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Mighty Good Thing: The Returns to Tenure

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Abstract

The human capital earnings function is part of the toolbox of labour economists. Returns to labour market experience are interpreted as returns to general human capital, and returns to job tenure as returns to job-specific human capital. There is, however, an awareness that there are other models capable of explaining these correlations, notably a search or 'job-shopping' model and a number of papers have attempted to distinguish the two hypotheses using mostly data on wage growth for job-stayers and movers. The results have been mixed. This paper takes a different approach to the same issue. It shows how a simple search model can be used to predict the nature of the relationship between wages, experience and tenure if one has data on labour market transition rates. This is what is done in this paper using data from the UK Labour Force Survey. The conclusions are that while part of the returns to experience can be explained by the search model, there is a substantial part that must be interpreted as a 'true' return to experience. In contrast, we show how the search model over-predicts the returns to tenure and the data seem broadly consistent with a model in which the 'true' returns to tenure are close to zero.

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Mighty Good Thing: The Returns to Tenure

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Introduction

Since at least the work of Mincer (1958, 1974), earnings functions have been an essential part of the toolbox of labour economists. These earnings functions are typically cross-section regressions of some measure of the wage or earnings on worker characteristics like age, job tenure, education and training, sex and race (even beauty and sexual orientation) and employer characteristics (see Polachek and Siebert, 1992, for a recent survey).

There is an accepted way to interpret the observed returns to age and tenure in earnings functions. The returns to age are interpreted as returns to general human capital (net of any current investment in this capital) (see Mincer, 1974, or Ben-Porath, 1967) while returns to job tenure are interpreted as returns to firm-specific human capital. So engrained are these attitudes that some have claimed that the fact that wage profiles are flattened when a minimum wage is raised (see Hashimoto, 1981) is evidence of the adverse effect of the minimum wage on training, a leap of the imagination that seems somewhat too large. But estimates of the returns to education, the extent of discrimination and diagnoses of the causes of rises in wage inequality amongst many other applications are all based on the conventional interpretations of earnings functions.

This would not be a problem if there were no plausible alternative interpretations of the empirical regularities found in earnings functions. Unfortunately this is not the case. Among the most prominent alternative hypothesis (and the one on which this paper will be based) is a model based on search and job-shopping. The more time one has spent searching for a job the more likely it is that one has found a good one: hence average wages rise with experience. And the longer the time one has spent in a job, the more likely it is a good one: hence wages may rise with tenure[1]. In this alternative view of the labour market it is job mobility that accounts for the wage growth typically found in a working life (see, for example, Topel and Ward, 1992).

Perhaps the strongest piece of evidence that there is something to the search story is from studies of the earnings of displaced workers, those workers who have lost their jobs through plant closure (which is taken to be involuntary on their part). There are a number of studies of this type (*eg* see Jacobson, LaLonde and Sullivan, 1993, for a survey). As Jacobson, Lalonde and Sullivan (1993, p.26) write, “much academic research on displacement has examined whether human capital theory can account for the observed earnings reduction following dislocation”. The main way in which the human capital approach would try to explain the losses of earnings would be through the loss of firm-specific human capital. As the returns to specific human capital are normally thought to be embodied in the estimated returns to job tenure, this means that we would expect earnings losses to be associated to tenure on the previous job. In addition, as the return to labour market experience is generally thought to measure returns to general human capital, we would not expect earnings losses to be systematically related to experience. Another way of expressing this is to say that if the human capital approach predicts that the residuals from earnings equations for displaced workers are not systematically different from zero. But, in general, they are. For example, Topel (1990) finds that earnings losses are also positively associated with labour market experience. There is a simple explanation for this. There are two types of workers

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1 The predictions of the search model for the returns to tenure are actually more complicated than this and are discussed in more detail later.

with zero tenure in the labour market: those who have lost their previous job involuntarily and have re-entered the labour market, and those who have voluntarily changed jobs. It is hardly surprising that there are differences in the labour market fortunes of the two groups but they are traditionally lumped together in the estimation of earnings functions. This is where a search approach can potentially be helpful. If part of the returns to experience and tenure are the result of searching for good jobs then displaced workers are likely to lose some or all of these returns. However, although this literature gives us some reason to believe in the importance of search effects, it is likely that the traditional human capital approach also contains some element of truth so that it is important to try to estimate the relative importance of the two views.

There is an existing literature that attempts to do this (Abraham and Farber, 1987; Marshall and Zarkin, 1987; Topel, 1986, 1991; Altonji and Shakotko, 1987; Altonji and Williams, 1992, 1997). These studies attempt to use panel data to separate the part of the returns to experience and tenure (though the emphasis is commonly on the latter) that is the result of job-shopping. Results are mixed *eg* Topel (1986) claims to find no 'true' returns to tenure while, using a different methodology, Topel (1991) finds large effects close to the cross-section estimates. In this paper we take a different approach to the same issue. We show how information on labour market transition rates and the wage distribution for labour market entrants can be used together with a simple search model to derive predictions about the returns to experience and tenure in a 'pure' search model. As these transition rates are observable we can then try to compare these predictions with the reality.

The structure of the paper is as follows. We start by deriving the implications of a pure search model for the distribution of wages conditional on age and job tenure showing how the predictions can be quantified using readily available information. We then use British data to compare these predictions with the reality. Our main conclusion is that while there does appear to be a substantial part of the returns to experience which cannot be explained by the search model, this model appears to be able to the vast bulk of the returns to tenure.

1. The Returns to Age and Tenure in a Pure Search Model

We start with a simple search model in which workers try to work their way up a job ladder, although we shall see that in order to derive much in the way of general theoretical results, we will have to make some simplifying assumptions fairly quickly.

We will distinguish workers by their potential labour market experience which we shall denote by a (though we will generally refer to potential experience simply as experience as is done in most earnings functions) and their tenure which will be denoted by t. Obviously we must have t#a. We assume that individuals enter the labour market at experience 0 and they permanently exit the labour market at a rate $d_r(a)$: this 'death' rate will have no effect on any of the results that follow. We also assume that workers leave employment for non-employment at a job destruction rate $d_u(a)$ that may also vary with experience.

Assume that non-employed individuals receive job offers at a rate $?_u(a)$, and employed workers at a rate $?_e(a)$ so that the job offer arrival rate potentially depends on labour market experience.[2] We assume that all job offers can be uniquely characterised by their position on the

2 One might wonder about allowing the transition rates for the employed to also depend on other factors *eg* job tenure and the position on the ladder. While this would be a useful extension, the problem caused by this is that the worker's job mobility decision becomes much more complicated and we can no longer assume that every worker will always prefer a job offer that is higher on the ladder as taking a new job sets

job ladder F which must, by construction, be distributed uniformly on the unit interval. We assume that jobs do not change their position in the wage hierarchy over time. Non-employed workers are assumed to accept all job offers, though employed workers only accept job offers that are at a higher position on the ladder so that the rate at which workers of experience a currently employed at a firm at position F on the job ladder quit to other firms is given by $\lambda_e(a)(1-F)$. It is this on-the-job search and the job mobility it implies that means that the distribution of workers will not be uniform on the job ladder: it is important to be clear about this distinction between the distribution of job offers and the distribution of wages across workers.

At this point it is worth considering which wage policies are consistent with this behaviour of workers. It is consistent with a wage policy of the form w(F,a) so that there could be a 'true' effect of experience on wages.[3] The reason is simple: if wages in all firms rise with experience but firms do not change their position on the job ladder then the relative attractiveness of working in this firm will not change over time. One special case we shall pay particular attention to is where the log wages offered by firms are of the separable form w(F,a)=w(F)+f (a). But it should be equally obvious that the search behaviour of workers described above is not consistent with 'true' returns to tenure *ie* wage policies of the form w(F,a,t). There are two reasons for this. First, if wages rise with job tenure within firms then, though the firm will be at position F in the wage offer distribution at entry for a worker with tenure t, it is now effectively at a higher position as their wage has risen. In this case the firm will be effectively at position T(F,a,t) in the wage offer distribution which must satisfy w(F,a,t)=w(T(F,a,t),a,0) and it is this 'adjusted' position which will determine the job mobility of workers. In this case we cannot derive the workers' mobility decision without knowledge of the form of the wage offer distribution, a problem that does not arise when the 'true' returns to tenure are zero. The second problem occurs if returns to tenure are non-linear. Then the rate of wage growth will differ across jobs and workers would be expected to take account of this as well as the current level of wages in making their job mobility decisions (see Topel, 1986, for an elaboration of this point).

While these are not insurmountable problems (see Hartog and Teulings, 1996, for the working out of one special case) it does make life more difficult, so we work here with a benchmark assumption of no true returns to job tenure. How adequate is this assumption is one of the main topics of this paper.

Let us start with some notation. Normalise the size of the labour force of experience zero to 1 and denote by u(a) the number of non-employed workers of experience a. Let us denote by N(F,a) the number of workers employed at position F or lower on the job ladder of experience a (for employment we use upper case letters to denote cumulative densities and lower case to denote densities). For the dynamics of non-employment we must have:

$$\frac{\partial u(a)}{\partial a} = -[\lambda_u(a)+\delta_r(a)]u(a) + \delta_u(a)N(1,a) \qquad \textbf{(1)}$$

which simply says that the change in the level of non-employment is the difference between

tenure to zero which may then have consequences for future job opportunities. With such a generalization one also has to introduce the wage function at an earlier stage to determine the optimal mobility decision.

3 In what follows we will write as if the 'true' return to experience is explained by returns to human capital as is the traditional explanation. But it is important to note that nothing in what follows is a test of this hypothesis and there are other possible reasons for why wage offers might depend on experience.

inflows and outflows. Now consider the equation for the dynamics of N(F,a). We must have:

$$\frac{\partial N(F,a)}{\partial a} = -[\delta_r(a)+\delta_u(a)+\lambda_e(a)(1-F)]N(F,a) + \lambda_u(a)Fu(a) \qquad \textbf{(2)}$$

which again says that the change in the stock is equal to the inflow (which can only come from non-employment) minus the outflow. To solve these differential equations one needs initial conditions specifying the non-employment rate u(0) among labour market entrants, and the distribution of new entrants on the job ladder. For the latter condition it is most natural to assume that as these people have had time to receive at most one job offer they are distributed uniformly on the job ladder so that N(F,0)=[1-u(0)]F.

We can simplify the framework somewhat by noticing that the 'death' rate plays no role in the distribution of workers on the job ladder or on the non-employment rate. One can see this by replacing u(a) in every equation by:

$$\tilde{u}(a) = u(a)e^{\int_0^a \delta_r(a)da} \qquad \textbf{(3)}$$

and N(F,a) in every equation by:

$$\tilde{N}(F,a) = N(F,a)e^{\int_0^a \delta_r(a)da} \qquad \textbf{(4)}$$

Effectively these transformations convert from levels to rates. After this transformation the equations (1)-(2) no longer contain the death rate so that the expressions for the distribution of workers on the job ladder also do not depend on the death rate. The reason for this is obvious: as the death rate is independent of employment status and position on the job ladder (assumptions which might of course be questioned in reality) the death rate simply determines the size of a particular age group and not the distribution across labour market states. Given this irrelevance of the death rate we will work from now on with the formulae in (1)-(3) with the death rate set equal to zero: this is without loss of generality.

The set-up so far is exactly the same as in Manning (1996) where the focus was on the distribution of wages conditional on experience. Here we generalise this by looking at the distribution of wages jointly conditional on experience and job tenure. So, let us consider how we can derive this distribution. Let us denote by n(F,a,t) the density of workers at position F on the job ladder of current experience a and job tenure t. What we know about these people is that they must have entered the job at experience (a-t) and neither been laid-off nor received a better job offer since. Hence we must have:

$$n(F,a,t) = e^{-\int_0^t [\delta_u(a-t+s)+\lambda_e(a-t+s)(1-F)]ds} . R(F,a-t,0) \qquad \textbf{(5)}$$

where R(F,a-t,0) is the density of new recruits at experience level (a-t). These new recruits must come from one of two states: from non-employment and from those employed at a lower point than

F in the job ladder. Hence we have:

$$R(F,a-t,0) = \lambda_u(a-t)u(a-t) + \lambda_e(a-t)N(F,a-t) \qquad \textbf{(6)}$$

for a>t. For a=t, matters are rather different as R(F,0,0)=(1-u(0)).[4] Given the solution for u(a) and N(F,a) derived earlier we can obviously use (5) and (6) to solve for n(F,a,t). Given a solution n(F,a,t) it is simple to work out the distribution of workers on the job ladder given experience and job tenure. Define G(F|a,t) to be the fraction of workers at position F or below given experience and tenure. This is given by:

$$G(F|a,t) = \frac{\int_0^F n(f,a,t)df}{\int_0^1 n(f,a,t)df} \qquad \textbf{(7)}$$

Let us now consider the predictions of this model for the relationship between the wage distribution, experience and tenure. For a discussion of the prediction of this model for the relationship between earnings and experience alone see Manning (1996).

In the general case, it does not seem possible to provide a convenient closed-form analytical expression for the conditional distribution function in which we are interested.[5] However, the following proposition shows that this does not prevent us from examining the effect of age and tenure on expected wages.

Proposition 1: If dln(n)/dx is increasing (resp. decreasing) in F then the distribution G(F|a,t) is increasing in the sense of first-order stochastic dominance (resp. decreasing) in variable x.

Proof: See Appendix.

To consider the impact of experience and tenure on the wage distribution let us combine (5) and (6) to yield:

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4 Unless (1-u(0))=1 this means there is a discontinuity at a=t for the reason that those in starting jobs at experience zero have just been placed there randomly, while those starting jobs at any experience level strictly greater than zero are systematically selected in some way.

5 One exception is if all workers are initially in employment, there are never any quits to unemployment, the initial wage distribution has an extreme value distribution and job offers are exponentially distributed (see Hartog and Teulings, 1996). Then the wage distribution conditional on age and tenure has an extreme value distribution. But a lot of special assumptions are needed to get this result.

$$\log(n(f,a,t)) = -\int_0^t [\delta_u(a-t+s)+\lambda_e(a-t+s)(1-F)]ds + \log[\lambda_u(a-t)u(a-t)+\lambda_e(a-t)N(F,a-t)] \qquad \textbf{(8)}$$

Let us start with the most general easy result to prove. Notice that we can simplify (8) somewhat if we look at the distribution of wages conditional not on current experience and job tenure but on experience at the start of the current job (a-t) and job tenure. Let us define a_0 to be starting experience and use the function $n_0(F,a_0,t)$ to denote the density of workers at position f given starting experience and tenure. We must have:

$$\log(n_0(F,a_0,t)) = -\int_0^t [\delta_u(a_0+s)+\lambda_e(a_0+s)(1-F)]ds + \log[\lambda_u(a_0)u(a_0)+\lambda_e(a_0)N(F,a_0)] \qquad \textbf{(9)}$$

This way of writing things shows that, conditional on starting experience, job tenure affects the distribution of workers on the job ladder solely through the effect on the proportion remaining after a certain period of time. As the following proposition says we can sign this.

Proposition 2: Conditional on starting experience the wage distribution is increasing in job tenure.

Proof: Simple differentiation of (9) leads to:

$$\frac{\partial^2 n_0(f,a_0,t)}{\partial f \partial t} = \lambda_e(a_0+t) > 0 \qquad \textbf{(10)}$$

so that simple application of Proposition 1 gives us the result we want.

The intuition is straightforward. Among workers who start jobs at the same experience level the ones who survive a longer period of time are the ones with the low separation rates (which are the workers with the better paid jobs) so that among workers with long job tenure we would expect to find disproportionate numbers of workers towards the top of the job ladder.[6]

Given that the effects of job tenure on the wage distribution are unambiguous let us now turn to the effect of starting experience. As will become apparent, matters are not so clear-cut here and the effect is ambiguous. To try to make this clear let us concentrate on the particularly simple case where the transition rates are independent of experience, non-employment rates are constant and $\lambda_e=\lambda_u$. Manning (1996) shows that these assumptions are sufficient for the distribution of

6 This reasoning also suggests when this result might fail. Suppose there is individual heterogeneity in λ_e. The long tenure individuals will then tend to be those with low job-to-job mobility rates who will tend to be concentrated down the bottom end of the job ladder. So, one should not conclude that one cannot construct labour market models in which this result on may be violated.

wages conditional on experience alone to be increasing in experience. But, as we shall see, including job tenure as an extra conditioning variable means that even this result no longer holds.

Proposition 3: Even if non-employment rates are constant, transition rates are constant and job offer arrival rates independent of labour market state, it is possible that expected wages, conditional on job tenure and experience are declining in experience.

Proof: See Appendix

Proposition 3 is worded in a somewhat curious way because it is never true that rising experience leads to a worse distribution in the sense of first-order stochastic dominance but it can get worse at some points in the distribution. To understand the reason for this, suppose we observe two sets of workers with different experiences but with identical job tenure. We can divide each of these sets of workers into two groups:

I. those that arrived in the present job directly from another job
II. those that arrived in the present job from unemployment

The distribution of wages among these two groups will be different but, if we condition only on experience and tenure, the observed wage distribution will be a mixture of the two.[7] As the wage distribution shifts up with experience (the result in Manning, 1996) the wage distribution must be higher for an older worker from group I than for a younger worker. In contrast the wage distribution among those from group II must be independent of experience as becoming unemployed is like being reborn as a labour market entrant in the model presented here. In addition the wage distribution among group II must be less than that among group I. If the proportion of workers from the two groups did not vary with experience then the fact that the wage distribution of the first group increases with experience and the wage distribution of the second group is independent of experience would mean that the distribution of the mixture of the two must be increasing with age. The source of the ambiguity in the impact of experience on wages described in Proposition 3 is that the proportion of workers from the two groups does change and not in a way that is necessarily monotonic in age.

As we vary experience, the job-to-job mobility rate falls which tends to increase the proportion of new recruits from group II and the unemployment rate falls which tends to reduce the proportion from group I. To consider a specific example, suppose that the unemployment rate is one for labour market entrants so that for very young workers we know that the bulk of recruits must have come from unemployment so that the proportion from group II initially falls with experience. But, there comes a point at which the proportion of new recruits from group II may start to rise again because the job-to-job mobility rate falls faster with experience than the unemployment rate. Intuitively when we observe an old worker with low job tenure it is quite unlikely that they arrived in this new job because they got a better job offer and relatively likely that they arrived in the new job after an intervening period of unemployment. This may mean that, conditional on tenure, average wages are declining in experience over some range.

What we have done so far is to consider the distribution of wages conditional on job tenure and starting experience: however, most empirical applications focus on wages conditional on job tenure and current experience. Obviously the current experience effect is simply the starting

7 Of course, one would like to have the data on where the workers came from but, in most data sets, this is not available.

experience effect but the job tenure effect is the job tenure effect of Proposition 2 minus the starting experience effect. One might think, given Proposition 3, that it is very difficult to say anything about this effect but a very simple result can be derived for the case where transition rates are constant.

Proposition 5: If transition rates are constant, then the wage distribution is increasing (decreasing) in job tenure as:

$$d_u \ \% \ (?_e \& ?_u) u(a \& t) \quad > \ (<) \quad 0 \qquad \textbf{(11)}$$

Proof: See Appendix.

One can use Proposition 5 in a number of ways. First, one can ask the question "when does an earnings function give an unbiassed estimate of the returns to tenure?". In this case the 'true' returns to tenure are zero and by inspection of (11) one can see that this condition is satisfied in a number of cases. First, if d_u=0 (so that no workers ever enter unemployment) and either u(a-t)=0 at all ages or $?_e$=$?_u$. These conditions are obviously rather restrictive. But the effect of tenure on expected wages can be positive or negative. As in the case of age there are two effects working in the opposite direction. On the one hand high job tenure means that the current job started at a young age and hence is likely to have been a low wage job. On the other hand, the fact that the job has lasted a long time means that no better job offer has been received and this makes it likely to be a mighty good thing. There are some unambiguous predictions. As u(a) tends to $d_u/(d_u+?_u)$ as a goes to infinity, the left-hand side of (11) is then automatically positive meaning that expected wages should be increasing in job tenure for the oldest age groups (though the experience level at which this result is relevant could conceivably be infeasible).

If $?_e$=$?_u$, on-the-job search is as effective as off-the-job search so that expected wages are related only to total time spent in the labour market since last leaving unemployment. A long job tenure is an indication that the worker has been in employment for a long time so that the tenure effect is positive if the job destruction rate is positive. But, if it is zero, expected wages will be unrelated to tenure. This is a point emphasized in Topel (1991), though given the actual configuration of transition rates in our data, he gives this example somewhat more weight than might be warranted.

This section has examined the predictions of a simple search model for the relationship between the wage distribution, experience and tenure. It has attempted to provide some insight into the general results that can be derived. But, from the practical point of view it is (7) that is most useful as it shows how one can use information on transition rates (which are observable) to derive predictions about the distribution of workers given experience and job tenure. How well these predictions coincide with the reality is the subject of the rest of this paper.

2. Estimation Strategy

While it is convenient in a theoretical model to work in continuous time, this becomes computationally infeasible when one tries to make the model operational.[8] So, let us briefly

8 The problem here is not that one cannot infer the transition rates of a continuous time process from discrete observations when those transition rates are constant, but that this becomes exceedingly difficult

describe a discrete time version of the model. Suppose, for the moment, that the unit of time is so short that no more than one job offer is received within it (the appropriateness of this assumption is an issue which we address further below). Denote by $G(F|a)$ the fraction of workers at position F or below in the wage offer distribution of experience a. Those in employment at experience a can be divided into two groups: those who have been in continuous employment in the last period and those who have had some period of non-employment. Denote by s(a) the proportion who have had continuous employment. Of these $G(F|a-1)$ will have been employed at a position lower than F in the previous period of whom $\lambda_e(a)$ will have received another job offer (this should now be interpreted as a probability) and, of these a fraction (1-F) will have left. For those entrants from non-employment a fraction F will be at F or below. This means that we must have:

$$G(F|a) = s(a)[1-\lambda_e(a)(1-F)]G(F|a-1) + [1-s(a)]F \qquad \textbf{(12)}$$

Given the initial condition $G(F|0)=F$, this can be solved given data on s(a) and $\lambda_e(a)$. Now consider how the distribution of F conditional on experience and tenure can be derived. Let us denote by $\delta_u(a)$ the probability of a worker employed a period ago having lost their job and, conditional on not having lost their job, let $\lambda_e(a)$ be their probability of having received another job offer. Consider the number of workers with experience a and tenure t who are at position F in the wage offer distribution. We know two things about these workers:

- they must have been recruited to position F at experience (a-t)
- they have not lost their job nor received a better offer since

Denote by R(F,a-t) the flow of recruits to position F at experience (a-t). We must have:

$$R(F,a-t) = [1-\delta_u(a-t)]\lambda_e(a-t)[1-u(a-t-1)]G(F|a-t-1) + [1-s(a-t)][1-u(a-t)] \qquad \textbf{(13)}$$

The first term is those workers in employment at (a-t-1) who did not lose their job, received a wage offer of F and wanted that job (i.e. were previously employed at a job of position less than F). The second group is the recruits from unemployment which, from our earlier definition we know must be equal to (1-s)(1-u). One can simplify this formula by noting that:

$$[1-u(a-t)] = [1-\delta_u(a-t)][1-u(a-t-1)] + [1-s(a-t)][1-u(a-t)] \qquad \textbf{(14)}$$

Substituting this into (13) we have that:

$$R(F,a-t) = [1-u(a-t)]\left(\lambda_e(a-t)s(a-t)G(F|a-t-1) + [1-s(a-t)]\right) \qquad \textbf{(15)}$$

Given this the density of those at position F of experience a with job tenure t is given by:

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when, as here, transition rates are potentially non-constant.

$$n(F|a,t) = R(F,a-t).\prod_{s=0,..(t-1)}[1-\delta_u(a-s)][1-\lambda_e(a-s)(1-F)] \qquad \textbf{(16)}$$

Given this the density of F given (a,t) is worked out according to the formula in (7). We have now shown how knowledge of $[s(a),\delta_u(a),\lambda_e(a)]$ is sufficient to work out the distribution of workers across the wage offer distribution conditional on experience and job tenure. But we need to convert the wage offer distribution to actual wages. Let us consider how we can do this. Suppose we are interested in the average wage conditional on experience and tenure. We can write this as:

$$\begin{aligned} E(w|a,t) &= \int w(F,a)dG(F|a,t) \\ &= \int w(F,0)dG(F|a,t) + \int [w(F,a)-w(F,0)]dG(F|a,t) \end{aligned} \qquad \textbf{(17)}$$

The two terms in the second line can be given the following interpretation. The first is the average wage of someone with experience a and tenure t if there were no ‘true’ returns to experience or tenure and the wage paid to an older workers at a given point in the wage offer distribution is exactly the same as that paid to a labour market entrant. This term is a natural measure of the contribution of the search process to the profile. This term can be computed given knowledge of $G(F|a,t)$ and $w(F,0)$ which can be estimated from the observed wage distribution for labour market entrants as $G(F|0,0)=F$ by definition. The second term in the second line of (17) can be interpreted as the ‘true’ returns to experience. If $w(F,a)=w(F)+\phi(a)$ then this term is simply equal to $\phi(a)-\phi(0)$ which is the unambiguous measure of the ‘true’ return to experience in this case.

3. The Data

The data we use in this study comes from the UK Labour Force Survey for the period March 1993 to February 1996. This corresponds to the entire available period for which the LFS has wage information. In this period individuals were in the LFS for five quarters but were only asked about their wage in the final quarter. However, in the four previous quarters they were asked about their labour market status and, if in work, on their job tenure. This is supplemented by information on their age and the age they left full-time education to compute potential years of labour market experience. Most of our analysis is based on the sample of individuals for whom five quarters of information are available. This raises issues of attrition bias: the LFS is an address-based survey so that individuals who change address are deliberately not followed and are replaced in the sample by any who move into the address. As moving address is often associated with labour market transitions (we can see this by looking at the movers-in) this causes potential bias in our estimates of transition rates. One way of assessing the extent of this problem is to compare our estimates of transition rates from the LFS from those derived from the British Household Panel Study (BHPS) which does not suffer from this problem. The BHPS is also useful in overcoming another limitation of the LFS, namely that we have only 5 discrete observations on the labour market state which will cause us to miss very short labour market states which happen to fall between two observation points. The BHPS collects retrospective information on labour market activity over the previous year which, in theory, can be used to pick up all spells however short (see Paull, 1996, for a discussion of the evidence on the reliability of this information).

The unit of time that we used for the analysis is a year. The trade-off in deciding on the unit of time is the following. Using a long period increases the cell sizes and hence the precision of the estimates of transition rates and average wages, but increases the proportion of the population which will have received more than one job offer in the period (which is the assumption on which the formulae (12)-(16) are based). Below we argue that, for our data, this latter problem is unlikely to be very serious, so a year seems to be a reasonable period for analysis. Accordingly we assign to each individual in their fifth quarter a level of experience equal to the years of labour market experience completed (*ie* it is an integer value) and, in the case of those in work, a level of job tenure equal to the years of tenure completed in the firm. Of the 93810 individuals for whom we had wage information, we had to discard 1.6 per cent of the observations who had reported tenure greater than experience or tenure missing altogether.

Figure 1 shows the non-employment rates by experience and sex. The data from the LFS and BHPS correspond very closely and show the pattern we would expect with a u-shaped relationship between non-employment rates and experience for men and a similar relationship with the addition of a 'bump' for women associated with time taken out of the labour market primarily to care for children.

The theory suggests that the fraction of labour market entrants is important in the relationship between wages and experience. Figure 2 plots [1-s(a)] for our data. For the LFS, labour market entrants are defined as those workers who have recorded any period of non-employment in the first four quarters of their presence in the panel. This obviously does not include those who had a job at one interview, lost it and found another by the next interview so should lead to an under-estimate of the actual numbers. The BHPS figures should allow for this as a labour market entrant is defined as someone with less than 99% of their time in employment over the previous year. The numbers for the BHPS and LFS are very similar, suggesting that any bias in the LFS is rather small. For men the proportion of entrants is a decreasing convex function of experience. For women the proportion of entrants is slightly higher on average but the picture is similar, with the addition of a noticeable 'bump' when women return to the labour market after having children.

Now consider the rate at which workers change jobs. For those workers who have been in continuous employment we compute the fraction who have changed jobs in the previous year which we determine by whether current reported tenure is less than a year. Figure 3 presents the estimates of the job-changing rates from the LFS and BHPS. For both men and women the picture is very similar with the job-changing rate being a declining convex function of experience. Of course, this only gives the fraction of job offers received that are accepted (which we will denote by ?(a), not the job offer arrival rate that the theory requires, but we can establish the relationship between the two according to the formula:

$$?_e(a) = \frac{?(a)}{\int_0^1 (1-F)\,dG(F|a-1)} \qquad \textbf{(18)}$$

Now let us consider the extra information needed to work out (17). For this we need the job loss rates. This is given by the fraction of those in employment at the first interview who have had any subsequent recorded period of non-employment. Figure 4 presents the relevant information. This is the one place where the LFS and BHPS seem to give rather different results, with job destruction rates being much higher in the LFS than the BHPS and the BHPS showing none of the marked rise in job destruction rates for older workers that is apparent in the LFS. One possible explanation for the discrepancy is that labour market transitions tend to ‘disappear’ in retrospective surveys which is how the BHPS information is collected (see Paull, 1996).

Before we proceed we need to discuss the assumption that a year is a period sufficiently short for at most one job offer to be received. We can obtain information on the adequacy of this assumption from both the LFS and BHPS. There are two groups of workers who we might worry about here. First, those in continuous employment who we assume have had at most one job change but might have had more. We can work out the number of different jobs held by these individuals in the BHPS and LFS. This information is tabulated in Table 1a. For those who have had at least one change (itself a small fraction of those in continuous employment) only 10 per cent have had more than one change.

The other group are the entrants into employment from non-employment who we have assumed to have had at most one job since non-employment but might have had more than one. The relevant fact here is the number of jobs held since the last spell of non-employment. This is tabulated in Table 1b. Again, only something like 10 per cent of employment entrants have had more than one job since entering employment. Given the information in Tables 1a and 1b, we will proceed on the basis that it is reasonable to assume that at most one wage offer has been received in the course of a year.

Wages are computed as average hourly earnings in the main job. We converted all wages to a common date by taking out time means.

Now consider how we can compute the predictions of the pure search model. We use the fact that for labour market entrants $G(F^*0)=F$ so that $w(F,0)=w(G,0)$ for these workers *ie* we can estimate the wage offer distribution by the actual distribution of wages among labour market entrants. We also compute $G(F^*a)$ and $g(F^*a,t)$ using the recursive formulae in (12) and (16), the formula in (7) and our estimates of the transition rates. There is a steady-state assumption being made in this, namely that in estimating the transition rates that someone with a=40 had 20 years ago we can use the transition rates of someone with a=20 today rather than 20 years ago. This is likely to be dangerous if there are important cohort effects or aggregate effects *eg* because of the business cycle. There is one important way in which the study period is unusual, namely that the 1990s were a period when the transition rates of men and women seem to have almost converged (as we have seen in Figures 2 and 4). This is for two reasons: the increasing labour market attachment of women and the increased risk of job loss for men (unemployment rates for men are now substantially above those for women). As Manning (1996) shows this was not true in earlier periods. The consequence of this is that the model predicts more similar profiles for men and women than one would probably predict if one used more historical data. One way of thinking about this problem is that older women in our sample are assumed to have had the same level of labour market attachment in their youth as young women do today, when their actual attachment was much less. This problem should be borne in mind in what follows.

4. Results

4.1 The Relationship Between Wages and Experience

Although it is not the main focus of the paper, we will start by looking at the relationship between wages and experience when we do not control for job tenure. Figure 5 presents the actual and predicted profile for men and women. Both profiles are normalized so that the earnings of labour market entrants are zero. The search model predicts the concavity of the profile though the predicted profile for women has a ‘bump’ caused by withdrawal from employment for domestic reasons which no longer exists in the actual profile (though interestingly Manning, 1996, shows that it used to).

In the simple model where $w(F,a)=w(F)+\phi(a)$ and there are no effects of job tenure, the gap between the actual and predicted profiles can be interpreted as the ‘true’ returns to experience after removing the search effects. But this interpretation is only valid if there are no ‘true’ effects of tenure, so let us turn to this issue.

4.2 The Relationship Between Wages, Experience and Tenure

Figure 6 presents the average wage profiles for men and women for given experience and tenure levels, focusing on the returns to tenure. These profiles are normalized on the average wages of labour market entrants being zero which makes it rather hard to separate the returns to tenure from the returns to experience. To make this job somewhat easier Figure 7 normalises on the average wage of someone of zero tenure being zero for each experience level. As one can see the returns to tenure of men and women are very similar; they seem always to be positive and they seem to be lower at higher levels of experience.

Now consider how well the search model can explain the returns to tenure. Figures 6 and 7 also present this information. As can be seen the parameters of the search model also predicts a return to tenure that is everywhere positive, and it is of a very similar order of magnitude to the actual observed. Quite how similar is hard to tell from the graphs so Table 2 presents some simple regressions to summarize the data.

The ‘observations’ used in these regressions are a particular sex-experience-tenure combination. In the regressions that follow we weight by the relevant cell size (one might also want to adjust for differences in variances but this is not straightforward when we work with the predicted profiles). In the first column we present a simple regression of the actual mean log wage on a full set of experience dummies and a cubic tenure term. The second column performs a similar regression for the predicted mean log wage. As can be seen the predicted tenure effect is a similar order of magnitude. In the third column we simply take the difference between the actual and the predicted. This residual is correlated with the tenure terms, implying that the search model cannot explain all the observed returns to tenure. However, the gap between the actual and predicted is quite small and not always in one direction so that the search model does appear to do quite a good job in explaining these returns. One can also see that the experience dummies are very significant because of the fact seen earlier that the search model seriously under-predicts returns to experience. But, if the wage offer function is of the form $w(F,a)=w(F)+\phi(a)$ then one should be able to fully explain these experience dummies using the gap between the actual and predicted profile conditional just on experience. To see this note that in this case we have:

$$\begin{aligned} E(w|a,t) &= \int w(F,0)\,dG(F|a,t) + \phi(a) - \phi(0) \\ &= \int w(F,0)\,dG(F|a,t) + \left[E(w|a) - \int w(F,0)\,dG(F|a)\right] \end{aligned} \qquad (19)$$

The term in square brackets on the second line is the gap between the actual and predicted profile conditional on experience alone and is our estimate of the 'true' experience effect. This can be estimated using our earlier results that were reported graphically in Figure 5. The second F-statistic in the third column shows that one can accept the hypothesis that there is no extra experience effect once one has taken out this estimate of the 'true' experience effect.

These results suggest that the data is broadly consistent with a model in which w(F,a)=w(F)+f (a) and there are no 'true' returns to tenure. Let us now consider whether there is any other evidence consistent with this view.

4.3 The Variance Profile

If it is the case that w(F,a)=w(F)+f (a) then it should be the case that the actual and predicted variances should coincide as the additively separable experience term will add nothing to the variance. Tables 8a and 8b show the actual and predicted variance profiles for men and women respectively. The actual and predicted must, by construction, coincide for zero experience and tenure. As can be seen, the actual and predicted variances are in the right ball-park, though the actual profile shows a very marked decline in the early years of job tenure, while the predicted declines only more gradually.

4.4 The Distribution of Job Tenure

The model we have presented also has implications for the distribution of job tenure among workers given experience.[9] Recall that the function n(F,a,t) gave us the density of workers at position F with experience a and t. From this function one can derive the distribution function of tenure given experience $J(t|a)$ by the following formula:

$$J(t|a) = \frac{\int_0^t \int_0^1 n(F,s,a)dF}{\int_0^a \int_0^1 n(F,s,a)dt} \qquad \textbf{(20)}$$

which can be computed given the search model. Figures 9a and 9b present the predicted and actual cumulative tenure distributions for men and women respectively. To the naked eye they coincide, suggesting that the model does a good job in predicting the distribution of job tenure in the population. The ability of the simple search model to predict the distribution of tenure can also be thought of as a test of certain simplifying assumptions of our model e.g. the assumption that job offers arrive at the same rate at all points in the wage distribution so that these results are confirmation that our simple model does not seem to be grossly at variance with the facts.

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9 Reference should be made here to Mortensen (1988) who compared the job turnover predictions of a search model of the Jovanovic (1979a, 1979b, 1984) type and a model of specific human capital.

5. Tenure Profiles by Education

What we have done so far is to group all education groups together. But it might be the case that there are important differences across education groups. In terms of their experience profiles, Manning (1996) showed that the profiles for those who left full-time education at an earlier age have very steep growth for the initial years but then flatten out very quickly. More educated workers have growth at a more gradual pace over more years but the maximum return to experience is less than for the less-educated. This pattern is repeated in the data used here as Figure 10a shows (group 1 are those who left school with no qualifications, group 2 those who left at 16 with some qualifications, group 3 those who left at 18 and group 4 those who left at age 21 or above). But what about the tenure profile? There is a lot of information to summarize here and a simple way of doing this is shown in Tables 3a and 3b where we use the approach of Table 2 to provide parametric estimates of the returns to tenure. As can be seen there are no very marked differences across education groups in the returns to tenure and the actual returns are tracked pretty well by the predicted returns. For 7 out of the 8 sex-education combinations one can accept the hypothesis that the residual returns to experience conditional on experience and tenure can be fully explained by the residual returns conditional on experience alone.

6. Conclusions

In this paper we have investigated the predictions of a simple search model for the returns to tenure and experience. We have shown how information on labour market transition rates and the wage distribution of labour market entrants can be used to quantify the relationship between wages, experience and tenure predicted by the search model. We then applied these results to British data. While we found that the search model can explain part of the returns to experience, we also a found a substantial part that could not be explained by the model, and so should be interpreted as the 'true' returns to tenure. In contrast we showed how the search model can explain the bulk of the returns to tenure without need for any true effects of tenure on wages. One should remember that our results are based on the assumption that there are no such 'true' returns and that our equations would need modification if there were such returns. However, it would appear that understanding the process of search and job mobility does have the potential to explain a considerable part of earnings functions, and so should perhaps receive more attention than it commonly does.

Appendix

Proof of Proposition 1

To work out the effect on G of x, differentiate (7) with respect to x (it is actually more convenient to differentiate ln(G)):

$$\frac{\partial \ln G(F|a,t)}{\partial x} = \frac{\int_0^F \frac{\partial n(f,t,a)}{\partial x}df}{\int_0^F n(f,t,a)df} - \frac{\int_0^1 \frac{\partial n(f,t,a)}{\partial x}df}{\int_0^1 n(f,t|a)df}$$

$$= \frac{\int_0^w \frac{\partial \ln(n(f,t|a))}{\partial x} n(f,t|a)df}{\int_0^w n(f,t|a)df} - \frac{\frac{\int_0^1 \frac{\partial \ln(n(f,t|a))}{\partial x} n(f,t|a)df}{\int_0^{\bar{F}} n(f,t|a))}}{\partial x})$$ **(21)**

$$= E\left(\frac{\partial \ln(n(f,t|a))}{\partial x}\Big|f \leq F\right) - E\left(\frac{\partial \ln(n(f,t,a))}{\partial x}\right)$$

We can sign this unambiguously if the partial derivative of ln(n) with respect to x is monotonic in F. If it is increasing in F, then ln(G) is decreasing in x which implies first-order stochastic dominance.

Proof of Proposition 3

If $?_e=?_u/?$, then if we define J(F,a)=u(a)+N(F,a), combining (1) and (2), we must have:

$$\frac{\partial J(F,a)}{\partial a} = -?(1-F)J(F,a) + d_u[1-J(F,a)]$$ **(22)**

which has as a solution:

$$J(F,a) = e^{-[\delta_u + ?(1-F)]a} J(F,0) + \frac{\delta_u [1 - e^{-[\delta_u + ?(1-F)]a}]}{\delta_u + ?(1-F)} \tag{23}$$

From (6) we know that the starting experience effect works only through ?J so that the test of Proposition 1 can be applied just to ln(J). We have:

$$\frac{\partial J(F,a)}{\partial a} = -[\delta_u + ?(1-F)] \left[J(F,a) - \frac{\delta_u}{\delta_u + ?(1-F)} \right]$$

$$\Rightarrow \quad \frac{\partial \ln(J(F,a))}{\partial a} = -[\delta_u + ?(1-F)] + \frac{\delta_u}{J(F,a)} \tag{24}$$

which implies that:

$$\frac{\partial^2 \ln(J(F,a))}{\partial a \partial F} = ? - \frac{\delta_u}{J(F,a)^2} \cdot \frac{\partial J(F,a)}{\partial F} \tag{25}$$

so that the test of Proposition 1 depends on whether:

$$?J(F,a)^2 \geq \delta_u ? a \left(J(F,a) - \frac{\delta_u}{\delta_u + ?(1-F)} \right)$$

$$+ \delta_u e^{-[\delta_u + ?(1-F)]a} \frac{\partial J(F,0)}{\partial F} + \frac{? \delta_u^2 \left(1 - e^{-[\delta_u + ?(1-F)]a} \right)}{[\delta_u + ?(1-F)]^2} \tag{26}$$

The simplest way to show the sign of this is ambiguous is to evaluate at a=0. Then J(F,a)=J(F,0)=[u(0)+F(1-u(0))] and (26) becomes:

$$?[u(0) + F(1 - u(0))]^2 \geq \delta_u (1 - u(0)) \tag{27}$$

which is clearly always positive for u(0) close enough to zero and negative for u(0) close enough to one. For u(0) at its steady-state value we have:

$$\left[\frac{\delta_u + ?F}{\delta_u + ?} \right]^2 - \frac{\delta_u}{\delta_u + ?} \tag{28}$$

the sign of which depends on F.

As we do not have first-order stochastic dominance appropriate choice of the wage function w(F,a) can make average wages decreasing (or increasing) in labour market experience.

Proof of Proposition 5

By taking the logs of (5) and (6) and differentiating with respect to t we have that:

$$\frac{\partial \ln(n|a,t)}{\partial t} = -[\delta_u + \lambda_e(1-F)] - \frac{\lambda_e \frac{\partial N(w|a-t)}{\partial a} + \lambda_u \frac{\partial u(a)}{\partial a}}{\lambda_e N(w|a-t) + \lambda_u u(a-t)} \qquad \textbf{(29)}$$

Now, using (1) and (2) we can write this as:

$$\begin{aligned}
[\lambda_e N(w|a-t) + \lambda_u u(a-t)]\frac{\partial \ln(n,t|a)}{\partial t} &= -[\delta_u + \lambda_e(1-F)][\lambda_e N + \lambda_u u] \\
&\quad - \lambda_e\left(\lambda_u F u - (\delta_u + \lambda_e(1-F))N\right) - \lambda_u\left(\delta_u(1-u) - \lambda_u u\right) \qquad \textbf{(30)} \\
&= -\lambda_u\left(\delta_u + (\lambda_e - \lambda_u)u(a-t)\right)
\end{aligned}$$

As N is increasing in F (by definition) the application of the rule of Proposition 1 gives (11).

Table 1a
Number of Job Changes For Those in Continuous Employment Who Have Changed Jobs

	LFS		BHPS	
No. of Job Changes	Proportion	Sample Size	Proportion	Sample Size
1	90.1	5456	89.3	1334
2	9.0	546	9.0	134
3	0.8	48	1.5	23
4	0.0	2	0.1	1
5	0.0	0	0.0	0
6	0.0	0	0.1	1

Table 1b
Number of Job Changes Since Labour Market Entry for Labour Market Entrants

	LFS		BHPS	
No. of Job Changes	Proportion	Sample Size	Proportion	Sample Size
0	91.1	10320	90.8	1608
1	8.3	936	8.0	142
2	0.6	70	1.0	18
3	0.0	5	0.1	3

Table 2
Estimates of the Returns to Tenure

dependent variable	sex	tenure/10	$(tenure/10)^2$	$(tenure/10)^3$	R^2	Number of cells	F-test for experience effects
actual mean log wage	men	0.417 (0.026)	-0.157 (0.018)	0.023 (0.003)	0.91	1079	353.5
predicted mean log wage	men	0.348 (0.009)	-0.060 (0.006)	0.005 (0.001)	0.98	1079	169.2
residual mean log wage	men	0.069 (0.025)	-0.097 (0.017)	0.017 (0.003)	0.78	1079	198.47 0.28*
actual mean log wage	women	0.452 (0.023)	-0.154 (0.019)	0.022 (0.004)	0.85	1033	202.9
predicted mean log wage	women	0.408 (0.015)	-0.102 (0.011)	0.012 (0.002)	0.95	1033	106.3
residual mean log wage	women	0.044 (0.020)	-0.052 (0.017)	0.009 (0.003)	0.63	1033	99.3 1.00*

Notes: 1. All regressions are weighted using cell sizes: standard errors are heteroscedastic-consistent.

2. Numbers of observations differ because there are some cells with missing information.

3. All regressions include a full set of experience dummies. The F-test in the final column is a test of the hypothesis that the coefficients on these dummies are all zero. Degrees of freedom are 45 and the number of observations minus 49. The test statistics marked with an asterisk are tests of the hypothesis that the experience effects can be fully explained by the 'true' experience profile as estimated from the difference between the actual and predicted wage-experience profile (*ie* not controlling for tenure).

Table 3a
Estimates of the Returns to Tenure by Education: Men

dependent variable	education	tenure/10	$(tenure/10)^2$	$(tenure/10)^3$	R^2	Number of cells	F-test for experience effects
actual mean log wage	1	0.330 (0.038)	-0.154 (0.026)	0.025 (0.005)	0.65	987	73.1
predicted mean log wage	1	0.160 (0.009)	-0.022 (0.006)	0.002 (0.001)	0.94	987	9479.3
residual mean log wage	1	0.170 (0.038)	-0.131 (0.026)	0.024 (0.004)	0.43	987	37.8 1.19*
actual mean log wage	2	0.336 (0.028)	-0.114 (0.020)	0.015 (0.004)	0.75	1049	125.8
predicted mean log wage	2	0.181 (0.005)	-0.031 (0.003)	0.003 (0.001)	0.98	1049	278.6
residual mean log wage	2	0.154 (0.027)	-0.082 (0.020)	0.013 (0.004)	0.59	1049	98.5 3.16*
actual mean log wage	3	0.418 (0.036)	-0.140 (0.026)	0.019 (0.005)	0.89	1026	208.4
predicted mean log wage	3	0.354 (0.013)	-0.077 (0.008)	0.008 (0.001)	0.96	1026	61.1
residual mean log wage	3	0.063 (0.038)	-0.062 (0.027)	0.011 (0.005)	0.77	1026	128.0 0.64*
actual mean log wage	4	0.395 (0.039)	-0.141 (0.027)	0.018 (0.005)	0.73	1026	211.7
predicted mean log wage	4	0.223 (0.019)	-0.042 (0.012)	0.007 (0.002)	0.82	1026	32.3
residual mean log wage	4	0.172 (0.046)	-0.099 (0.031)	0.010 (0.006)	0.56	1026	106.9 1.50*

Note: As For Table 2.

Table 3b
Estimates of the Returns to Tenure by Education: Women

dependent variable	education	tenure/10	$(tenure/10)^2$	$(tenure/10)^3$	R^2	Number of cells	F-test for experience effects
actual mean log wage	1	0.410 (0.033)	-0.168 (0.028)	0.023 (0.006)	0.63	904	63.2
predicted mean log wage	1	0.237 (0.009)	-0.051 (0.006)	0.006 (0.001)	0.96	904	204.1
residual mean log wage	1	0.172 (0.035)	-0.118 (0.029)	0.017 (0.007)	0.38	904	21.5 0.94*
actual mean log wage	2	0.429 (0.042)	-0.134 (0.036)	0.014 (0.007)	0.65	797	40.1
predicted mean log wage	2	0.317 (0.016)	-0.071 (0.012)	0.008 (0.002)	0.93	797	96.9
residual mean log wage	2	0.113 (0.041)	-0.063 (0.035)	0.007 (0.007)	0.38	797	19.1 1.44*
actual mean log wage	3	0.397 (0.024)	-0.130 (0.020)	0.017 (0.004)	0.81	972	269.3
predicted mean log wage	3	0.411 (0.015)	-0.113 (0.011)	0.014 (0.002)	0.94	972	86.4
residual mean log wage	3	-0.014 (0.023)	-0.016 (0.019)	0.002 (0.004)	0.66	972	186.6 0.48*
actual mean log wage	4	0.234 (0.031)	-0.074 (0.027)	0.011 (0.006)	0.53	937	282.4
predicted mean log wage	4	0.245 (0.012)	-0.033 (0.008)	0.005 (0.001)	0.92	937	50.7
residual mean log wage	4	-0.015 (0.032)	-0.041 (0.027)	0.006 (0.006)	0.35	937	211.1 0.70*

Note: As for Table 2.

Figure 1
Non-Employment Rates by Experience and Sex

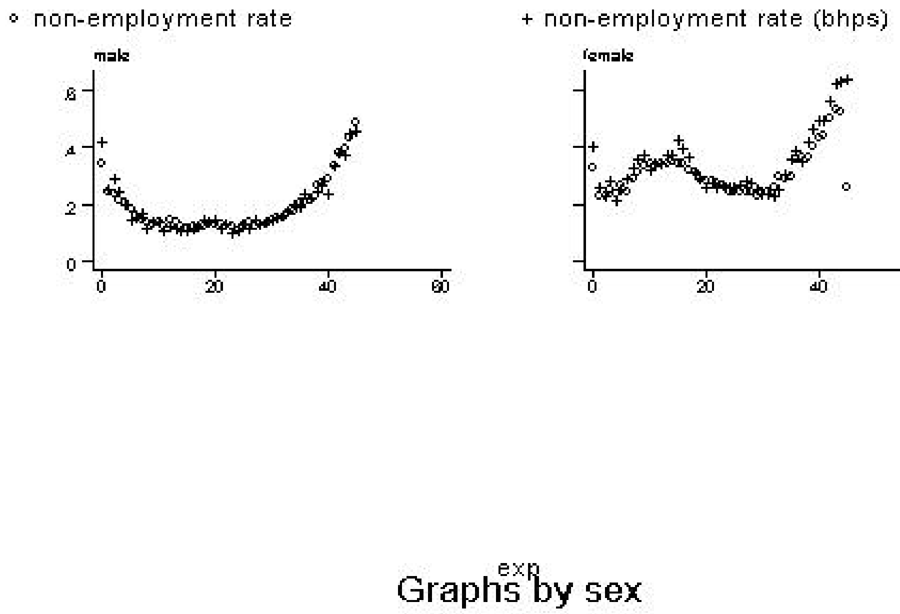


Figure 2
The Entrant Share by Experience and Sex

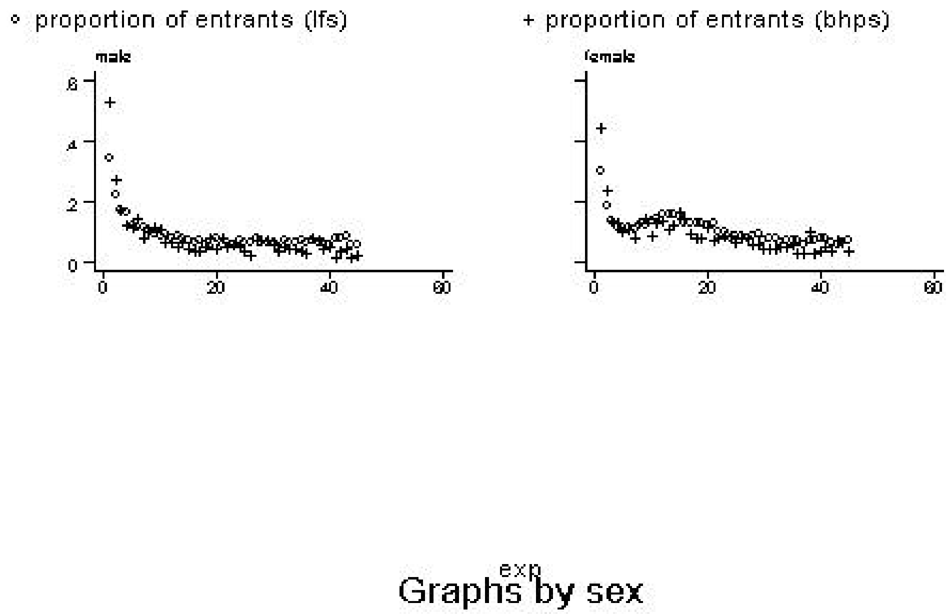


Figure 3

Job-Changing Rates by Experience and Sex

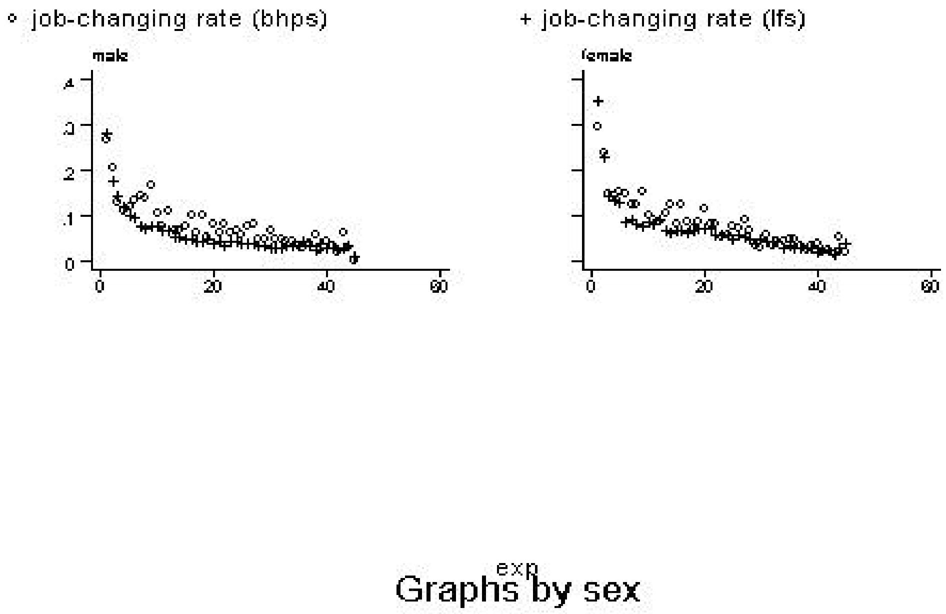


Figure 4
Job Destruction Rates by Experience and Sex

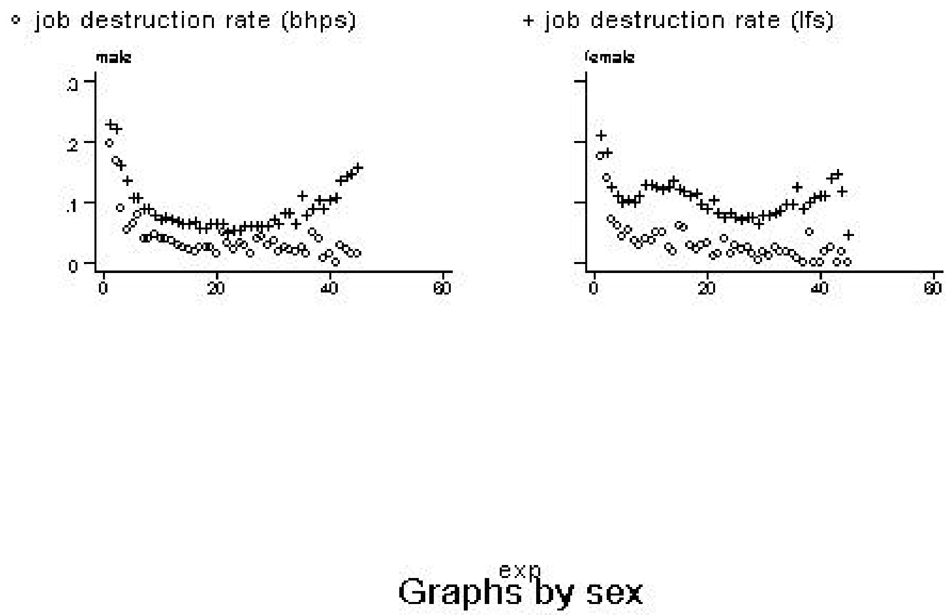


Figure 5
Wage-Experience Profiles by Sex

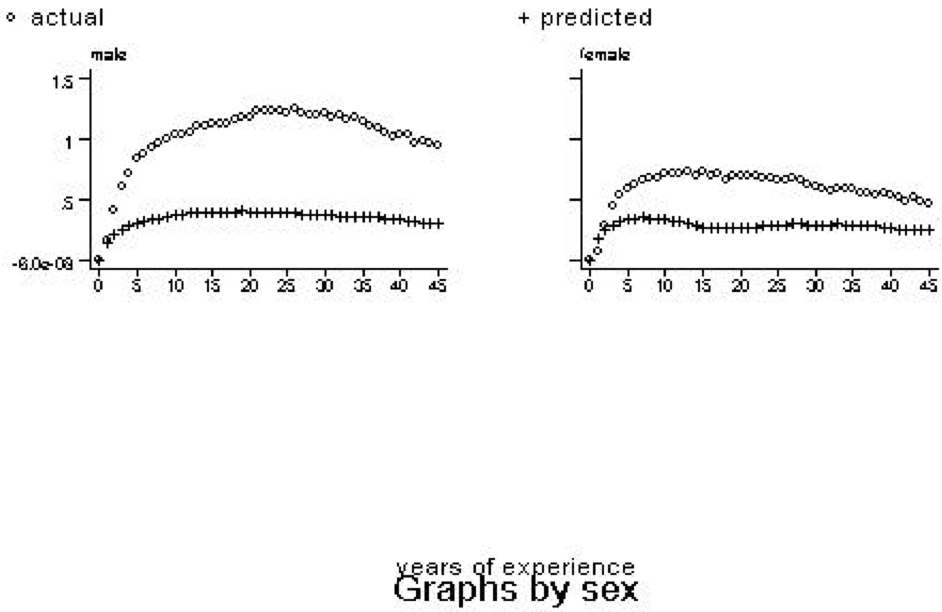


Figure 6a
Actual and Predicted Wage-Tenure Profiles by Experience: Men

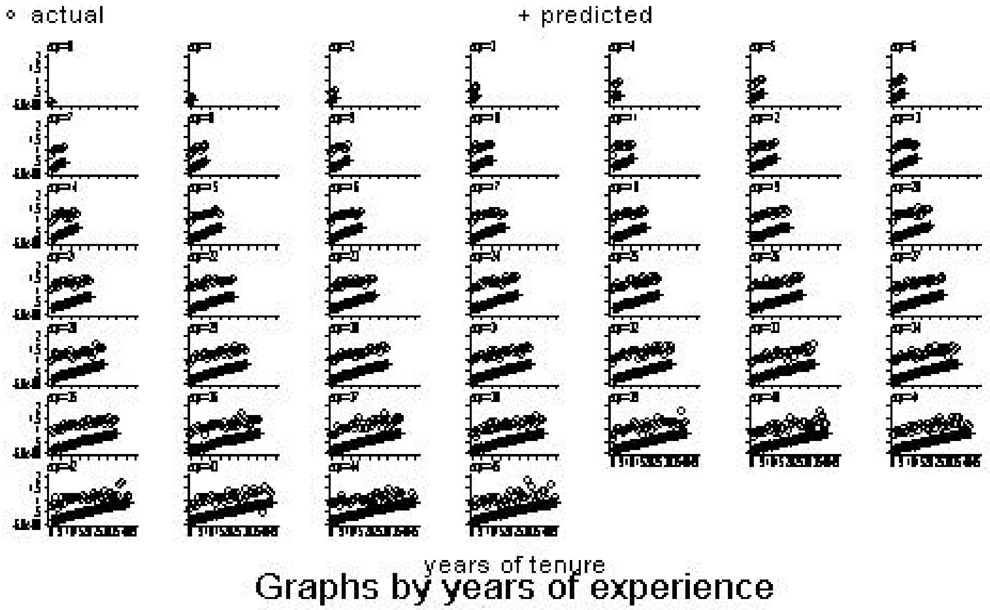


Figure 6b
Actual and Predicted Wage-Tenure Profiles by Experience: Women

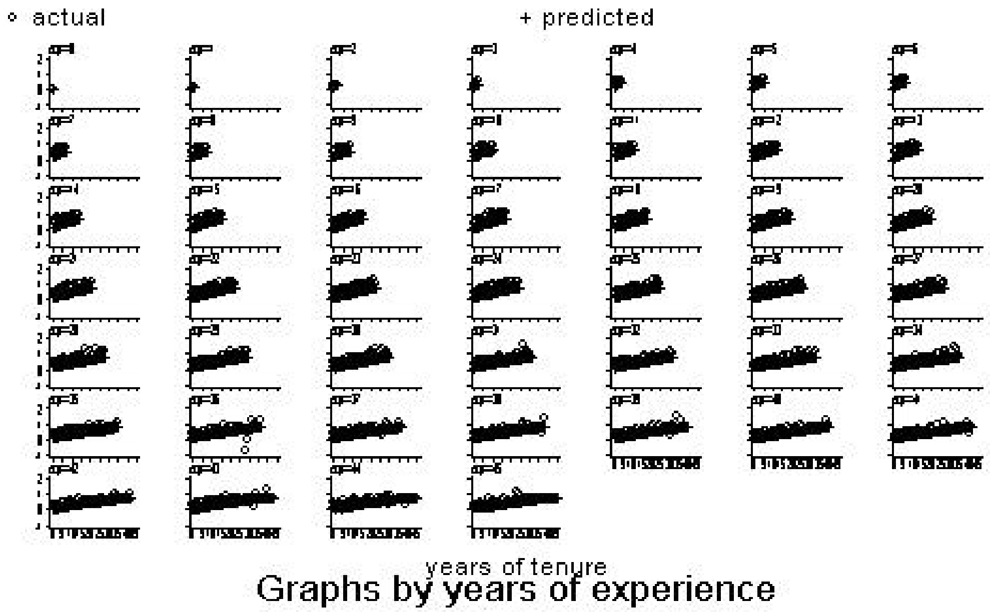


Figure 7a
Actual and Predicted Wage-Tenure Profiles Relative to Zero Tenure: Men

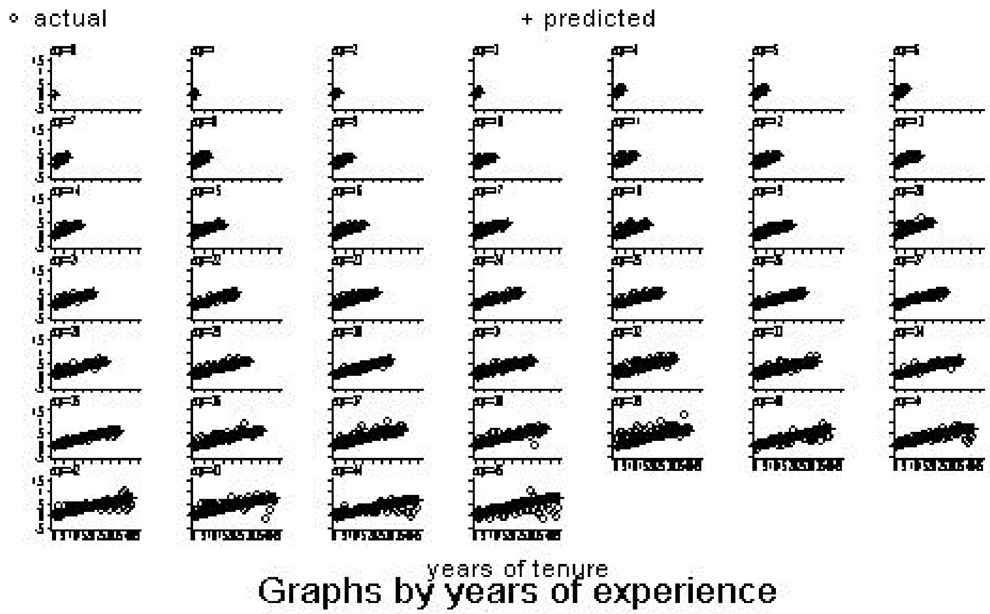


Figure 7b
Actual and Predicted Wage-Tenure Profiles Relative to Zero Tenure: Women

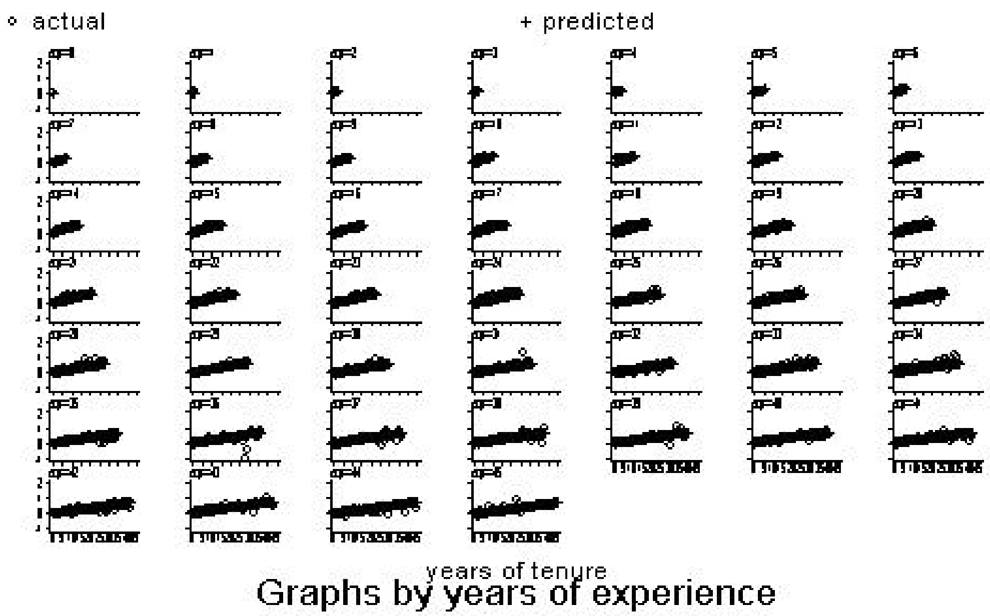


Figure 8a
Actual and Predicted Variance Profiles: Men

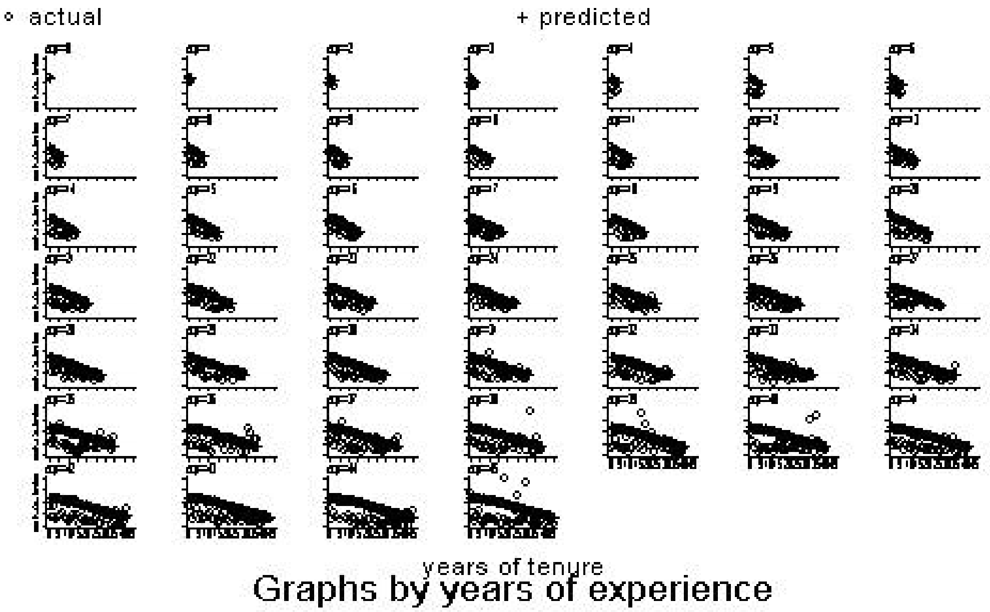


Figure 8b
Actual and Predicted Variance Profiles: Women

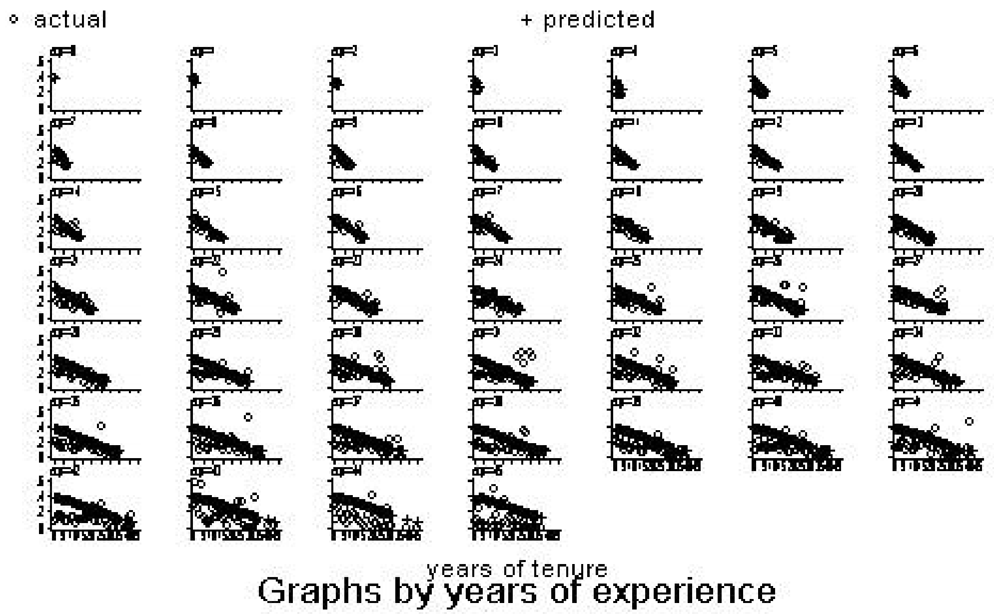


Figure 9a
Predicted and Actual Tenure Distributions: Men

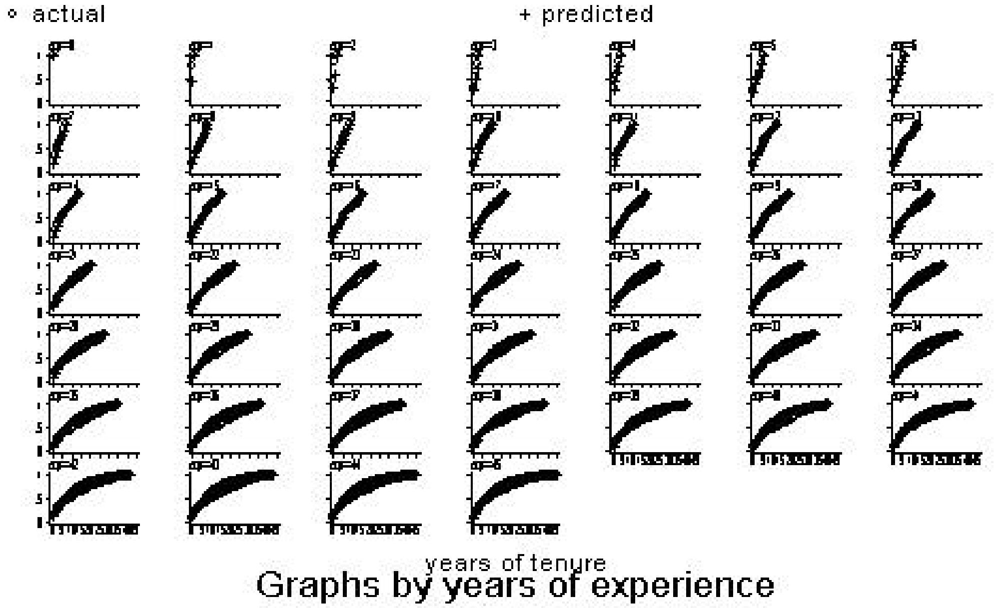


Figure 9b
Predicted and Actual Tenure Distributions: Women

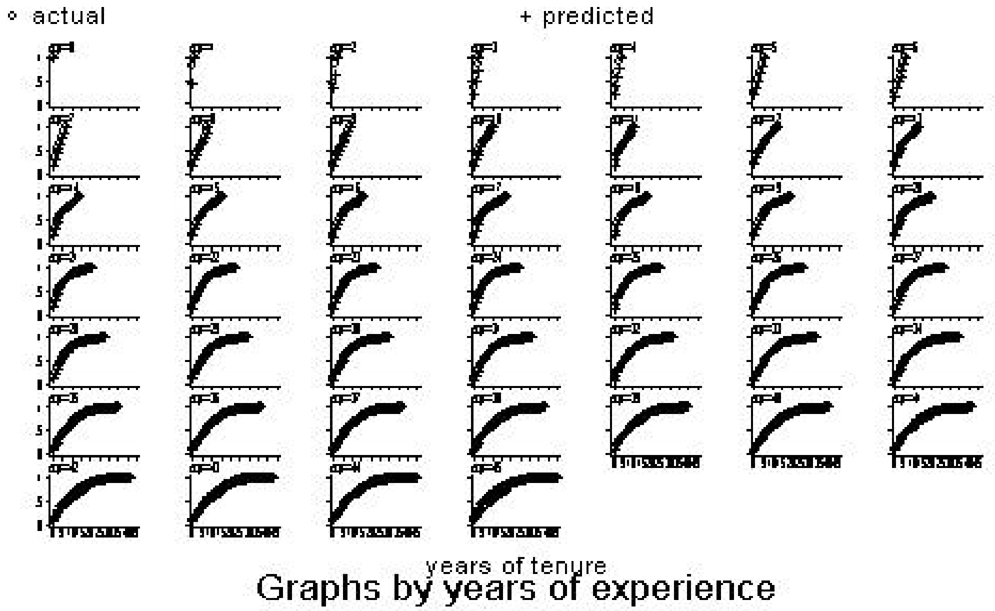


Figure 10a
Predicted and Actual Wage-experience Profiles by Education: Men

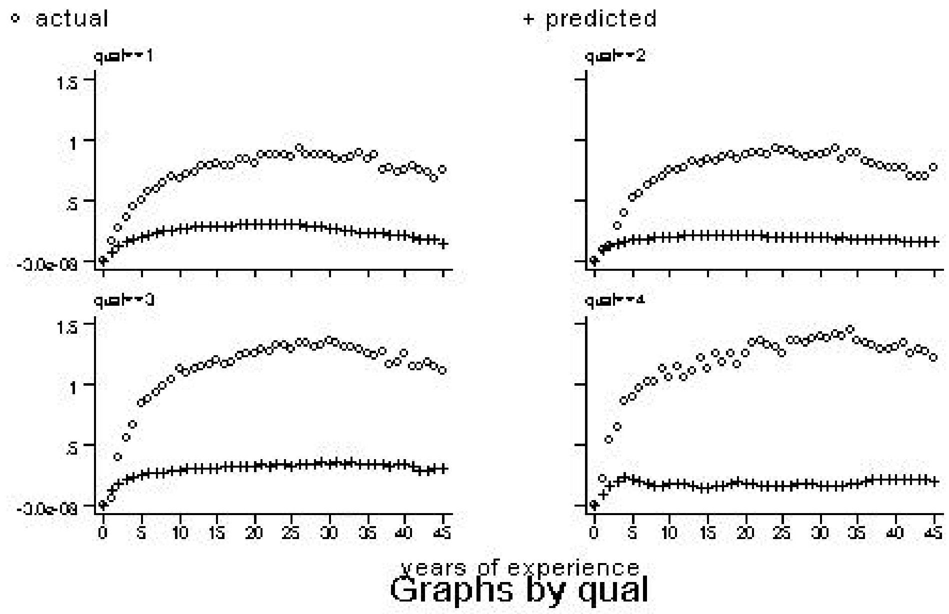
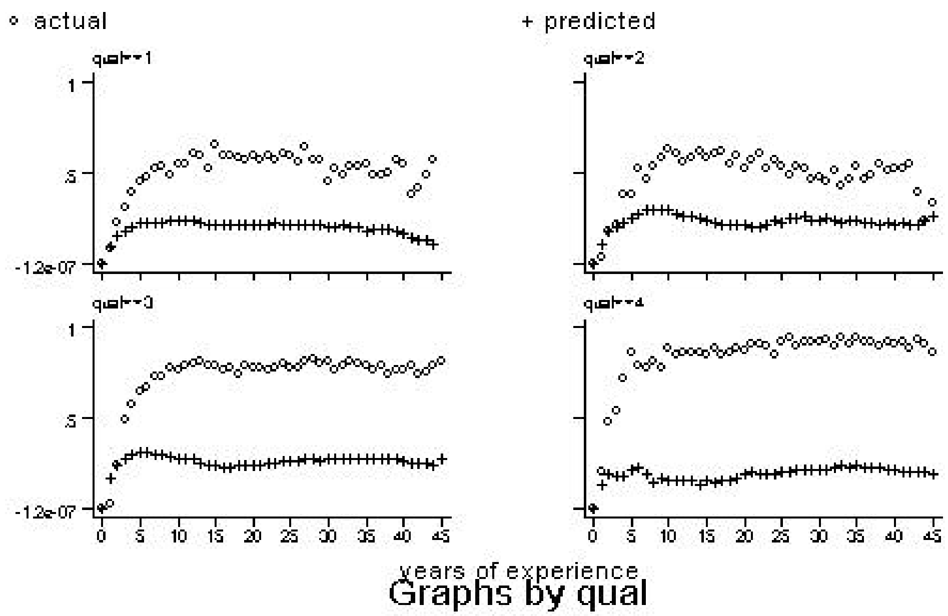


Figure 10b
Predicted and Actual Wage-Experience Profiles by Education: Women



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