiring ratio at high ranks becomes even more prominent. For example, in the firms with more than 5,000 workers, only 17% of new workers in rank seven are hired from outside the firm.

However, column [5] tells an alternative story. It shows how many of the new entrants to each rank are from the same occupation, regardless of whether they are from the same firm, something no other previous study has looked at. Column [5] gives a different perspective on the same patterns found in column [4]. That is, at high ranks most workers come from the same occupation, while at lower ranks most workers come from different occupations. Here is the cause to assert that these occupation-specific aspects are important and that the relevant boundary of an ILM is determined by occupation.

[19] Note that the hierarchical structure is not a pyramid, where the bottom rank is the largest. Instead, rank four is largest . Thus, we have also repeated the analysis using workers from rank 4 and above since lower rank jobs may constitute separate internal labor markets. None of the qualitative results have changed.

The models presented in section 2 show that, to resolve these potentially conflicting implications about the boundaries of ILMs, we must distinguish more detailed sources of hiring. For example, we need to distinguish whether a worker filling a given position comes from "within the same firm and within the same occupation" or from "within the same firm but different occupation". We present such analysis in the following sections.

4. Hiring and Boundary of ILM

We first present the results of our hiring analysis as mentioned in section 2, observing the relative importance of firm- and occupation-specific aspects to the boundaries of ILMs.

4.1 Firm and Occupation

To clarify the relative effects of firm- and occupation-specific aspects in hiring, we estimate the multinomial logit model of hiring as suggested by section 2.2. Table 3 shows the relative probability of each hiring strategy.

[Table 3 here]

Column [1] in Table 3 estimates the relative probability of 'hiring from outside firm but within occupation' to 'hiring within firm and within occupation', that is, the probability of hiring from outside the firm conditional on hiring within the occupation. From equation (13), the coefficient of rank ($\beta_f = 0.2550$) measures the effect of firm-specific aspects in the hiring decisions. Column [2] measures the relative probability of 'hiring within firm outside occupation'. From (14), the coefficient of rank ($\beta_o = 0.5358$) measures the effect of occupation-specific aspects in hiring decision. These results suggest that the importance of occupation-specific aspects is about twice that of firm-specific aspects in a hiring decision.

From (15), the coefficient of rank in column [3] should be the sum of β_f and β_o. However, it is slightly less than $\hat{\beta}_o$. This could be because few workers are hired from outside the firm and outside the occupation[20]. Column [4] shows the relative probability of hiring new entrants. From (16), the coefficient of rank variable in this regression is the sum of β_f, β_o, and λ_g. Thus, assuming $\hat{\beta}_f = 0.2550$ and $\hat{\beta}_o = 0.5358$, the effect of general human capital is $\hat{\lambda}_g$ =0.7614. Therefore, while the effect of occupation-specific aspects on hiring decision is larger than that of firm-specific aspects, the effect of general human capital appears to be the largest.

We also re-estimate Table 3 using rank dummies. Figure 2 shows the coefficient of each rank dummy.

[Figure 2 here]

Recall that if a firm is the boundary of an ILM, a higher rank means less likelihood of hiring from outside the firm. Table 2 shows that when, like previous studies, we do not control for occupation, the outside hiring ratio decreases in rank. However, Figure 2 shows that once we control for occupation, the outside hiring ratio does *not* decrease in rank. This result strongly suggests that the firm is not a relevant boundary of an ILM.

On the other hand, controlling for firm, the relative probability of hiring from outside the occupation decreases significantly. This implies that for a high rank job, a firm would hire someone from the same occupation in a different firm rather than someone from a different occupation in the same firm, again implying that occupation-specific aspects have a much larger effect on firms' hiring decisions than do firm-specific aspects, and that the boundary of an ILM is largely determined by occupation.

4.2 Heterogeneity among Occupations

So far we have analyzed the average effects of occupation- and firm-specific aspects across different occupations[21]. However, these effects may differ depending on

[20] For example, in rank 7, only 8.7% of new workers are from outside the firm and outside the occupation.
[21] Also, the analysis in Table 3 ignores the fact that ranks are not exactly comparable across different occupations.

occupation. Clearly, one would expect occupation-specific aspects to have larger effects in professional occupations such as medicine or academia, and firm-specific aspects to have larger effects in occupations such as sales.

To analyze the heterogeneity across occupations, we repeat the multinomial logit analysis for each occupation. Figure 3 shows the estimates of β_o and β_f in each occupation.

[Figure 3 here]

Figure 3 shows that in a majority of occupations, β_o is larger than β_f. However, it also shows the large heterogeneity across occupations. In occupations #640 (medical care), #775 (restaurant work), #600 (personnel service), #25 (secretarial work), and #110 (management of production), the effect of occupation-specific aspects on hiring is particularly larger than the effect of firm-specific aspects. On the other hand, in occupations #830 (sales), #330 (architectural work), #470 (technical service), and #160 (administration), the effect of firm-specific aspects is larger.

This heterogeneity provides an interesting challenge to existing theoretical models. As discussed in the beginning, most theoretical research has focused on firm-specific aspects and largely ignored (or implicitly assumed away) occupation-specific aspects. Our results suggest that we must not only incorporate occupation-specific aspects into theoretical models, but also try to understand the particular combination of firm- and occupation-specific aspects that determine an ILM or a worker's career in each different occupation. This heterogeneity also poses new questions for future research: Why are firm-specific aspects more important in some occupations than in others? What does this heterogeneity imply for the organizational structure of a firm? We discuss potential answers to these questions in the conclusion.

5. Mobility and Boundary of Career

As suggested by section 2.1, we can also quantify and estimate multinomial logit regressions of career choice to measure the relative effects of firm- and occupation-specific aspects on workers' careers.

[Table 4 here]

In Table 4, column [1] shows the relative probability of 'changing firm within the same occupation' to 'staying within the same firm and the same occupation'. As shown in equation (5), if firm-specific aspects are important, this probability should decrease as firm tenure increases. Column [1] shows that the coefficient of firm tenure has the correct sign and is the largest among the three tenure variables. This implies that firm tenure is the most important in deciding firm changes. Our measure of the effect of firm-specific aspects is $\beta_f = 0.04449$.

Column [2] estimates the relative probability of 'changing occupation within the same firm to 'staying within the same firm and the same occupation'. Here the coefficient of occupation tenure has the correct sign and is the largest among the three tenure variables, which is consistent with equation (6). The measure of the effect of occupation-specific aspects is $\beta_o = 0.06753$. That is, the effect of occupation-specific aspects on workers' career choice is 50% larger than that of firm-specific aspects.

From equation (7), we can also simultaneously estimate β_f and β_o by estimating the relative probability of 'changing both firms and occupation' to 'staying within the same firm and the same occupation'. From column [3] in Table 4, $\beta_o (= 0.0859)$ is 59% larger than $\beta_f (= 0.05616)$.

Occupation-specific aspects matter more than firm-specific aspects in workers' choice of career. In other words, workers' careers are more likely to be restricted within the boundary of an occupation than within the boundary of a firm.

6. Wages and Tenure

6.1 Firm tenure and Occupation tenure

Now we analyze how wages are linked to labor market experience, firm tenure, and occupation tenure. Consider the standard wage equation (17) in section 2.3. The coefficients of experience and of each tenure variable are often interpreted as the returns to general human capital, firm-specific human capital, and occupation-specific human capital, respectively. [22]

As emphasized in the literature, the problem in estimating (17) is that the unobserved matching qualities are likely to be correlated with experience and tenure variables. For example, those with good occupation matches are less likely to change occupation and so have long occupation tenure. We control for some of these correlations using the instrumental variable methodology proposed by Altonji and Shakotko (1987) and Parent (2000). However, this method does not control for all possibilities, such as correlation between experience and firm match quality (see Parent 2000 or Kambourov and Manovskii 2002). On the other hand, if we are interested not just in the effect of tenure on human capital but also in its effect on matching, the ordinary least squares estimation method can be sufficient.

Table 5 presents the wage regression results. Column [1] estimates the wage model in OLS. The coefficient of occupation tenure ($\alpha_o = .002495$) is larger than that of firm tenure ($\alpha_f = -.00622$). On the other hand, the coefficient of experience ($\alpha_g = .00792$) is largest among the three. This result is consistent with the result from the hiring analysis of section 4. It is also consistent with other studies based on limited samples (e.g. Kambourov and Manovskii 2002). Rank has large explanatory power as shown in column [2]. Aside from the centralized wage bargaining system, this could be because workers have different learning speeds, so rank is a better proxy of human capital than tenure. Controlling for rank does not change the qualitative result, however.

[Table 5 here]

In column [3], following Altonji and Shakotko (1987) and Parent (2000), we present instruments for the experience, firm tenure, and occupation tenure with their

[22] Under the theory of long-term contracts, the coefficient of firm tenure could be also interpreted as the long-tenure premium.

deviations from the means. For example, if τ_{ift} is worker *i*'s firm tenure at time t, then the instrument for the firm tenure is $\tau_{ift} - \bar{\tau}_{if}$ where $\bar{\tau}_{if}$ is the sample mean of worker *i*'s firm tenure in firm f. By construction, this instrument is not correlated with the firm match quality (θ_{if}). Column [3] and [4] in Table 5 show the same qualitative results as OLS: the coefficient of occupation tenure is still larger than the coefficient of firm tenure while the coefficient of experience is largest.

The coefficients of both occupation and firm tenure are generally small. In fact, the coefficient of firm tenure is negative. As discussed in section 4.3, this is because the coefficient of firm tenure captures both the returns to firm-specific human capital and the changes in firm-matching quality. Since firms cannot fire workers in Sweden, workers change firms only when they can find a better match. That is, in (21), $\theta_f - \theta_{f'}$ will be negative. Therefore, if the returns to firm-specific human capital (λ_f) are small, the coefficient of firm tenure in a wage regression can even be negative.[23]

Furthermore, there is no correction in the instruments for experience and firm- and occupation tenure for potential correlations between experience and firm-match or experience and occupation-match. If having more experience helps in finding a better occupation match, then the estimates of experience will be biased up and the estimates of occupation tenure will be biased down. In fact, column [2] in Table 4 shows that the probability of changing occupation increases with experience. On the other hand, column [1] in Table 4 shows that experience has no significant effect on the probability of changing firm. Therefore correcting the biases due to correlations between experience and occupation tenure and between experience and firm tenure, the occupation tenure coefficient should increase, becoming much larger than the firm tenure coefficient.[24]

These considerations illustrate the same things about the boundaries of internal labor markets as our analyses of hiring and career choice: our wage analysis results

[23] Parent (2000) also finds the coefficient of firm tenure to be negative in several industries.

[24] Other biases can arise if firm tenure and occupation-match are correlated or if occupation tenure and firm-match are correlated. For example, longer occupation tenure may help find a better firm-match. This will bias the coefficient of occupation tenure up and bias the coefficient of firm tenure down. However, Table 4 suggests that the effect of firm tenure on the probability of changing occupation and the effect of occupation tenure on the probability of changing firm are similar. Thus, these biases are likely to cancel each other out.

strongly suggest that occupation-specific aspects have a greater effect on wages than firm-specific aspects. These results also corroborate earlier wage studies based on limited samples.

6.2 Heterogeneity across firms and occupations

This section examines some of the factors that contribute to the heterogeneity across firms in terms of the relative importance of all these aspects on wages, career choice, and hiring decisions. The analyses of hiring and career choice in the previous sections imply that occupation-specific aspects become relatively more important in higher ranks, and Table 2 shows that large firms tend to hire from within. This could mean that firm-specific aspects are more important in large firms, but could be simply because it is easier to find a suitable candidate for a vacancy within the boundary of a large firm. Thus, in Table 6, we study the effects of rank and firm size on the returns to firm and occupation tenure.

Furthermore, Figure 3 shows that different occupations demonstrate large heterogeneity in hiring in terms of the relative importance of occupation- and firm-specific aspects. Our model in section 2 suggests that occupation tenure should have a larger effect on wages in occupations where occupation-specific aspects matter more. Similarly, firm tenure should have a larger effect in occupations where the firm-specific aspects matter more. To test these hypotheses, we also estimate, from the hiring analysis in Figure 3, the effects of the interaction between occupation tenure and β_o and the effects of the interaction between firm tenure and β_f.

[Table 6 here]

Column [1] in Table 6 shows that the coefficient of occupation tenure remains much the same in higher ranks, but the coefficient of firm tenure decreases in higher ranks. Therefore, as expected, the relative importance of occupation tenure over firm tenure increases in higher ranks. The coefficient of experience also increases significantly with

rank, suggesting that higher ranks require more general human capital but less firm-specific human capital than lower ranks.

Column [2] estimates the effect of firm size. As in the analyses of hiring and career choice, firm size has only a small effect on the coefficients of experience and tenures in wage models. This result implies that larger firms fill more jobs from within because it is easier to find a suitable candidate within a larger firm and not because firm-specific aspects are more important in large firms.

In column [3], we use the estimates of occupation-specificity (β_o) and firm-specificity (β_f) from the hiring analysis in Figure 3 and study how they interact with firm- and occupation tenures in determining wages. As predicted, both the interaction between β_o and occupation tenure and the interaction between β_f and firm tenure have positive coefficients. Furthermore, both the interaction between β_o and firm tenure and the interaction between β_f and occupation tenure have negative coefficients. Therefore, in occupations where occupation-specific aspects are important in hiring, occupation tenure has a larger effect on wages and firm tenure a smaller effect. Similarly, in occupations where firm-specific aspects are important in hiring, firm tenure has a larger effect on wages, occupation tenure a smaller effect.

7. Hiring and Wage Policies

Hiring policies and wage-setting practices are closely related. Some, following a firm-based concept of internal labor markets, argue that because new workers are hired only through the bottom ranks (or ports of entry) of an ILM, the wages within the ILM are isolated from external labor market conditions and are largely determined by firm-specific factors such as firm tenure. Others argue that hiring new workers only through the bottom ranks is necessary to provide incentives for the firm's workers through tournament-style long-term contracts (e.g. Chan 1996). Even though the importance of ports of entry in hiring and the importance of firm-specific aspects in determining wages are both essential concepts in modern labor market theory, surprisingly few studies have tested the relationship between the two.

As we discussed above, column [3] in Table 6 shows the relationship between the results of the hiring and wage analyses. To analyze the relationship more clearly, however, we also estimate the coefficients of occupation tenure (α_o) and firm tenure (α_f) for each occupation and compare them with the estimates from our hiring analysis. Figure 4 shows both $\hat{\alpha}_o - \hat{\alpha}_f$ and $\hat{\beta}_o - \hat{\beta}_f$ from the hiring analysis in Figure 2.

[Figure 4 here]

Figure 4 shows a significant positive relationship between $\hat{\alpha}_o - \hat{\alpha}_f$ and $\hat{\beta}_o - \hat{\beta}_f$. That is, in an occupation where occupation-specific aspects matter more than firm-specific aspects in hiring, occupation tenure also has a larger effect on wages than firm tenure.
Note that the hiring analysis and the wage analysis are based on different variables and different empirical specifications: the hiring analysis is based on multinomial regressions of firms' hiring choice and rank, while the wage analysis is based on linear IV regressions of workers' wages and tenures. The consistency of the results between the two analyses despite these differences not only confirms the predictions of our basic model, but also suggests that the same variables drive the hiring heterogeneity and the wage heterogeneity across occupations.

8. Conclusion

Extant theories about internal labor markets generally focus on firm-specific aspects and ignore occupation-specific aspects. Our results point to the importance of revising the theories in order to capture both the relative importance of occupation-specific aspects and the heterogeneity across occupations.

Among our most intriguing findings is the large heterogeneity across occupations with respect to the relative effects of occupation tenure and firm tenure on wages, hiring, and career choice. What drives this heterogeneity? One conjecture is that teamwork demands both occupation-specific skills and team skills, whereas professionals, supplying individual expert output, rely mainly on occupation-specific skills. In an occupation where teamwork is less important, firm tenure will be less

important. Similarly, in firms that rely less on teamwork, firm tenure will be less important.

Another interesting question the findings raise is this: how does heterogeneity across occupations influence both firms and workers? One conjecture is that in occupations where occupation tenure and other occupation-specific aspects are important, workers' wages and ranks are extremely sensitive to changes in the occupation-specific labor market across firms. On the other hand, for occupations where firm-specific aspects are important, worker's wages and ranks will be much less sensitive to changes in the occupation-specific labor market outside the firm. The effects of heterogeneity on workers' careers in turn affect the employer's freedom to negotiate/set wages and organize work.

This heterogeneity and the relative bargaining power of a given occupation may influence employers' delegations of decision rights. Employers whose firms comprise multiple occupations, some specialized and others not, may be inclined to delegate decision rights. But the employer must do this for both occupations due to administration and coordination cost. Firms with less specialized labor need not delegate decision rights to the same extent. In fact, it may be advantageous to many firms to streamline their organizations by separating specialized and general occupations, thus avoiding the high administrative cost of having two different systems working simultaneously. This in turn will lead to a population of heterogeneous firms, each firm dominated by either specialized or non specialized workers. Occupation degree of specialization will generate a labor market segregated along degree of specialization rather than along firm boundaries.

All these issues imply potential new directions for the study and theory of internal labor markets. In fact, they suggest a rethinking of the very nature of the internal labor market. The bulk of previous research and theory has assumed that firm-specific aspects, such as firm-specific human capital or implicit long term contracts, significantly influence wages, hiring and promotion practices, and workers' career choices. But our results point to the importance of occupation-specific aspects: Firms' hiring and promotion practices are more influenced by occupation-specific aspects of the workers'

careers and of the occupations themselves, occupation tenure yields greater wage returns than firm tenure in most occupations, and analysis of workers' career decisions shows that long occupation tenure, more so than long firm tenure, is the common trait of workers who are well-matched to their jobs. Our research suggests that the boundaries of internal labor markets must be reexamined. Internal labor markets may be most usefully defined by occupation rather than firm. We submit this paper as a small initial step in that direction.

Appendix A Three-Digit Occupation Codes

BNT Family	BNT Code	Levels	
0			**Administrative work**
	020	7	General analytical work
	025	6	Secretarial work, typing and translation
	060	6	Administrative efficiency improvement and development
	070	6	Applied data processing, systems analysis and programming
	075	7	Applied data processing operation
	076	4	Key punching
1			**Production Management**
	100	4	Administration of local plants and branches
	110	5	Management of production, transportation and maintenance work
	120	5	Work supervision within production, repairs, transportation and maintenance work
	140	5	Work supervision within building and construction
	160	4	Administration, production and work supervision within forestry, log floating and timber scaling
2			**Research and Development**
	200	6	Mathematical work and calculation methodology
	210	7	Laboratory work
3			**Construction and Design**
	310	7	Mechanical and electrical design engineering
	320	6	Construction and construction programming
	330	6	Architectural work
	350	7	Design, drawing and decoration
	380	4	Photography
	381	2	Sound technology
4			**Technical Methodology, Planning, Control, Service and Industrial Preventive Health Care**
	400	6	Production engineering
	410	7	Production planning
	415	6	Traffic and transportation planning
	440	7	Quality control
	470	6	Technical service
	480	5	Industrial, preventive health care, fire protection, security, industrial civil defense
5			**Communications, Library and Archival Work**
	550	5	Information work
	560	5	Editorial work – publishing
	570	4	Editorial work – technical information
	590	6	Library, archives and documentation
6			**Personnel Work**

	600	7	Personnel service
	620	6	The planning of education, training and teaching
	640	4	Medical care within industries
7			**General Services**
	775	3	Restaurant work
8			**Business and Trade**
	800	7	Marketing and sales
	815	4	Sales within stores and department stores
	825	4	Travel agency work
	830	4	Sales at exhibitions, spare part depots etc.
	835	3	Customer service
	840	5	Tender calculation
	850	5	Order processing
	855	4	The internal processing of customer requests
	860	5	Advertising
	870	7	Buying
	880	6	Management of inventory and sales
	890	6	Shipping and freight services
9			**Financial Work and Office Services**
	900	7	Financial administration
	920	6	Management of housing and real estate
	940	6	Auditing
	970	4	Telephone work
	985	6	Office services
	986	1	Chauffeuring

Appendix B Sample Description of Four-Digit Occupation Codes

Occupation Family 1: Occupation # 120- Manufacturing, Repair, Maintenance, and Transportation
11% of 1988 sample
There is no rank 1 in this occupation.
Rank 2 (4% of occupation # 120 employees) - Assistant for unit; insures instructions are followed; monitors processes
Rank 3 (46%) -In charge ofa unit of 15-35 people
Rank 4 (45%) - In charge of 30-90 people; does investigations of disruptions and injuries
Rank 5 (4%) - In charge of 90-180 people; manages more complicated tasks
Rank 6 (0.3%) - Manages 180 or more people
There is no rank 7 in this occupation.

Occupation Family 2: Occupation #310- Construction
10% of the 1988 sample
Rank l (0.1%) - Cleans sketches; writes descriptions
Rank 2 (1%) - Does more advanced sketches
Rank 3 (12%) - Simple calculations regarding dimensions, materials, etc.
Rank 4 (45%) - Chooses components; does more detailed sketches and descriptions; estimates costs
Rank 5 (32%) - Designs mechanical products and technical products; does investigations; has 3 or more subordinates at lower Ranks
Rank 6 (8%) - Executes complex calculations; checks materials; leads construction work; has 3 or more subordinates at rank 5
Rank 7 (1%) - Same as rank 6 plus has 2-5 rank 6 subordinates

Occupation Family 3: Occupation #800- Marketing and Sales
19% of 1988 sample
Rank l (0.2%) - Telesales; expedites invoices; files
Rank 2 (6%) - Puts together orders; distributes price and product information
Rank 3 (29%) - Seeks new clients for 1- 3 products; can sign orders; does market surveys
Rank 4 (38%) - Sells more and more complex products; negotiates bigger orders; manages 3 or more subordinates
Rank 5 (20%) - Manages budgets; develops products; manages 3 or more rank 4 workers
Rank 6 (7%) - Organizes, plans, and evaluates salesforce; does more advanced budgeting; manages 3 or more rank 5 workers
Rank 7 (1 %) - Same as rank 6 plus 2-5 rank 6 subordinates

Occupation Family 4: Occupation #900- Financial Administration
5% of 1988 sample
Rank 1 (1%) - Office work; bookkeeping; invoices; bank verification
Rank 2 (7%) - Manages petty cash; calculates salaries
Rank 3 (18%) - More advanced accounting; 4-10 subordinates
Rank 4 (31 %) - Places liquid assets; manages lenders; evaluates credit ofbuyers; manages 3 or more rank 3 employees
Rank 5 (28%) - Financial planning; analyzes markets; manages portfolios; currency transfers; manages 3 or more rank 4 employees
Rank 6 (12%) - Manages credits; plan routines within the organization; forward-looking budgeting; manages 3 or more rank 5 employees
Rank 7 (2%) - Same as rank 6 plus 2-5 rank 6 subordinates

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Table 1 Summary Statistics

Year	Number of workers	Age (mean)	Female (%)	# of Firm Changers	# of Occup. Changers	# of New Entrants	Wage (mean)	Number of Firms	Firm Size (mean)	Number of Occupation	Occupation Size (mean)
1986	181,589	40.9	23	6,903	10,334	12,079	12,127	570	373	51	7,531
1987	189,315	40.9	23.3	7,915	10,984	11,915	12,857	593	377	51	7,609
1988	196,495	40.8	24.1	9,454	13,132	14,072	13,833	636	369	51	7,853
1989	191,494	40.5	24.9	9,581	13,911	15,798	15,260	630	369	51	7,938

Note: New firms, dying firms[25], and firms under merger or split are excluded. New entrants at the age over 40 are excluded. Firm size and occupation size are measured by the number of white-collar workers in firms and in occupations, respectively. The wage is measured in Kronor by the monthly payment including salary, bonus, and fringe benefits.

Table 2 Hiring from Within Firm or Within Occupation

	[1]		[2]	[3]	[4]	[5]
rank	N	(%)	stay	import	within firm	within occup.
7	2036.00	1.07	1626.75	409.25	0.688	0.702
6	11503.50	6.06	9397.75	2105.75	0.717	0.656
5	37030.50	19.52	29946.75	7083.75	0.689	0.607
4	65825.75	34.70	52179.25	13646.50	0.538	0.457
3	49180.50	25.92	37363.75	11816.75	0.381	0.293
2	22015.00	11.60	15801.50	6213.50	0.247	0.129
1	2132.00	1.12	1355.00	777.00	0.103	0.043

(a) For Firm Size >100

fsize>5000

	[1]		[2]	[3]	[4]	[5]
rank	N	(%)	stay	import	within firm	within occup.
7	303.75	1.27	256.50	47.25	0.832	0.722
6	1404.50	5.89	1178.50	226.00	0.854	0.660
5	5383.00	22.58	4448.50	934.50	0.808	0.626
4	9288.75	38.96	7439.25	1849.50	0.650	0.464
3	5192.25	21.78	3787.25	1405.00	0.380	0.203
2	1976.00	8.29	1415.50	560.50	0.334	0.123
1	295.25	1.24	195.75	99.50	0.107	0.021

(b) For Firm Size >5,000

Note : rank: 7(=highest) –1(=lowest). Column 1shows the average number of white-collar employees (N) in each rank between 1986 and 1989, Column 2 shows number of employees who stay at the same rank, the same occupation, and at the same firm from the previous year (stay). Column 3 shows the number of employees that have changed either their occupation or their firm compared to the previous year. Column (4) and (5) show the composition of new imports. Column (4) in (a), for example, can be read as follows, on average, 68.8 % of new hires to rank 7 were hired from within the same firm.

[25] Firms that disappear from the dataset within two years.

Table 3 Hiring Strategy and Rank

Number of obs = 168210
Comparison Group="within firm within occup" Pseudo R2 = 0.1307

	outside firm within occup	within firm outside occup	outside firm outside occup	new entrants
	[1]	[2]	[3]	[4]
rank	**-.2550**	**-.53583**	**-.53128**	**-1.5523**
	(.00921)	(.00813)	(.01091)	(.00932)
firm size	-0.00019	-.00001	-.00011	-.00002
	(5.29e-06)	(3.21e-06)	(5.38e-06)	(3.26e-06)
fsize growth	.94364	-.30941	.94425	.93734
	(.03068)	(.04224)	(.03076)	(.03068)
occup size	1.98e-07	5.42e-07	.00002	-2.38e-06
	(.00001)	(.00001)	(.00001)	(.00001)
osize growth	1.0595	-.18294	-.40266	-.57263
	(.28987)	(.28548)	(.35446)	(.24202)

Note: All regressions include occupation and year dummies. 'fsize growth' and 'osize growth' measures the annual growth rate of firm size and occupation size, respectively.

Table 4 Career Choice and Tenure

Number of obs = 483510
Comparison Group="within firm within occup" Pseudo R2 = 0.0594

	outside firm within occup	within firm outside occup	outside firm outside occup
	[1]	[2]	[3]
Experience	0.0014	.03387	.06766
	(.00228)	(.00271)	(.00379)
Firm Tenure	**-.04449**	.01856	**-.05616**
	(.00191)	(.00245)	(.00370)
Occup. Tenure	.01472	**-.06753**	**-.08590**
	(.00219)	(.00244)	(.00392)
Age	-.01249	-.02999	-.04922
	(.00083)	(.00101)	(.00163)
Female	-.13173	.09789	-.12495
	(.01613)	(.01835)	(.02639)
Firm Size	.00007	4.45e-07	-.00003
	(2.33e-06)	(2.97e-06)	(4.68e-06)
Fsize growth	-.41963	-.16640	-.00273
	(.20399)	(.03961)	(.00644)
Occup. Size	-.00014	-.00001	-.00003
	(8.96e-06)	(.00001)	(.00001)
Osize growth	3.7486	-.17743	.60481
	(.20399)	(.27599)	(.35472)

Note: All regressions include industry, occupation, and year dummies. 'fsize growth' and 'osize growth' measures the annual growth rate of firm size and occupation size, respectively.

Table 5 Wage Regression I

(dependent variable=log(wage))

	[1] OLS	[2] OLS	[3] IV-GLS	[4] IV-GLS
age	.00631	.00459	.00226	.00341
	(.00008)	(.00004)	(.00019)	(.00013)
experience	.014066	.00370	.029241	.00792
	(.00022)	(.00012)	(.00071)	(.00058)
otenure	.002495	.00026	.00184	.00323
	(.00021)	(.00011)	(.00027)	(.00022)
ftenure	-.00622	-.00237	-.01317	-.00601
	(.00019)	(.00010)	(.000314)	(.00030)
firm size	1.11e-06	-8.86e-07	1.81e-06	-5.90e-08
	(2.46e-07)	(1.38e-07)	(2.65e-07)	(1.56e-07)
fsize growth	.00025	.00065	.00066	.00073
	(.00024)	(.00017)	(.00026)	(.00018)
female	-.20591	-.06498	-.20272	-.06554
	(.00151)	(.00083)	(.00156)	(.00087)
rank=7		1.2021		1.18655
		(.00083)		(.00531)
rank=6		.93849		.923348
		(.00497)		(.003175)
rank=5		.65483		.641651
		(.00226)		(.002648)
rank=4		.40127		.394101)
		(.00209)		(.002248)
rank=3		.22863		.225748
		(.00209)		(.002059)
rank=2		.091678		.091846
		(.001938)		(.00196)
#obs.	534398	534398	534398	534398
R^2	.4934	.8138	.4701	.8104

Note: The wage is measured by the total monthly compensation in Kronor. All regressions include occupation, industry, town, and year dummies. Standard errors are adjusted for correlation within individuals. 'experience' measures the number of years a worker has stayed in our data (i.e. labor market). 'otenure' and 'ftenure' stand for the occupation tenure and the firm tenure, respectively.

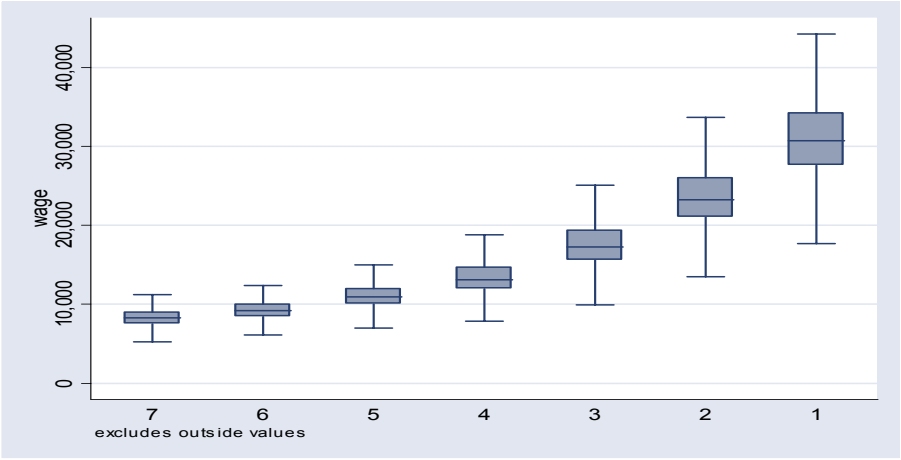
Table 6 Wage Regression II

(dependent variable=log(wage))

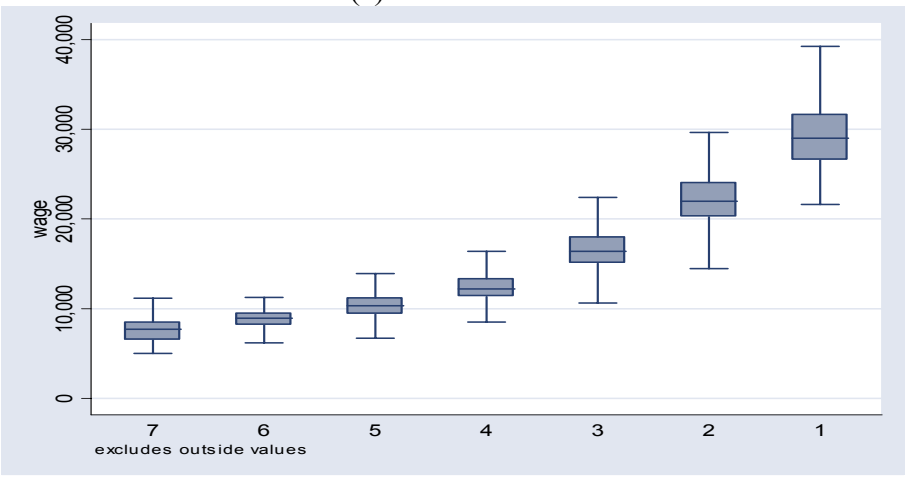
	[1]	[2]	[3]	[4]
rank	.1859			.18614
	(.0006)			(.00064)
rank*experience	.00321			.00316
	(.0001)			(.0001)
rank*otenure	.00010			-.00005
	(.00010)			(.00010)
rank*ftenure	-.00185			-.00173
	(.00010)			(.00010)
fsize*experience		1.18e-06		3.59e-07
		(1.03e-07)		(5.45e-08)
fsize*otenure		-1.05e-08		4.05e-08
		(8.28e-08)		(.4.52e-08)
fsize*ftenure		-5.53e-06		-1.71e-07
		(1.04e-07)		(5.52e-08)
β_o			.10806	-.02283
			(.00388)	(.00286)
β_f			.05267	.01389
			(.00369)	(.00265)
β_o * otenure			.00464	.00128
			(.00048)	(.00028)
β_o * ftenure			-.00618	-.00063
			(.00045)	(.00026)
β_f * otenure			-.01486	-.00487
			(.00042)	(.00025)
β_f * ftenure			.00839	.00233
			(.00041)	(.00024)
#obs.	534,398	534,398	533,310	533,310
R^2	.7987	.4943	.4965	.7992

Note: All regressions include the same variables in Table 5 except rank dummies. Standard errors are adjusted for correlation within individuals. β_0 and β_f are the measures of occupation and firm specificity, respecitively, estimated from the hiring analysis by each occupation in Figure 3.

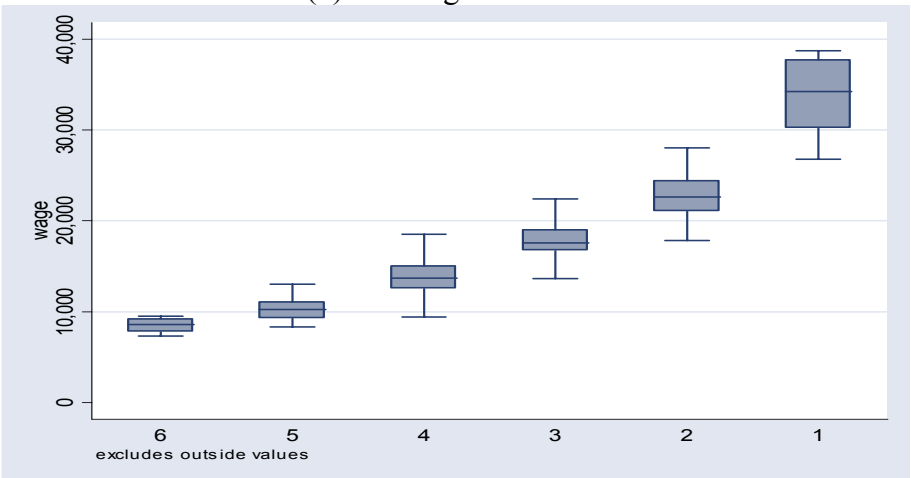
Figure 1 Wage Distribution (Box Plot) and Rank



(a) All Firms



(b) The largest firm

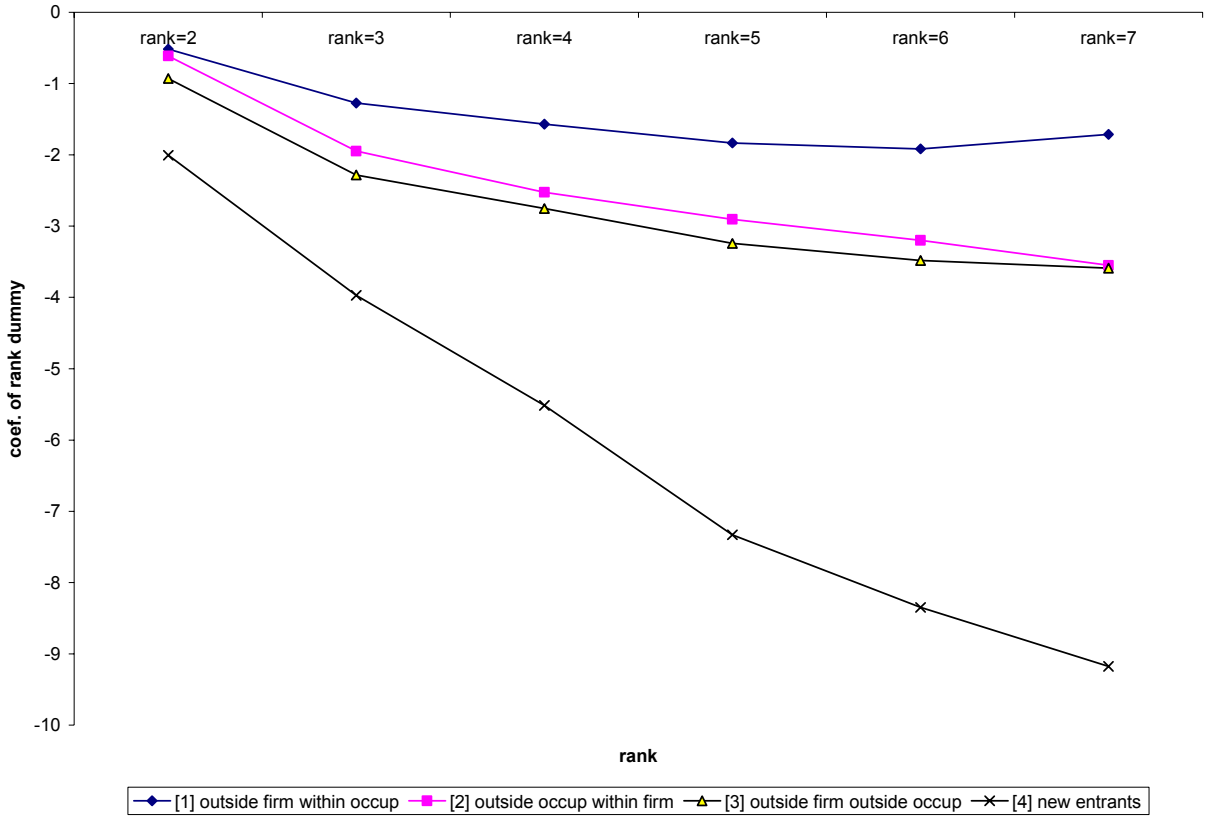


(c) Occupation=800 in the largest firm

Note: These figures show the box plots of wages in 1988.

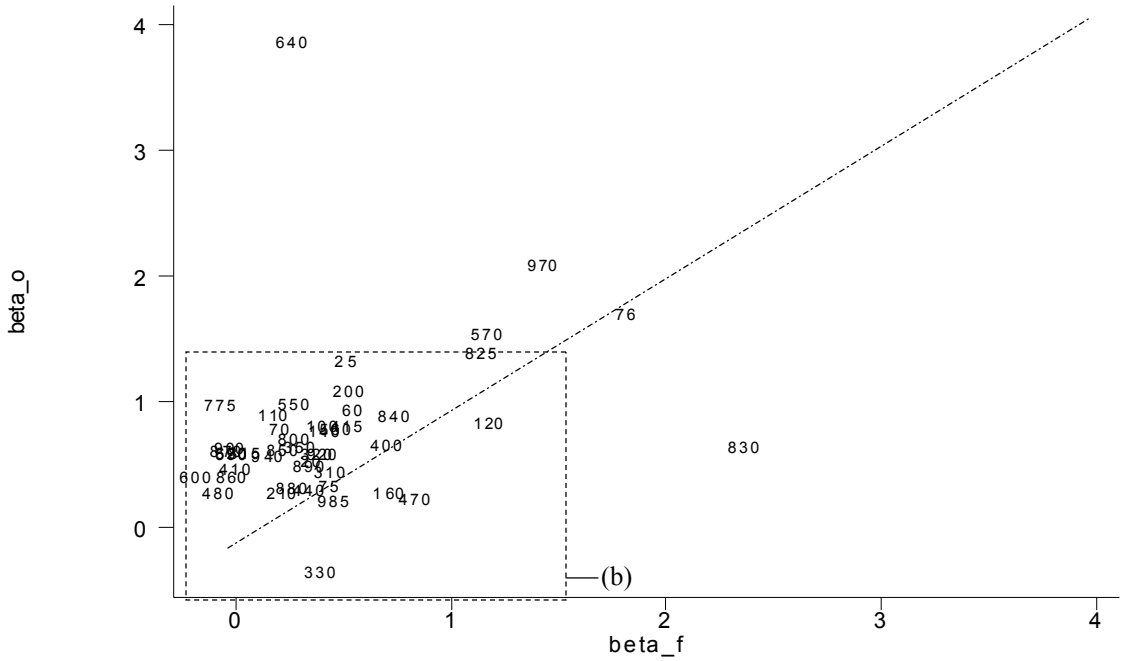
Figure 2 Hiring Strategy and Ranks

(for all occupations)

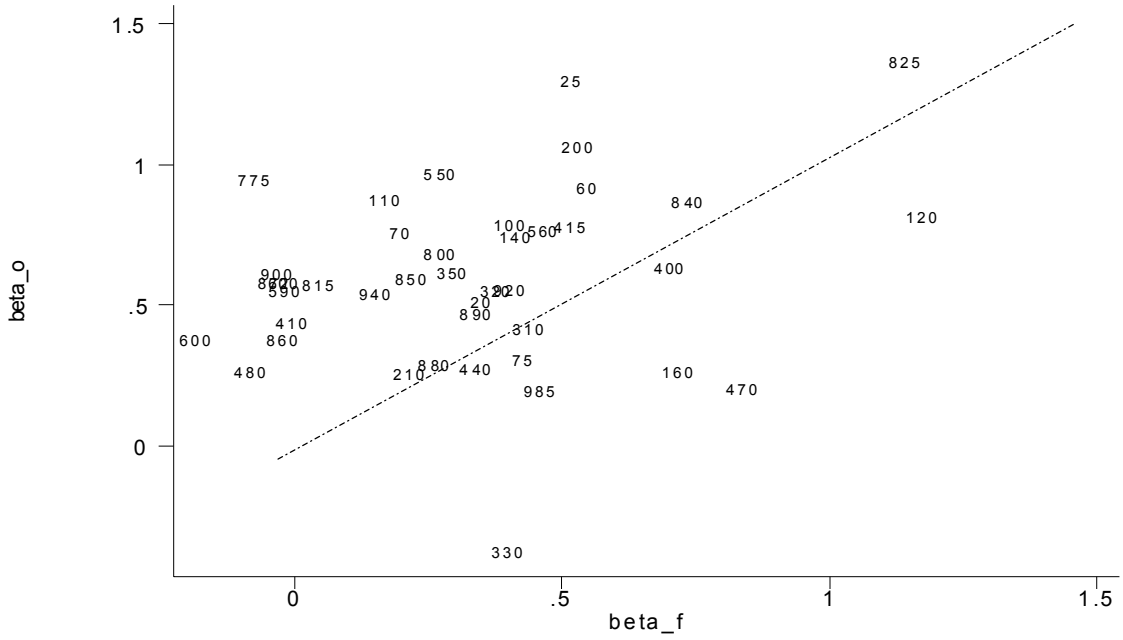


Note: The figure shows the coefficients of rank dummies in the multinomial logit analysis that is the same as Table 3 except for that the ranks are controlled as dummies. The comparison group is "within firm within occupation" hiring. Therefore, [1] represents the probability of hiring from outside firm conditional on within occupation hiring. Similarly, [2] represents the probability of hiring from outside occupation conditional on within firm hiring.

Figure 3 Heterogeneity in Occupation



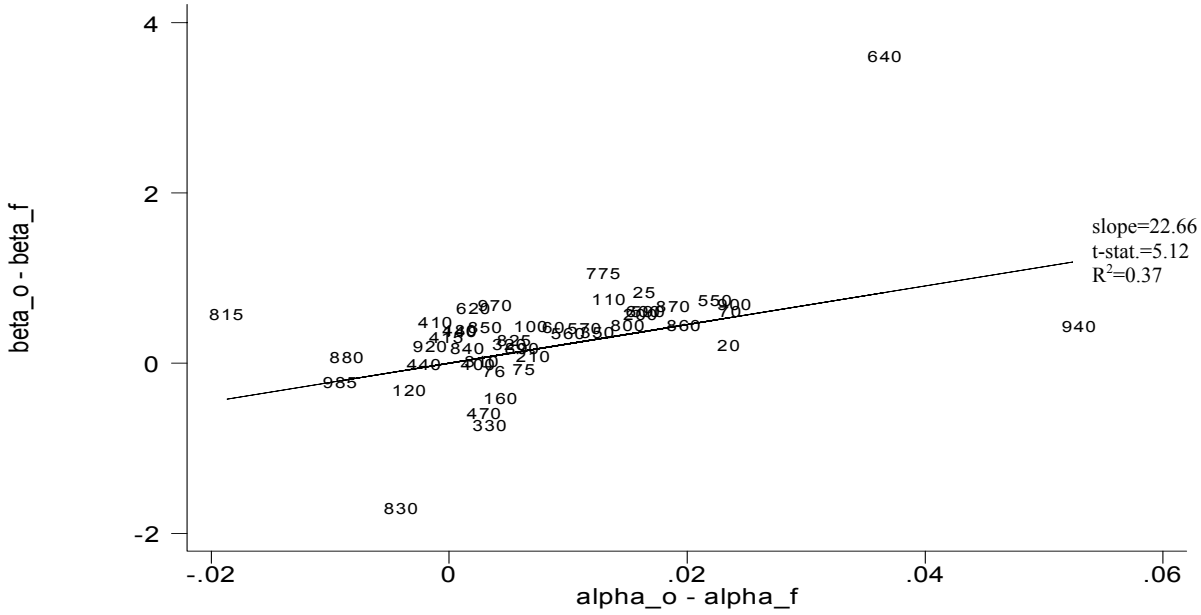
(a)



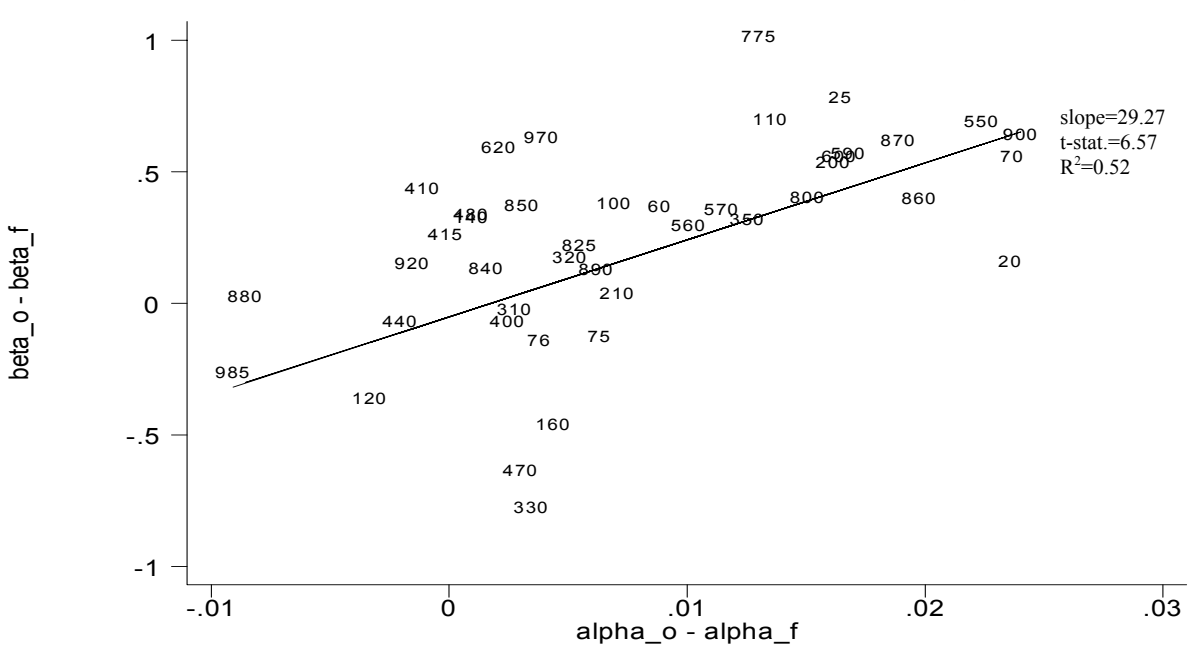
(b)

This figure shows the estimates of the hiring multinomial analysis in Table 3 repeated for each occupation. Beta_f is the coefficient of rank in column [1], and beta_o is the coefficient of rank in column [2]. For the description of the occupation code, see appendix A

Figure 4 Hiring and Wage: Occupation vs. Firm



(a) All Occupations



(b) Without Outliers

Note: Beta_f and beta_o are as defined in Figure 3. Alpha_o and alpha_f are the coefficients of occupation tenure and firm tenure in the wage regressions done by each occupation. The solid lines are from the weighted regressions with the occupation size as weights. For the description of occupation code, see appendix A.