Employers' search and the efficiency of matching*

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Abstract

Labour turnover is typically higher for unskilled workers in low productivity jobs. This paper suggests that this empirical finding is due to the matching process being less efficient at the bottom than at the top of the jobs' distribution. A simple theoretical model of employers' search shows that firms find it optimal to invest relatively little in advertisement and screening when recruiting for low productivity jobs. This generates more separations and higher turnover. Unique data from a sample of recruiting establishments in Britain, containing detailed information about employers' recruitment practices, are used to test the implications of the model.

Keywords: Labour turnover, Matching, Recruitment, Hiring.

1 Introduction

High levels of workers' mobility characterise the labour markets of virtually all industrialised economies. Large numbers of workers constantly flow across labour market states. This issue has been the focus of a huge literature that has identified at least two sources of labour mobility. The first is reallocation of workers due to changes in preferences and technology, which make some sectors grow and other shrink (Farber (1999), Jovanovic(1979a)). The second is labour mismatch, that is the search of both workers and employers for the best possible partner in an employment

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relation (Jovanovic 1979a and 1979b, Flinn 1986). Due to information asymmetries, a labour relationship terminates whenever a better partner becomes available for either of the two parties. The existing evidence (Jovanovic et al. 1990) suggests that, of these two sources, mismatch is likely to be the most important factor in explaining these large labour market flows, especially since they mostly occur within rather than across industrial sectors.

Despite this important result, relatively little attention has been paid to the analysis of the enormous efforts both workers and employers put into looking for a good partner. This paper contributes to the literature on labour mobility by developing and empirically testing a simple model that describes how employers choose the level of investment in advertisement and screening activities and how this investment affects the quality of matches.

Understanding the determinants of match quality is important for explaining the overall level of labour turnover as well as differences across jobs and workers. In fact, another well documented, but less analysed, finding is that labour turnover is usually higher in lower occupations compared to more productive jobs. For example, table 1 shows the fraction of employed workers who experienced a job change (i.e. moved to a different job or to unemployment or to inactivity) between two adjacent quarters in the United Kingdom for the years 1992 and 2003 by occupation in the starting job[1]. As it is evident from the figures in the first two columns, labour turnover is constantly higher at the bottom than at the top of the jobs' distribution. About 8% to 9% of workers in elementary occupations change job or move into non-employment between two adjacent quarters, while this fraction is about 3-4% for managers.

Few explanations have been explicitly put forward for this empirical regularity. A popular one suggests that people try to climb up the jobs' ladder, moving from lower level, lower paying jobs up to better ones. Workers who already hold good jobs tend to move less and this leads to the observed patterns. Alternatively, it has also been argued that young workers, who normally occupy jobs at a lower occupational level, change employment frequently during their first years in the labour market in an attempt to explore their capabilities and to find jobs that meet their tastes (Topel et al. 1992).

However, these explanations don't seem to satisfactorily conform with some additional evidence.

[1] 2003 is the most recent year for which this exercise is possible and 1993 is the closest one to the period covered by the data used in the rest of the paper.

In fact, if workers at the bottom of the occupations' distribution would leave their jobs more often to look for better ones, we should observe more job-to-job than job-to-unemployment transitions at the bottom than at the top. As columns 3 and 4 in table 1 illustrate, this is not at all clear in the data. Although the numbers show some variation across occupations, it is hard to argue that there exists a clear trend towards a lower incidence of job-to-unemployment transitions at the bottom than at the top of the jobs' distribution.

Moreover, the same explanations would also suggest that workers from the lowest occupational groups would move more frequently to another, possibly higher, group. Unfortunately, the data (column 5 and 6) don't show any particular trend in the fraction of job-to-job movers who also change occupational group. This figure ranges between 50% and 80% with unclear patterns across occupations. Oi (1962) and McCall (1990) find similar results for the US during the early 30s and early 80s respectively.

Other explanations can be indirectly extrapolated from the work of the many authors that contributed to the literature on labour turnover. For example, Moscarini (2001) argues that the wedge of productivity over the opportunity cost of labour is larger for skilled than unskilled workers, thus reducing their incentive to change job. Also, the observed negative correlation between tenure and mobility is often explained by match-specific training: with tenure one acquires a knowledge (of the environment, familiarity with co-workers, with the procedures, etc.) which makes that specific match more valuable to both the worker and the firm than the average alternative (Mortensen (1978)). As a consequence, longer tenure is associated with a lower probability of job ending (Farber 1999). This result, together with the suggestion (Parsons (1972)) that the incidence of match-specific training is higher in top, managerial jobs, would be sufficient to generate higher turnover in lower occupations. This idea is also supported by the recent work of Hayes et al. (2004), who look at the implications for labour turnover of the introduction of team-work. When people work in teams, their complementarities make the departure of one team member a plausible reason for the others to leave as well, thus generating higher turnover. Since the practice of team-work appears to be more common in managerial jobs, this would also lead to the observed pattern in turnover across jobs. Furthermore, women are more prone to change labour market status due to family reasons. Hence, female dominated occupations are likely to show higher levels of turnover.

However, figure 1 shows that, even when one controls for all these effects (age, education,

tenure, gender), labour turnover still differs substantially across occupations. The bars in figure 1, in fact, represent the coefficients on the occupational dummies obtained from a probit model for the probability of experiencing a job change between two adjacent quarters in the United Kingdom in 1993 and 2003. The visual inspection of figure 1 already indicates that the probability of a job separation, conditional on individual characteristics, is still higher in lower occupations and the tests reported at the bottom of each panel confirm that the hypothesis of all identical coefficients is rejected.

These results have been presented to show that the existing research on the sources of labour mobility is unable to satisfactorily explain the patterns of turnover across occupations. This paper contributes to the literature in this direction. It takes the suggestion in Jovanovic et al. (1990) that mismatch is likely to be the main cause of labour turnover and shows that the matching process is less efficient for low productivity jobs, which will consequently be more prone to separation (both voluntary and involuntary). The focus of the analysis if primarily on the employers' side of the labour market.

The theoretical section of the paper shows that firms find it optimal to invest relatively little in recruitment and screening activities for low productivity jobs, while they are much more careful in the hiring of top level workers. Hence, matches of unskilled workers in low productivity jobs are more likely to be "bad", in the sense that the same worker (job) can be paired with another job (worker) into a more productive match. This leads to more separations and more job instability for unskilled workers in lower level occupations.

The empirical implementation of the theory is carried out exploiting a unique dataset of recruiting establishments in Britain. Using these data it is possible to construct several measures of recruitment intensity, distinguishing between advertisement and screening activities. Various econometric estimates will then show that employers invest more in both types of recruitment for top level jobs and relatively little at the bottom of the occupations' distribution. Finally, these measures of recruitment intensity will be correlated with various indicators of the quality of the match, such as satisfaction of the employer with the recruit, initial wages and tenure. Results support the motivating idea of this paper: matches created through more intensive screening last longer, pay higher wages and make employers more satisfied with the person taken on.

From the normative viewpoint, this paper documents that the allocation of unskilled workers in

low-productivity jobs might be subject to more serious mismatch than other workers and jobs. As a consequence, these workers are likely to experience greater job and income instability. Although this paper does not attempt to conduct a general equilibrium analysis, policy intervention aimed at improving the quality of matching at the bottom end of the jobs' distribution might lead to overall efficiency and equity gains.

I have already discussed how this paper takes the move from the existing literature on labour turnover. However, it also contributes to another, small but growing, strand of the literature: the analysis of employers' search. The widely accepted search and matching approach to the study of the labour market has fostered an enormous amount of empirical work on the search behaviour of workers. Manly due to the scarcity of data, however, very little is known about the corresponding behaviour of employers. In fact, individual level data on recruitment activities are extremely rare. A few exceptions are Brown et al. (1999) and Manning (2000) on British data, Barron et al. (1987) and Holzer (1994) using US data, van Ours et al. (1991 and 1992) and Gorter et al. (1999 and 2003) using Dutch data. These papers address important issues, like the cyclical behaviour of the vacancy rate, the shape of the hazard of vacancy filling and the optimal recruitment strategies of employers, all issues that can only be explored with detailed data at the vacancy level. This paper is another example of how a better knowledge of the firm's side of the labour market can contribute to our understanding of many phenomena.

The paper is organised as follows: section 2 presents a simple model of optimal employers search, section 3 describes the data which will be used in section 4 to test empirically the implications of the model. Section 5 concludes.

2 Employer's search: a theoretical framework

The model in this section is both a simplification and an extension of the theory in Pellizzari (2004). The starting point is a simple matching model in which firms with unfilled vacancies and workers who need a job (or want to change job) look for each other. The existence of frictions in the labour market prevents them from meeting instantaneously and leads to positive rents associated with formed matches. For simplicity and clarity, the model is partial equilibrium and formalised in discrete time.

The first departure from the standard matching model consists in the introduction of heterogeneity in the market, a crucial ingredient to make recruitment and screening activities play a meaningful role. Jobs differ in the technology employed and, consequently, in the skill requirements. Each job j in the model should be seen as an occupation in its empirical implementation. Vacancies are unfilled jobs. For each vacancy of type j there exists two types of workers, *suitable* and *unsuitable*. This implies that a given worker might be unsuitable for one job but suitable for another. A suitable worker in job j produces a positive amount of output, p_j, while an unsuitable worker is totally unproductive[2]. The type of the match is unknown to both the worker and the firm until production takes place and output can be observed.

In each period, a firm with an unfilled vacancy j meets a jobseeker with probability $q(\theta_j)$, where θ_j represents labour market tightness, i.e. the ratio between vacancies and unemployment, $\theta_j = \frac{v_j}{u_j}$. According to the standard matching literature, $q(\theta_j)$ is assumed to be decreasing in θ_j: $\frac{\partial q(\theta_j)}{\partial \theta_j} < 0$. The subscript j on θ indicates that labour market tightness can vary by occupation with v_j representing vacancies of the same type (occupation) and u_j jobseekers with the skills required by the job.

In order to focus on the choice of recruitment strategy by the employer, the supply side of the market - the search behaviour of workers - and the wage negotiation process are taken as exogenous and modelled as follows: firms offer wages equal to a fraction β of expected productivity in the first period of work. If the worker then turns out to be suitable for the job, wages are updated to the same fraction β of actual productivity p_j, otherwise the match is destroyed (by either of the two parties) and the vacancy re-opened. If the match is continued, a separation will only occur due to exogenous shocks with per-period probability λ. For tractability, the parameters β and λ are assumed to be constant across jobs.

There exist two types of recruitment activities. Extensive recruitment (E_j) concerns all the actions taken by the employer to improve the probability of meeting a candidate (or to increase the number of applications received). These activities include mostly advertisement but also asking employees, holding career events at colleges and professional schools, use of public or private employment agencies, etc. Formally, extensive recruitment requires a linear cost cE_j and improves

[2]This extreme assumption is not crucial for the results of the model. Alternatively, one could make the assumption that unsuitable workers produce only a fraction $y \in [0, 1]$ of p.

the probability of meeting a job candidate. Hence, we need to rewrite $q(\theta_j)$ as $q(E_j|\theta_j)$, where E_j is a control variable for the firm and θ_j is an exogenous parameter. For an internal solution, we also need to assume $\frac{\partial q(E_j|\theta_j)}{\partial E_j} > 0$ and $\frac{\partial q(E_j|\theta_j)}{\partial E_j \partial E_j} < 0$. Extensive recruitment and labour market tightness can be either substitutes ($\frac{\partial q(E_j|\theta_j)}{\partial E_j \partial \theta_j} > 0$) or complements ($\frac{\partial q(E_j|\theta_j)}{\partial E_j \partial \theta_j} < 0$). This is left as an empirical issue.

Intensive recruitment (I_j) has to do with all the actions taken by the employer to improve her knowledge about the worker's unobservable type. These actions include interviewing and screening candidates and take place once contact has been established and before deciding whether to hire or reject a candidate. Formally, intensive recruitment is modelled as follows: upon meeting a candidate the employer receives a signal about the type of the worker. The signal can take two values, *"suitable"* or *"unsuitable"*, and it is correct with probability $\zeta(I_j)$. In other words, if the signal is *"suitable"* the candidate is suitable with probability $\zeta(I_j)$ and unsuitable with probability $1 - \zeta(I_j)$. Similarly if the signal is *"unsuitable"*. The function $\zeta(I_j)$ needs to be increasing and concave in I_j: $\frac{\partial \zeta(I_j)}{\partial I_j} > 0$ and $\frac{\partial \zeta(I_j)}{\partial I_j \partial I_j} < 0$. Moreover, when $I_j = 0$ the signal is totally uninformative and $\zeta(0) = 1/2$. For simplicity, let us assume that the cost functions of E and I are identical - i.e. they are both linear with marginal cost c - however the cost of I is only paid if a candidate is actually met in a given period while E has to be financed ex-ante.

Let us also assume that, for any vacancy j, there exists an exogenous fraction π_j of suitable jobseekers in the economy. Under these assumptions, only two hiring strategies are possible: hiring when the signal is *"suitable"* and rejecting otherwise or hiring anyone regardless of the signal received. The latter strategy obviously leads to a corner solution with $I_j = 0$ and becomes optimal only in uninteresting cases, such as when $\pi_j = 1$: when all candidates are equally good for the job investing in screening is useless and employers simply hire the first available candidate. In all other cases, employers find it optimal to hire only candidates who are signalled to be *"suitable"* for the job. We will then focus on this hiring strategy only, even if this restricts the range of parameter values within which the following analysis is valid.

Given the above assumptions, the value of an unfilled vacancy of type j for a representative firm can be written as follows:

$$V_j = -cE_j + \frac{q(E_j|\theta_j)}{1+r}\left[-cI_j + \pi_j\zeta(I_j)J(p_j) + (1-\pi_j)(1-\zeta(I_j))J(0) + (1-\pi_j)\zeta(I_j)V_j + \right.$$
$$\left. + \pi_j(1-\zeta(I_j))V_j\right] + \frac{1-q(E_j|\theta_j)}{1+r}V_j \quad (1)$$

where $J(p_j)$ and $J(0)$ are the value of a vacancy j filled with a suitable (who produces p_j) and an unsuitable (who produces 0) candidate and can be written as:

$$J(p_j) = p_j - w_j^e + \frac{1}{1+r}J_j \quad (2)$$

$$J(0) = -w_j^e + \frac{1}{1+r}V_j \quad (3)$$

where w_j^e is the initial wage, paid as a fraction of expected productivity given that the signal is *"suitable"*[3]*:*

$$w_j^e = \frac{\pi_j\zeta(I_j)}{\pi_j\zeta(I_j) + (1-\pi_j)(1-\zeta(I_j))}\beta p_j \quad (4)$$

and J_j is the continuation value of a job j filled with a suitable candidate:

$$(\frac{r+\lambda}{1+r})J_j = (1-\beta)p_j + \lambda V_j \quad (5)$$

Substituting (5) and (4) into (2) and (3) and then everything into (1), one obtains:

$$V_j\left[r + q(E_j|\theta_j) - \frac{\pi_j\lambda}{\lambda+r}\frac{q(E_j|\theta_j)}{1+r}\zeta(I_j) - q(E_j|\theta_j)(1-\pi_j)\frac{1+r\zeta(I_j)}{1+r} - \pi_j q(E_j|\theta_j)(1-\zeta(I_j))\right] =$$
$$= -c(1+r)E_j - cq(E_j|\theta_j)I_j + \pi_j\frac{1+r+\lambda}{r+\lambda}q(E_j|\theta_j)\zeta(I_j)(1-\beta)p_j \quad (6)$$

The optimal choice of E_j and I_j by the firm is described by the first order conditions of equation (6) with respect to these two control variables. The algebra is greatly simplified by imposing the usual free-entry equilibrium condition $V_j = 0$:

$$\pi_j\frac{1+r+\lambda}{r+\lambda}q'(E_j|\theta_j)\zeta(I_j)(1-\beta)p_j = c\left[1 + r + q'(E_j|\theta_j)I_j\right] \quad (7)$$

$$\pi_j\frac{1+r+\lambda}{r+\lambda}\zeta'(I_j)(1-\beta)p_j = c \quad (8)$$

[3]Only in this case the match would be actually formed.

where $q'_E(E_j|\theta_j) = \frac{\partial q(E_j|\theta_j)}{\partial E_j}$ and $\zeta'(I_j) = \frac{\partial \zeta(I_j)}{\partial I_j}$. Combining equation (7) and (8) yields:

$$q'(E_j|\theta_j)\frac{I_j}{1+r} = \frac{\eta_\zeta(I_j)}{1-\eta_\zeta(I_j)} \tag{9}$$

where $\eta_\zeta(I_j)$ is the elasticity of the precision of the signal $\zeta(I_j)$: $\eta_\zeta(I_j) = \frac{\partial \zeta(I_j)}{\partial I_j}\frac{I_j}{\zeta(I_j)}$.

Let us now describe intuitively the comparative statics effects of the parameters of the model. The appendix contains the formal derivation of these effects.

Equation (9) contains the first important result of the model. It shows that there is a positive (non negative) correlation between E_j and I_j. In other words, employers invest more in extensive recruitment when they also invest more in intensive screening. The intuition for this result is rather simple: as intensive recruitment increases the probability of eventually hiring a suitable candidate also increases, thus improving the marginal benefit of extensive recruitment.

From equation (9) it is also immediate to show that the effect of labour market tightness on E_j depends on whether E_j and θ_j are substitutes or complements in the matching process. If they are substitutes ($\frac{\partial q(E_j|\theta_j)}{\partial E_j \partial \theta_j} > 0$), an increase in θ_j leads to a lower probability of meeting a candidate and induces lower effort in E_j. The opposite happens if $\frac{\partial q(E_j|\theta_j)}{\partial E_j \partial \theta_j} < 0$. To anticipate here the empirical results of the next section, the evidence suggests that E_j and θ_j are substitutes.

Note incidentally, that investment in intensive recruitment, being incurred on only if a candidate is actually met, is not influenced by labour market conditions. This is evident from equation (8).

Inspection of equation (8) allows to derive the effects of two other interesting parameters: productivity, p_j, and the proportion of suitable workers, π_j. They are both positively correlated with I_j. Intuitively, the effect of productivity is relatively simple: employers invest more in screening when recruiting for highly productive jobs. In this case, in fact, failing to hire the right worker is very costly: not only does it require paying a high wage without getting any output in return, but it also means re-opening the vacancy later on with high losses in terms of forgone output. As for the fraction of suitable workers, an increase in this parameter also increases the marginal benefit of intensive recruitment and therefore leads to more expenditure in screening activities. Note, however, that this argument holds only for values of π_j that are consistent with the optimal hiring strategy assumed so far, i.e. hiring when the signal is good and rejecting otherwise.

So far we have discussed the implications of the model regarding the determinants of extensive and intensive recruitment and their correlation, however, it also allows to draw empirically testable implications on various measures of match quality as well. For example, equation (4) shows that more intensive recruitment and a higher fraction of suitable workers both have a positive impact on initial wages, w_j^e. More interesting for the initial motivation of this paper is the effect on the separation rate. The model contains two separation processes, one endogenous and one exogenous. The latter one (exogenous) hits "good" matches (i.e. jobs filled with suitable workers) with exogenous probability λ every period and it is unaffected by the endogenous variables of the model. This process can be seen as the effect of exogenous changes in consumers' preferences and firms' technologies. The endogenous separation process refers to "bad" matches (jobs filled with unsuitable candidates) being immediately destroyed as soon as production is observed. The probability that a newly created match is endogenously destroyed corresponds to the probability of its being a "bad" match:

$$\Pr\{\text{endogenous separation of job } j\} = \frac{(1-\pi_j)(1-\zeta(I_j))}{\pi_j\zeta(I_j) + (1-\pi_j)(1-\zeta(I_j))} \tag{10}$$

Empirically, equation (10) suggests that the probability of a separation occurring close to the engagement decreases with intensive screening.

Extensive recruitment, on the other hand, has a direct effect on $q(E_j|\theta_j)$, the probability of meeting a candidate and therefore on vacancy duration.

To summarise, the model delivers three sets of empirical implications. First, it predicts that extensive and intensive recruitment are positively correlated. Second, it allows to identify the determinants of intensive recruitment effort (implication (8)), which should be positively correlated with productivity, the availability of good candidates and should be unaffected by labour market tightness. Third, it indicates that recruitment effort, in the form of both extensive and intensive recruitment, is correlated with various outcome measures. In particular, extensive recruitment positively affects the meeting probability and, consequently, vacancy duration. Intensive recruitment directly affects initial wages and the overall quality of the match, reducing the probability of a separation (equation (10)).

In the remaining of the paper, after describing the data in the next section, these implications will be tested empirically.

3 The data: the 1992 Survey of Employers' Recruitment Practices (SERP)

The data used for the empirical implementation of the model come from an original survey conducted in the United Kingdom in 1992, the Survey of Employers' Recruitment Practices (SERP). This study was carried out by the British Social and Community Planning Research (SCPR) on behalf of the Employment Service. It was mainly aimed at investigating the use of public employment services by private employers compared to alternative recruitment methods[4].

To this end, one would ideally like to have information about a representative sample of engagements occurred in a determined time window. However, since the total population of all engagements is not easily recorded anywhere, it is rather difficult to extract such a sample. The approach taken by researchers at SCPR consisted in drawing a sample of 10,000 establishments from the 1989 Census of Employment, where an establishment is defined as *"the activities of a single employer at a single set of premises"*. The 1989 Census covered all existing establishments with 25 or more employees and was supplemented by a random sample of smaller establishments.

The subsample of 10,000 establishments extracted from the Census was designed to contain enough observations to conduct statistical analyses by region and establishment size. A purely random sample would have led to too many establishments located in London and the South East and too few establishments of small size (below 20-25 employees). For this reason, small firms and firms outside London and the South East were oversampled. Moreover, since the purpose of the study was the analysis of recruitment practices, which are usually similar across establishments belonging to the same organisation, another sampling adjustment was made in order to limit the number of units belonging to the same large firm (e.g. large food stores, etc.).

These 10,000 establishments were first contacted in Autumn 1991 via a brief preliminary telephone interview to collect the information necessary to categorize them along two dimensions: *in-scope* versus *out-of-scope* and *recruiting* versus *non-recruiting* establishments. Out-of-scope establishments were firms that had closed down or moved between the census in 1989 and the date of the telephone interview. They were excluded from the study. Recruiting establishments were defined as establishments that either had recruited one or more employees in the previous 12 months

[4] An earlier survey was conducted in 1978 but the study as not been replicated after 1992.

or had unfilled vacancies at the time of the interview. A recruit or engagement was defined as *"recruiting an employee, where a new contract of employment is involved"*.

All in-scope recruiting establishments were then contacted for a longer face-to-face interview, which formed the main source of information for the final survey. For budgetary reasons, only about half of the non-recruiting firms were contacted for a second short telephone interview. Eventually, the final survey contains information about 5,635 recruiting and 614 non-recruiting establishments. The interviews took place between May and November 1992. Within each establishment, the respondents were selected to be the main person responsible for the recruitment process. They were either personnel specialists (16%), general managers (27%), branch-depot managers (20%) or professional staff (9%).

Only the sample of recruiting establishments is needed for the purpose of this paper. Few observations have been dropped due to missing or incorrect values, leading to 5,343 valid establishments, which, corrected for the weights provided by the SCPR to recover the representativeness for the entire population, represent 6083 firms. The questions regarding the establishments were grouped into 3 sections of the questionnaire. The first one contains general enquires about the type of firm and activity as well as questions about the role of the respondent. The second section asks about the characteristics of the workforce, including information about current vacancies and recruits that were taken on in the previous 12 months. The third section includes detailed questions about the recruitment practices usually adopted by the firm. The descriptive statistics for the sample of establishments are reported in table 2.

A sample of engagements was then constructed from the 5,635 recruiting establishments according to the following rules. The total number of engagements that took place in the 12 months prior to the interview was recorded and divided into the 9 major groups of the Standard Occupational Classification (SOC). If there had been engagements in more than 5 occupational groups, the most recent one in each of the 5 groups in which the largest number of engagements had been made were selected. Otherwise, if recruitment only occurred in fewer than 5 occupational groups but in total more then 5 new recruits were taken on, the most recent in each group was selected, then, the second most recent starting with the most numerous group and so on until 5 engagements were selected. Finally, if fewer than 5 engagements were made in the previous 12 months, all of them were selected, regardless of the occupational group. This led to a sample of 22,707 engagements.

A set of detailed questions for each of the selected engagements was asked, including the characteristics of the job that was offered, those of the successful applicant, accurate information about the duration of the vacancy, the recruitment methods activated and their sequence, whether the recruit was still employed at the firm and how satisfied the employer was with him/her. However, in order to limit the lenght of the interview and not to discourage employers' participation in the survey, not all questions were asked for all engagements. The most completed set of information was collected for the most recent engagement in each establishment.

For this paper some observations had to be dropped from the original sample due to missing or incorrect values, resulting in a valid sample of 14,609 engagements, which, rescaled using the weights provided by SCPR to recover the representativeness of all engagements, represent 10,980 new employment contracts. The descriptive statistics for the sample of engagements used in this paper are reported in table 3.

4 Testing the empirical implications of the model

Before moving on to the empirical test of the model, it is worth checking the level of labour turnover by occupation in our sample. Respondents to the SERP report the composition of employment at their establishment by occupation, also indicating the fraction of employees in each group that have been continuously employed at the firm for more than 12 months. The responses are coded in intervals and are shown in table 4. The last line of the table gives an overall estimate of labour turnover by taking the mid point in each interval. These numbers are also plotted in figure 2.

Results from table 4 and figure 2 broadly confirm the discussion over table 1: there seems to be a general trend towards more unstable employment relationships in lower occupations. Apart from managers, craft/skilled service workers and operatives/assembly workers, higher occupations typically display a higher incidence of long-lasting employment contracts.

Once confirmed that data from the SERP support the basic empirical fact that motivates this paper, we can move on to the test of the various empirical implications of the theory presented in section 2. For clarity, let us classify these implications into three groups. First, the relationship between extensive and intensive recruitment: equation (9) shows that extensive recruitment is fully determined by labour market tightness and intensive recruitment. Employers search more when

they also screen more, while the effect of labour market tightness depends on whether E_j and θ_j are complements or substitutes in the matching process, an issue that was left as an empirical question. The second set of implications concerns the determinants of intensive recruitment effort (equations (8)): employers invest more in intensive screening when recruiting for highly productive jobs, i.e. when p_j is higher. Finally, the third set of implications addresses the initial question of the paper and relates the quality of the match to the effort exerted in recruiting: the probability of a separation soon after hiring is lower when intensive screening is stronger (equation (10)) and vacancy duration is shorter when extensive recruitment is stronger. Given the difficulty in observing π_j, the composition of workers' types in the economy, this parameter is assumed to be constant within regions. Regional dummies will be introduced in the estimation to control for different levels of π_j, as well as for other region specific factors.

Before testing these implications, it is crucial to find empirically measurable indicators of extensive and intensive recruitment. Respondents to the SERP survey are shown a list of 17 possible recruitment channels and they are asked to indicate how many of them were activated for each specific engagement, which channel was the first one used and which of them led to contact with the successful applicant. Using this wealth of information two measures for E_j and three for I_j are constructed. The distributions of these measures are shown in figures 3 and 4 respectively. Below is a description of how they are constructed.

The first indicator of extensive recruitment is the number of search channels activated for a single vacancy (figure 3, upper panel). For intensive recruitment we use the length of the screening process, measured as the number of days between contact with the successful applicant is first made and his/her first day of work (figure 4, upper panel). This measure, however, could be affected by a number of factors, others than mere screening time, like the need for the selected applicant to give notice to a previous employer or to complete an educational course. In order to avoid these problems, when the length of the screening process is used as a measure of intensive recruitment, additional controls will be introduced for the employment status of the successful applicant (employed, unemployed, in full-time education) and the situation of the vacancy (whether the previous person was still working in the post, whether it was a new position, etc.) at the time of recruitment.

A second measure of intensive recruitment can be constructed as the number of screening proce-

dures normally applied. However, this measure is only available at the establishment level (i.e. it is identical for all engagements taking place at the same establishment). The establishment section of the questionnaire, in fact, contains questions about how recruitment normally takes place. In this occasion, the respondents indicate whether formal screening procedures are used and, if the answer is positive, what they cover from the following list: definition of job requirements, requirement to use particular recruitment channels, use of application forms, short-listing procedures, interview procedures, selection procedures (tests, medical checks, etc.), other procedures. The number of these procedures normally used at each establishment is used as a second measure of intensive recruitment (figure 4, middle panel).

Additional indicators of both E and I can be constructed using a set of questions regarding the importance of various factors in the choice of the recruitment methods used. These questions are asked only for one engagement in each establishment, however the available answers will be used to compute a "grade" for each method and then associate it to each engagement according to either the first or the successful method used for that hiring. In this way, the measures described below are available for all engagement in the sample.

For extensive recruitment, the following question gives an indication of the cost effectiveness of the channels activated for a particular vacancy: *"...how important a factor in your use of the recruitment method(s) was keeping down the cost of announcing/advertising the vacancy?"*. The answers are ordered on a scale from 1 (not at all important) to 7 (very important). Each method can then be ranked by its advertisement cost effectiveness measured as the average answer to this question given by respondents who activated it first. Formally, the measure of extensive recruitment as cost effectiveness (E_j^c) for engagement j in which method m was the first channel to be activated, can be defined as follows:

$$E_j^c = \frac{\sum_{f \in F_m} (\textit{cost effectiveness})_f \cdot w_f}{|F_m|}$$

where F_m is the set of all hirings where method m was activated first and where a valid answer to the cost effectiveness question is available. $(\textit{cost effectiveness})_f$ is the importance of "*keeping down the cost of announcing/advertising the vacancy*" (on a scale 1 to 7) in engagement f. $|F_m|$ is the size of F_m. w_f is the sample weight of engagement f. The higher E_j^c, the lower investment in extensive recruitment.

This is our second measure of extensive recruitment and its distribution by method is described in the lower panel of figure 3. Not surprisingly, posting notices on the streets, using Jobcentre (i.e. the British public employment service), receiving a direct application from the candidate and re-employing a former employee are among the cheapest recruitment channels, while the most expensive methods are fee-charging agencies, keeping on a participant to a youth/employment training programme and approaching a candidate directly. However, some results are surprising. For example, advertising on local free sheets and recommendation are not chosen particularly for their low cost. This result is due to the fact that often these methods are used in combination with others and respondents give an evaluation of the overall combination of channels used.

A similar indicator is constructed for intensive screening using the following question: *"...how important a factor in your use of the recruitment method(s) was attracting only the most suitable candidates?"*. In this case, however, the ranking is made using the successful method instead of the first one used. Formally and analogously to E_j^c, a measure of intensive recruitment as accuracy in attracting good candidates (I_j^a) in engagement j, where contact with the successful applicant was obtained through method m, can be defined as follows:

$$I_j^a = \frac{\sum_{s \in S_m} (accuracy)_s \cdot w_s}{|S_m|}$$

where S_m is the set of all hirings where method m led to contact with the successful applicant and where a valid answer to the accuracy question is available. $(accuracy)_s$ is the importance of *"attracting only the most suitable candidates"* (on a scale 1 to 7) in engagement s. $|S_m|$ is the size of S_m. w_s is the sample weight of engagement s. The higher I_j^a the higher investment in intensive recruitment.

This is our third measure of intensive recruitment and its distribution by method is described in the lower panel of figure 4. Advertising on specialised trade press, fee-charging agencies, approaching a candidate directly and reemploying a previous employee are among the most "accurate" recruitment methods, while advertising on local free sheets, posting notices on the streets and using the Jobcentres rank very poorly.

To summarise and fix ideas, for each engagement there will be two measures of extensive recruitment - the number of channels activated and the "cost effectiveness" of the first method used.

Both these measures are available for all engagements. Intensive recruitment will be measured by three indicators - the length of the screening process, the number of formal screening procedures normally applied at the establishment and the accuracy of the method that led to contact with the successful applicant. The first indicator is only available for the most recent engagement in each establishment, the second one is available for all engagements but it only varies at the establishment level, the third is available for all engagements and varies both by establishment and by engagement within the same establishment.

Test 1: the correlation between extensive and intensive recruitment The empirical counterpart of equation (9) is a regression of extensive recruitment on intensive screening, controlling for labour market tightness. In table 5 this correlation is tested using our two measures of E and three measures of I.

The first four columns of table 5 use the number of activated channels as a measure of extensive recruitment. The estimates are obtained from an ordered probit regression, alternating the three measures of intensive recruitment as explanatory variables. Labour market tightness is measured, here as well as in all the other regressions reported below, as the ratio between the number of unfilled vacancies and the number of unemployment benefit claimants in the region where the establishment is located and in the month during which the engagement took place. Additionally, regional dummies are also introduced to control for variation in the availability of qualified applicants in the area (π_j).

The estimates of columns 1 and 2 confirm the prediction of equation (9): employers use more methods to advertise a vacancy when they also take more time to screen applicants and when they use more formal screening procedures. However, in contrast with the predictions, results in column 3 show that the number of activated channels is negatively correlated with the accuracy of the successful method. This contradicting result is robust to the introduction of establishments' fixed-effects. Remember that these could not be introduced in column 1 and 2 because the length of the screening process is only available for one observation in each establishment while the number of screening procedures is constant within establishments. However, our indicator of "accuracy" of recruitment does vary by both establishment and engagement, hence its effect on extensive recruitment can be identified even with the introduction of establishment's fixed-effects. Nevertheless,

ordered probit models do not easily allow to control for unobserved fixed-effects, thus, in order to facilitate the estimation, the results in column 4 of table 5 are obtained with a simple linear regression with fixed-effects.

The last 4 columns of table 5 repeat the same estimation using our measure of "cost effectiveness" as a dependent variable. Remember that now higher investment in extensive recruitment is associated with a lower value of the dependent variable. Moreover, given the nature of the dependent variable, the estimation can now be carried out with a simple linear model. In this case, results confirm the predicted positive correlation between E and I when the length of the screening process and the accuracy of recruitment are used as measures of I. Opposite results emerge using the number of formal screening procedures.

The theory of section 2 leaves the effect of labour market tightness as an empirical issue as it all depends on the complementarity or substitutability of E and θ in the matching process. Ideally, one would like to use a measure of θ that varies by region, occupational groups as well as over time. Unfortunately, reliable data on vacancies and unemployment during the years covered by the SERP exist only by region and month. A change in the occupational classification that occurred in the middle of 1992 makes it difficult to reconstruct data on vacancies by occupation for this period. This implies that our measure of θ only varies by region and month. Moreover, due to the presence of regional dummies in all the equations, the effect of θ is eventually identified only by the time-variation across months. Given the short time span of our analysis, this variation is often limited and the effect of labour market tightness is rarely significant. However, the coefficient on θ is significant in 3 out of the 4 last columns of table 5, where extensive recruitment is measured as cost effectiveness, and the point estimate is consistently positive. This implies that in tighter labour markets employers spend less on announcing and advertising their vacancies, suggesting that E and θ might be complements in the matching process[5].

Overall, most of the results in table 5 seem to support the predicted positive correlation between extensive and intensive recruitment, however, the difficulties in measuring these two variables lead to contrasting conclusions for some indicators.

[5] This result is consistent with the *"discouraged job"* effect, described in Pissarides (2000) and confirmed empirically in Pellizzari (2004).

Test 2: the determinants of intensive recruitment Equation (8) describes the determinants of investment in intensive recruitment, in particular it predicts that I should be positively correlated with productivity (p). This implication is tested in table 6, where our three measures of intensive recruitment are regressed on regional labour market tightness and a set of indicators of the productivity of the match, such as the occupational group, the type of contract and whether the job requires supervising other workers. A set of additional controls is also introduced in the regressions including regional dummies and all observable characteristics of the establishment and of the successful applicant. The estimation method is linear in all columns but column 2, where the dependent variable is the number of formal screening procedures applied at the establishment and an ordered probit is used. Moreover, in this case the dependent variable only varies across firms and the estimation is performed on the sample of establishments rather than engagements. Here the occupational dummies are replaced by the fraction of employees in each occupational groups over total employment at the firm.

In the last two columns the "accuracy" of recruitment is used as a measure of I and, as already noted above, this allows to introduce establishment's fixed-effects in the estimation. Hence, column 3 reports results without fixed-effects (but with standard errors corrected to account for correlation between observations within the same establishment) while these are included in column 4.

Results strongly confirm the implication that intensive recruitment effort is stronger when employers are filling high-productivity jobs. This is clearly indicated by the coefficients on the occupational dummies, which grow in size and significance moving from low to high occupations. These coefficients are also shown in figure 5, where they visually confirm the presence of a statistically significant trend towards more intensive recruitment in top occupations. Additionally, jobs that require supervising co-workers are typically associated with higher recruitment effort while the effect of non-permanent contracts is more ambiguous.

Finally, results seem to confirm the prediction that labour market tightness does not affect investment in intensive recruitment. Only in one of the columns of table 6 its coefficient is marginally significant and the signs of the various point estimates differ. However and as already noted above, we cannot rule out the possibility that this result is merely due to the limited time-variation in our measure of θ. It also interesting to note the effect of the establishment's size: larger firms tend to exert more recruitment effort.

Test 3: recruitment effort and the quality of matches The final set of empirical implications relates recruitment effort to various outcomes. Let us start with the effects of extensive recruitment. In the model E is assumed to be positively correlated with the meeting probability. Empirically, this implies that when more recruitment channels are activated for the same vacancy, more applications are received and vacancy duration is shorter.

Unfortunately, data from the SERP only allow to test the effect on the number of applications received. In fact, although data about vacancy duration are available, they are collected in such a way that the resulting sample is inevitably biased towards short durations. The SERP is a sample of engagements, i.e. of all completed durations. A random sample of vacancy durations would ideally include all vacancies posted on a given date and would follow them over time. Suppose that from this ideal sample we keep only vacancies that have been filled by a later date. The resulting sample would necessarily over-represent short durations. This is precisely the problem with the SERP: there certainly are vacancies that were posted together with those present in our data and which were still open at the time of the survey. This problem is similar in nature, but of opposite direction, to the more common *"stock sampling"*, which leads to oversampling of long durations instead. As a consequence, any estimation of vacancy duration made using the SERP data is doomed to be incorrect. For this reason, the estimations in table 7 only look at the correlation between extensive recruitment and the number of applications received[6].

To account for the discrete nature of the dependent variable, these equations are estimated using a Poisson regression. The set of explanatory variables alternates our measures of extensive recruitment and always includes additional controls: all observable characteristics of the vacancy and of the establishment, occupational and regional dummies. Unfortunately, information about the number of applications received is only available for the most recent engagement and only for those cases when contact with the successful applicant is made through a formal method (i.e. newspaper advertisement, internal and/or external notices, agencies). This reduces the sample to 1863 unweighted engagements and makes it impossible to control for unobservable fixed-effects at the firm level.

[6] The number of applications per vacancy in this dataset is much higher than similar statistics from other studies (Brown et al. (1999), Holzer et al. (1991), Manning (2000 and 2003), van Ours et al. (1992)). This is probably due to the overrepresentation of large establishments in the SERP which often have multiple vacancy openings.

In the first 2 columns of table 7 extensive recruitment is measured with the number of activated recruitment channels and it is introduced linearly in column 1 and with a separate dummy for each cumulative number of activated methods in column 2. In both cases the results are uncontroversial: activating more recruitment channels leads to more applications being received for the same vacancy. The dummies in column 2, however, indicate the presence of some non-linearities: using more than 4 methods does not increase the application rate any more.

In the third column, the number of activated methods is replaced by our indicator of cost effectiveness as a measure of extensive recruitment. The estimated coefficient is not significant but the point estimate confirms the previous results: when using cheaper recruitment channels, employers receive less applications.

Finally, it is interesting to note two more results from table 7. First, large firms systematically receive more applications. This is consistent with findings from various previous papers (Holzer at al. (1991)). Second, vacancies for supervisory jobs and jobs in the top occupational groups receive significantly less applications. This is consistent with the theory in Moscarini (2001) where it is argued that *"...workers with specialized skills search selectively and contact few vacancies where they have very high chances of beating competing applicants. The other workers search more randomly and apply to any vacancy they hear of..."* (pag. 594).

Let us now move on to the empirical analysis of the effects of intensive recruitment. The results, reported in table 8, strongly support the motivating idea of this paper: more intensive recruitment effort leads to matches of higher quality. The estimations reported in table 8 apply our three measures of intensive recruitment to three measures of match quality: satisfaction of the employer with the recruit, the initial wage and tenure.

In the SERP employers are asked whether they are satisfied with the person hired. This information is available for all engagements, even for those that are already terminated at the time of the interview. However, in several cases (12%) the respondent could not answer the question because the recruit had been at the firm for a too short period. These observations have been dropped from the sample. The first three columns of table 8 explore the correlation between intensive recruitment and satisfaction of the employer with the recruit. This is done by estimating a logit model for the probability of being "very satisfied" on intensive recruitment, controlling for all other observables characteristics of the vacancy and of the recruit. When possible, unobservable firm fixed-effect are

also included[7]. The estimates indicate that two measures of intensive recruitment - the number of formal screening procedures and the "accuracy" of the recruitment method - are strongly and positively correlated with employer's satisfaction. This result is consistent to the introduction of firm fixed-effects in column 3, where the accuracy of the successful recruitment method is used as a measure of I. The length of the screening process, used in column 1, appears to have no effect on satisfaction.

In the following three columns of table 8 - columns 4, 5 and 6 - the same exercise is repeated using the initial wage paid to the recruit as a measure of match quality. In this case a simple linear model is estimated including the same set of controls and introducing firm fixed-effects in column 6, when intensive recruitment is measured with the accuracy of the successful method, an indicator that varies by both establishment and engagement. Results unambiguously point towards higher wages paid to recruits that have been screened more accurately.

Finally, the last three columns of table 8 explore the effect of intensive recruitment on tenure, i.e. on the probability of a separation occurring shortly after the creation of the match. This is the correct empirical counterpart of equation (10): separations occurring soon after hiring are more likely than later separations to be due to inefficient matching. As already described in section 3, the SERP collects information about a set of engagements that took place within 12 months before the interview. Some of these matches, namely 7% of the total, had already been destroyed by the time of the survey. One can use the variation in job tenure generated by these matches to identify the effect of recruitment practices on the probability of a job separation occurring soon after hiring. Variation in the duration of matches that are still active also helps the identification of the parameters.

This is done using a proportional hazard model in discrete time, which will need to be adjusted for the peculiar way data on tenure are collected in the SERP. Uncompleted durations, i.e. tenure for continuing matches, can be computed in days using information about the date of the interview and the date when the recruit started his/her job. Uncompleted durations, however, are recorded in intervals: when the person has already left the firm the responded is only asked to indicate whether he/she had been employed less than a week, between a week and a month, between 1 and 3 months,

[7]Here, the logit specification is preferred to the probit, because it easily allows the introduction of unobservable fixed-effects.

etc.

For simplicity, we take a week as the basic time unit and the duration of uncompleted spells is reaggregated from days to weeks. Then, adopting a standard proportional hazard model, the likelihood contribution of a continuing match, j, lasting for T_j weeks is defined by the following survivor function:

$$\Pr\{t > T_j \mid X_j\} = S(T_j \mid X_j) = \exp\left[-H(T_j) \cdot e^{\gamma' X_j}\right]$$

where X_j is a set of controls, including all observable characteristics of the firm and the worker, and γ is the corresponding set of parameters. $H(T_j)$ is the so-called "integrated hazard", i.e. $H(T_j) = \int_0^{T_j} h_0(u)du$, where $h_0(u)$ is the baseline hazard at time u. Using this definition, it is customary to derive a discrete time hazard as follows:

$$\begin{aligned} h(T_j \mid X_j) &= \Pr\{T_j - 1 > t > T_j \mid X_j\} = \\ &= \frac{S(T_j - 1 \mid X_j) - S(T_j \mid X_j)}{S(T_j - 1 \mid X_j)} = 1 - \exp\left\{e^{\gamma' X_j}\left[H(T_j - 1) - H(T_j)\right]\right\} \end{aligned}$$

Rearranging this equation one can derive the following useful expression:

$$\log\left[1 - h(T_j \mid X_j)\right] = e^{\gamma' X_j}\left[H(T_j - 1) - H(T_j)\right]$$

and:

$$\log(-\log\left[1 - h(T_j \mid X_j)\right]) = e^{\gamma' X_j} + \log\left[H(T_j - 1) - H(T_j)\right]$$

Notice that now $H(T_j - 1) - H(T_j)$ is a function of the baseline hazard only:

$$\log\left[H(T_j - 1) - H(T_j)\right] = \log\left[\int_{T_j - 1}^{T_j} h_0(u)du\right] = \tau_j$$

which allows to rewrite the previous expression as:

$$\log(-\log\left[1 - h(T_j \mid X_j)\right]) = e^{\gamma' X_j} + \tau_j$$

hence:

$$h(T_j \mid X_j) = 1 - \exp\left[-\exp\left[e^{\gamma' X_j} + \tau_j\right]\right]$$

which is usually called *complementary log-log* transformation of the hazard. Writing the hazard in this form is useful for our purposes because it easily allows to account for differences in the coding of tenure by simply defining different τ_j's.

For destroyed matches that lasted between, say, T_l and T_u the corresponding τ_j can be written as:

$$\tau_j = \log\left[\int_{T_l}^{T_u} h_0(u)du\right]$$

This means that introducing a set of dummies for each coding of tenure (i.e. a dummy for matches that lasted less than a week, another for those lasting between a week and a month, and so on) allows to control for differences in time intervals.

Results are reported in the last three columns of table 8. While the length of the recruitment process appears to have no effect on the probability of job separation and the number of screening procedures is only mildly and positively correlated with it, the strongest result is in column 9, where the accuracy of the successful method is used as a measure of intensive recruitment. The estimated coefficient points towards a strong and significant effect of intensive recruitment in the direction of lowering the probability of a job separation.

Theoretically, it would be possible to introduce firm unobservable heterogeneity in this estimation. However, this is not done here for two reasons. First, when the baseline hazard is fully non-parametric the role of unobserved heterogeneity is minimal (Heckman at al. (1984)). Second, given the small faction of completed spells in our sample, imposing further restrictions on the likelihood function makes it difficult to identify all the parameters[8].

Overall, the results of table 9 support the basic idea of this paper: more intensive recruitment leads to matches of better quality that pay higher wages, last longer and make employers more satisfied with the person taken on.

[8] In fact, the maximum likelihood estimation of the model with unobserved heterogeneity does not converge easily.

5 Conclusions

The available evidence for various countries and time periods indicates that employment relationships are far less stable in low- than in high-productivity jobs. This regularity remains true after controlling for a number of personal and job characteristics, making it an interesting theoretical and empirical puzzle. This paper offers an explanation for this finding based on the idea that employers find it less profitable to invest in search and screening activities when recruiting for low-productivity jobs. As a consequence, matches at the lower end of the jobs' distribution are more likely to be of poor quality, in the sense that the same worker (job) can be paired with another job (worker) into a more productive match, hence they are destroyed more frequently.

This idea is formalised in a simple model in which employers optimally choose their investment in extensive (search and advertisement) and intensive (screening) recruitment, and the effects of such investment on match quality can be analysed. A unique dataset of hirings that took place in the United Kingdom in 1992 is used to test the model empirically. Results show that (i) investment in extensive and intensive recruitment are positively correlated, (ii) employers screen more intensively when recruiting for jobs in higher occupational groups and (iii) matches created through more intensive screening last longer, pay higher wages and make employers more satisfied with the person taken on.

Understanding the causes of differentials in labour turnover is important in itself, to improve our knowledge of the functioning of the labour market, but it is also interesting from a policy perspective. Unstable employment relationships for certain categories of workers and jobs can generate large inequalities both in income levels and in its variability. Most people spend their entire working life in the same occupation and industry and if the quality of matches in these jobs is constantly low they will experience higher job and earnings instability, leading to higher inequality and possibly higher poverty. Policies aimed at improving the quality of matching are, thus, likely to have positive effects on both equity and efficiency, particularly if they are focused on unskilled workers and elementary occupations.

Appendix: derivation of the comparative statics effects

Proposition 1 $\frac{\partial E_j}{\partial I_j} \geq 0$

Proof. Equation (9) can be rewritten as:

$$q'_E(E_j|\theta_j)\zeta(I_j) = (1+r)\zeta'(I_j) + \zeta'(I_j)q'_E(E_j|\theta_j)I_j \tag{11}$$

Taking the first partial differential with respect to E_j and I_j yields:

$$\frac{q''_{EE}(E_j|\theta_j)}{\zeta(I_j)}\left[1-\eta_\zeta(I_j)\right]dE_j = \zeta''(I_f)\left[1+r+q'_E(E_j|\theta_j)I_j\right]dI_j$$

which, given the properties of $q(\cdot)$ and $\zeta(\cdot)$, implies:

$$\frac{dE_j}{dI_j} \geq 0$$

■

Proposition 2 $\frac{dI_j}{d\theta_j} = 0$

Proof. The result is immediate from equation (8), which fully determines I_j and where θ_j does not appear. ■

Proposition 3 *If* $\frac{\partial q(E_j|\theta_j)}{\partial E_j \partial \theta_j} > 0$ *then* $\frac{\partial E_j}{\partial \theta_j} < 0$. *If* $\frac{\partial q(E_j|\theta_j)}{\partial E_j \partial \theta_j} < 0$ *then* $\frac{\partial E_j}{\partial \theta_j} > 0$.

Proof. Taking the first partial differential from equation (11) with respect to E_j and θ_j yields (knowing that $\frac{dI_j}{d\theta_j} = 0$):

$$\left[q''_{EE}(E_j|\theta_j)\zeta(I_j)\right]dE_j + \left[q''_{E\theta}(E_j|\theta_j)\zeta(I_f)\right]d\theta_j = 0$$

and:

$$\frac{dE_j}{d\theta_j} = \frac{q''_{E\theta}(E_j|\theta_j)\zeta(I_f)}{q''_{EE}(E_j|\theta_j)\zeta(I_j)}$$

which, given the properties of $q(\cdot)$ and $\zeta(\cdot)$, proves the proposition. ■

Proposition 4 $\frac{dI_j}{dp_j} > 0$

Proof. Taking the first partial differential of equation (8) yields:

$$\left[\zeta''(I_j)\pi(1-\beta)(1+r+\lambda)\frac{p}{r+\lambda}\right]dI_j + \left[\pi\zeta'(I_f)(1-\beta)(1+r+\lambda)\frac{1}{r+\lambda}\right]dp_j = 0$$

which, given the properties of $\zeta(\cdot)$, proves the proposition. ■

Proposition 5 $\frac{dI_j}{d\pi_j} > 0$

Proof. Taking the first partial differential of equation (8) yields:

$$\left[\zeta''(I_j)\pi(1-\beta)(1+r+\lambda)\frac{p}{r+\lambda}\right]dI_j + \left[\zeta'(I_f)(1-\beta)(1+r+\lambda)\frac{p}{r+\lambda}\right]d\pi_j = 0$$

which, given the properties of $\zeta(\cdot)$, proves the proposition. ■

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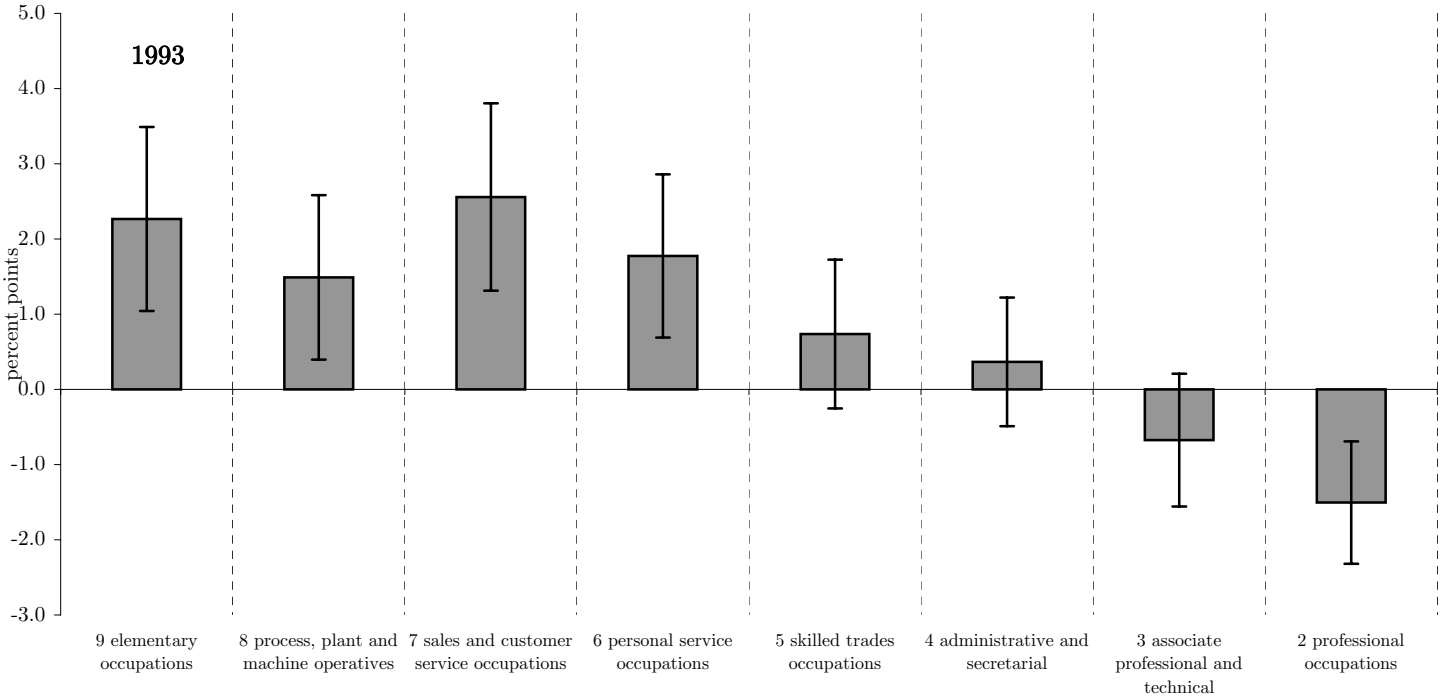
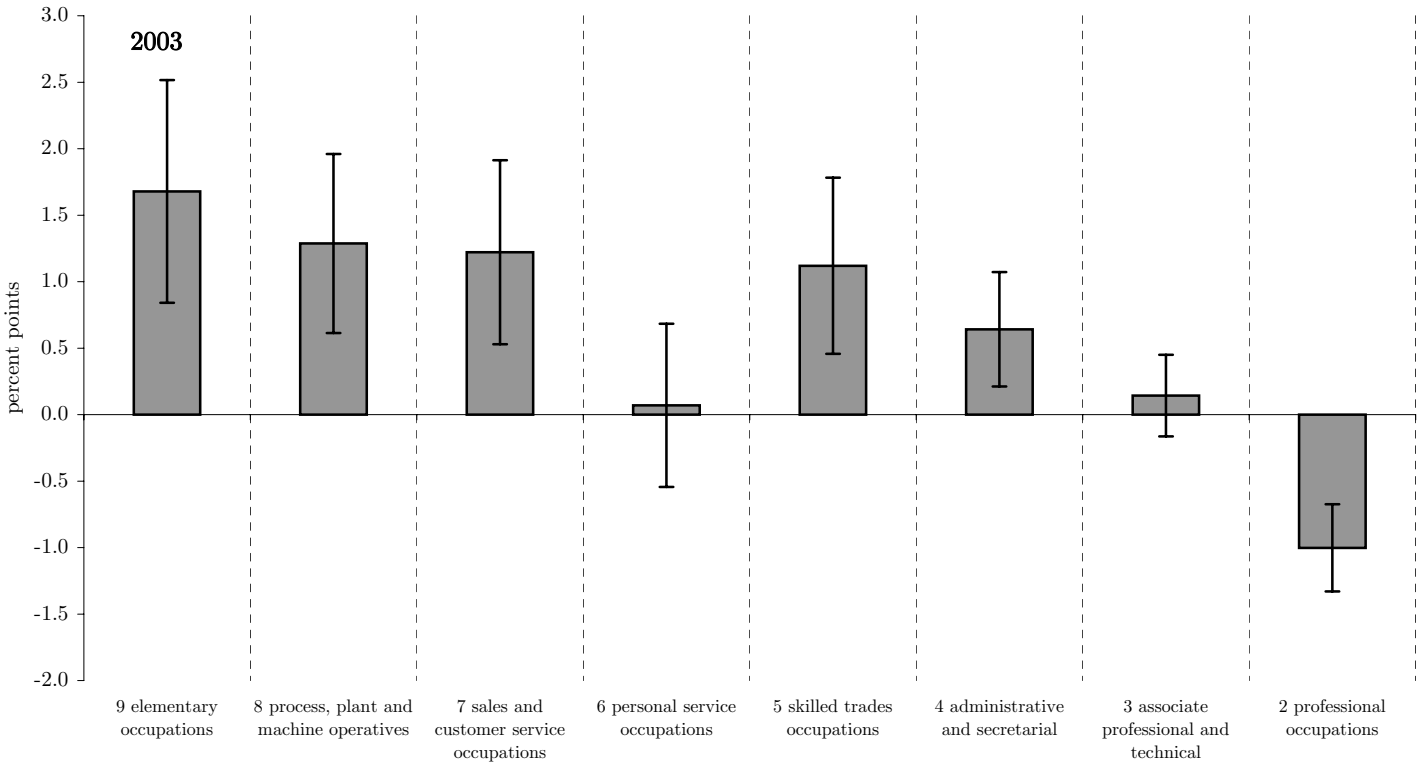
Figures and Tables

Figure 1: Conditional differences in labour turnover by occupation



test joint identity: Ho: occup2=...=occup9

$\chi^2(7) = 71.03$; Prob>$\chi^2(7)$=0.0000



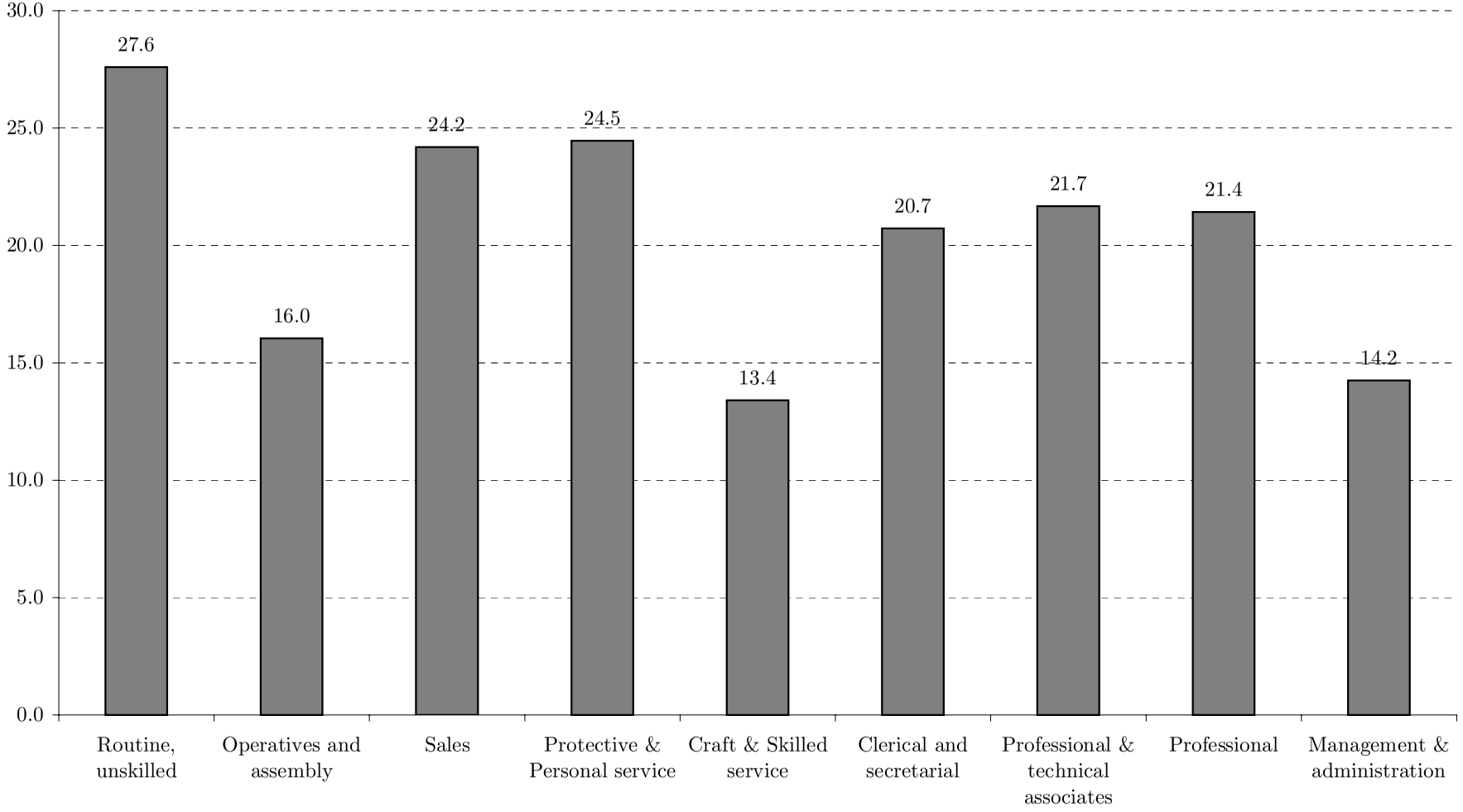
test joint identity: Ho: occup2=...=occup9

$\chi^2(7) = 437.70$; Prob>$\chi^2(7)$=0.0000

NOTE: Marginal effects of the occupational dummies obtained from a probit regression for the probability of job separation (to a new job, to unemployment or to inactivity) between the first and the second quarter of 1993 and 2003. The set of regressors includes gender, age, education, tenure, dummies for part-time and temporary jobs and for jobs in the public sector, industry and regional dummies. The vertical bars represent 95% confidence intervals. The reference category is "managers and senior officials".

Source: British LFS, 1993 and 2003.

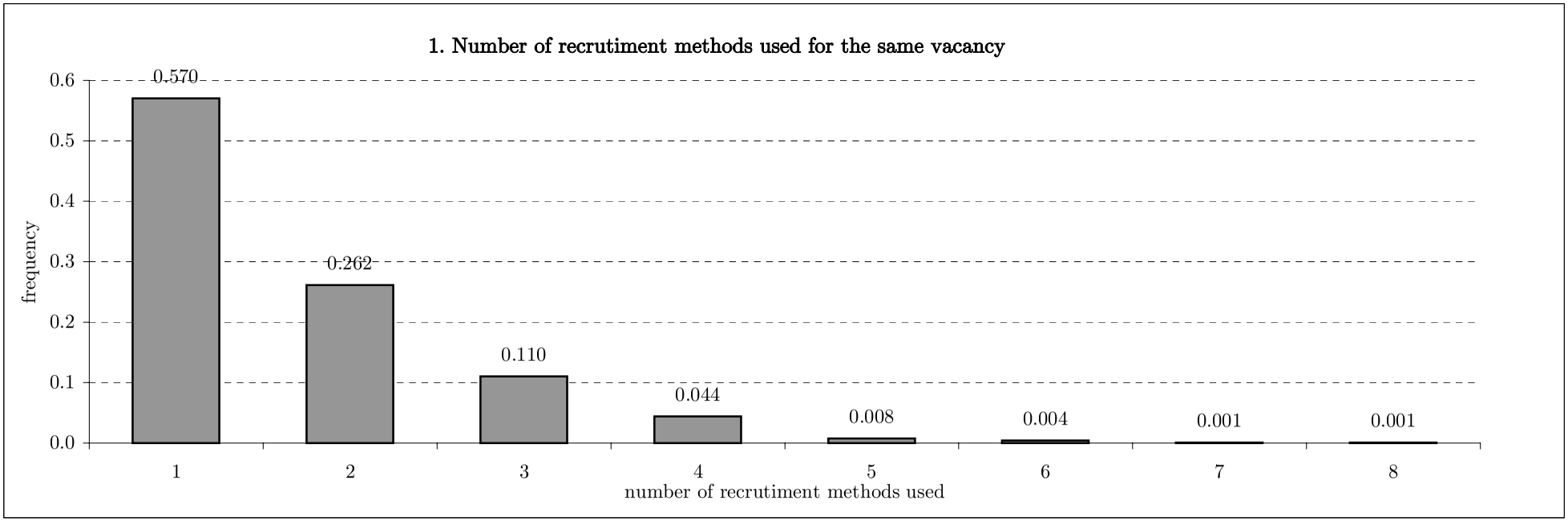
Figure 2: Estimated turnover*

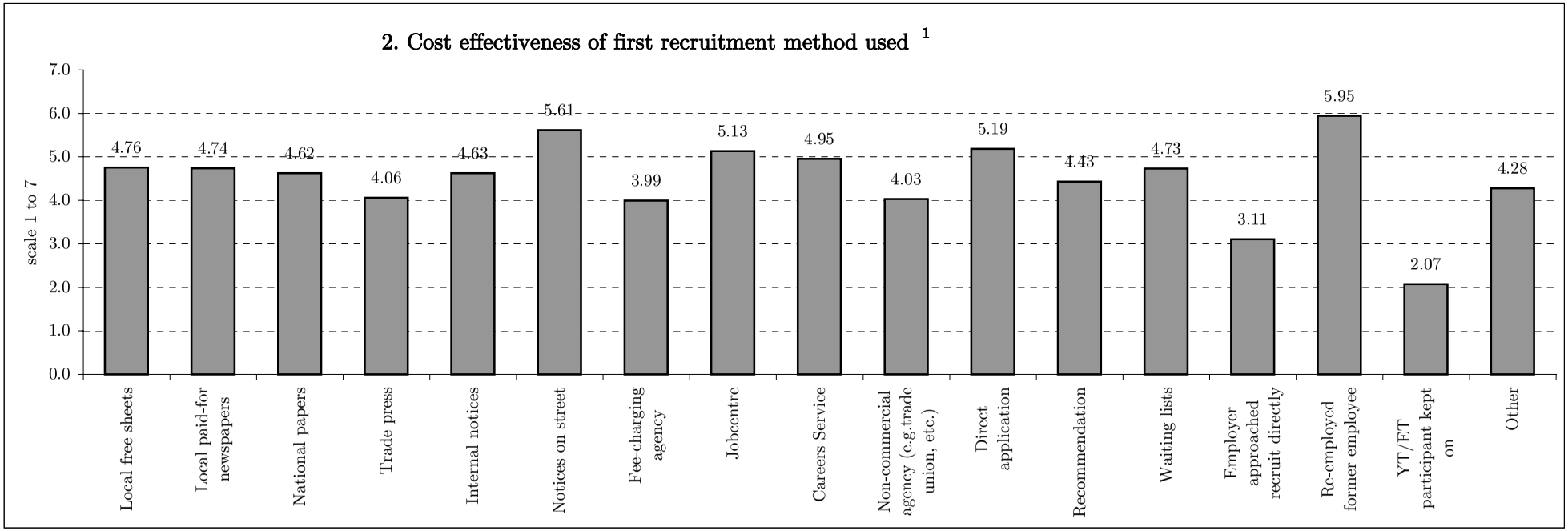


** Estimated % of current employees who have been continuously working at the establishment for longer than 12 months.*

source: Survey of Employers Recruitment Practices, 1992

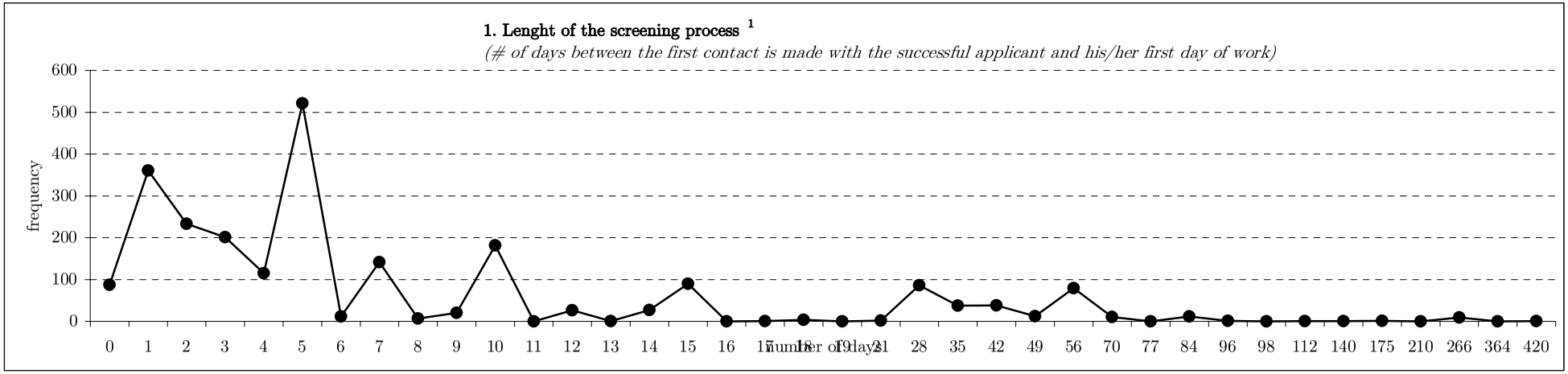
Figure 3: Measures of Extensive recruitment

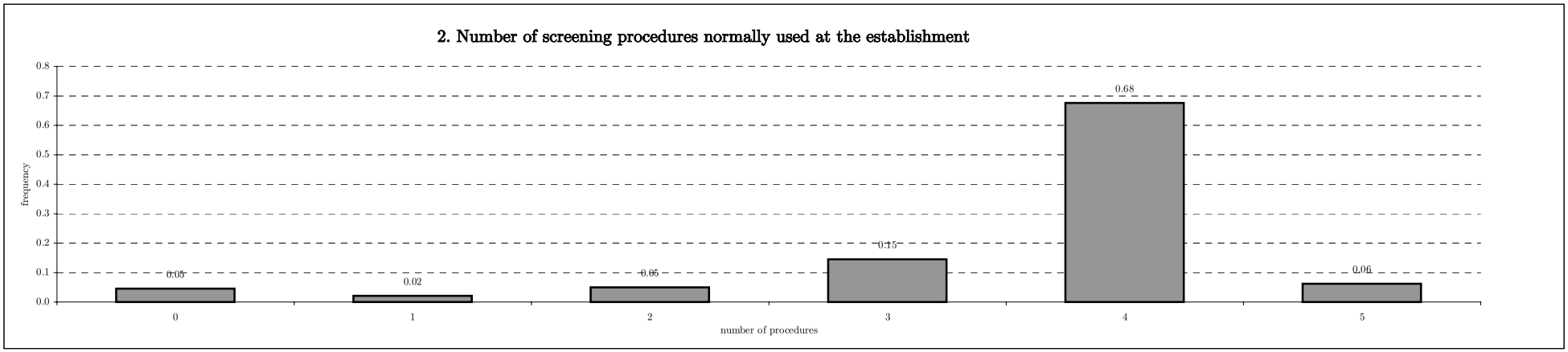


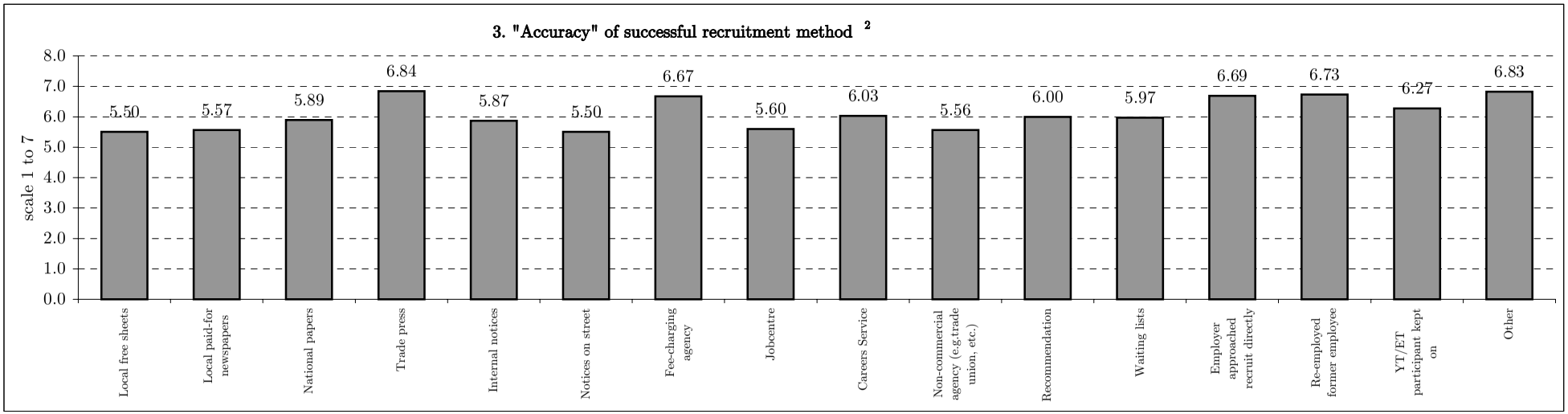


1. See text for a description of how this variable is constructed.

Figure 4: Measures of intensive recruitment



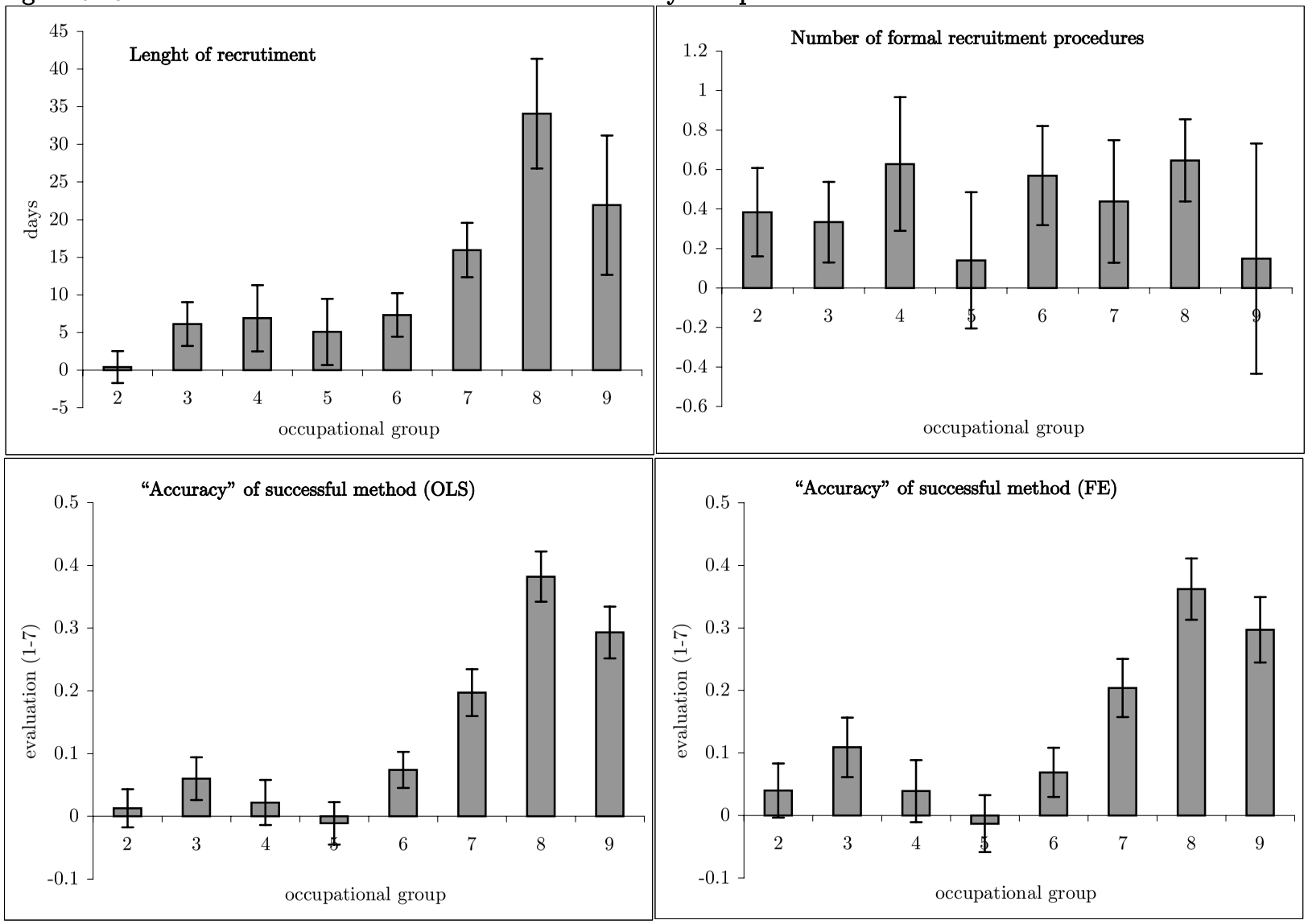




1. The sample is restricted to new or unfilled vacancies (i.e. vacancies where the previous person is still employed are excluded) and to workers who, at the time of recruitment were either unemployed or inactive (i.e. job-to-job and education-to-job movers are excluded)

2. See text for a description of how this variable is constructed.

Figure 5: Conditional differences in intensive recrutiment by occupations



Occupational groups: 1=routine & unskilled (reference); 2=operatives & assembly; 3=sales; 4=protective/personal services; 5=craft/skilled services; 6=clerical & secretarial; 7=prof. ass. & technical; 8=professional; 9=management/administration.

The vertical bars represent 95% confidence intervals

See text and table 6 for details.

Table 1: Labour turnover by occupation

	Turnover		% of movers into unemployment		% of industry stayers *among the emp.-to-emp. movers*	
Occupation	**1993**	**2003**	**1993**	**2003**	**1993**	**2003**
1 managers and senior officials	3.05	3.83	26.77	25.44	63.73	59.12
2 professional occupations	2.91	3.40	19.38	13.85	83.82	76.46
3 associate professional and technical	3.51	4.62	23.77	16.86	80.60	64.03
4 administrative and secretarial	4.71	5.52	22.34	15.47	68.64	63.06
5 skilled trades occupations	4.80	6.26	44.10	24.09	74.08	73.43
6 personal service occupations	7.01	5.30	19.19	14.48	73.06	64.51
7 sales and customer service occupations	8.38	9.73	21.51	15.81	55.97	51.12
8 process, plant and machine operatives	5.47	6.49	37.06	21.77	76.78	49.53
9 elementary occupations	7.56	9.01	29.08	22.26	61.47	55.19
Total	5.09	5.84	26.84	19.11	69.29	60.56

Note: turnover is computed as the fraction of dependent employees in the first quarter of the year who experienced a job change (to another job, to unemployment or to inactivity) by the time they were re-interviewed 3 moths later in the second quarter. The sample excludes transitions to retirement.
The % of occupation stayers is computed as the fraction of dependent employees in the first quarter of the year who are observed in another job but in the same occupation
Source: *Quarterly Labour Force Survey*

Table2: Descriptive statistics for the sample of establishments

	unweighted	weighted
Sample size	5343	6083
Variable	Mean	Mean
employment	314.83 (778.56)	40.53 (0.96)
manual workers[1]	0.30 (0.30)	0.21 (0.01)
professionals[2]	0.26 (0.24)	0.28 (0.01)
Labour intensity (labour costs as % of total costs)		
less than 25%	0.22 (0.41)	0.23 (0.01)
25% to 50%	0.29 (0.45)	0.31 (0.01)
50% to 75%	0.19 (0.39)	0.17 (0.01)
more than 75%	0.30 (0.46)	0.29 (0.01)
Industry		
energy, water, etc.	0.01 (0.11)	0.00 (0.00)
metal, minerals, etc.	0.04 (0.20)	0.02 (0.00)
metal goods, engineering, etc.	0.11 (0.32)	0.06 (0.01)
other manufacturing	0.13 (0.33)	0.06 (0.00)
construction	0.03 (0.18)	0.03 (0.00)
distribution, catering, etc.	0.22 (0.41)	0.33 (0.01)
transport and communication	0.04 (0.19)	0.05 (0.01)
Banking, insurance, etc.	0.15 (0.36)	0.17 (0.01)
other services	0.26 (0.44)	0.28 (0.01)
Trend in activity in the past 12 months		
expanding	0.41 (0.49)	0.43 (0.01)
contracting	0.20 (0.40)	0.16 (0.01)
Capital utilisation		
below full capacity	0.47 (0.50)	0.49 (0.01)
overloaded	0.01 (0.11)	0.02 (0.00)
1= change of ownership in the past 3 years	0.13 (0.33)	0.10 (0.01)
Region		
London	0.07 (0.25)	0.11 (0.01)
rest of South East	0.10 (0.30)	0.19 (0.01)
East Anglia	0.04 (0.19)	0.04 (0.00)
South West	0.10 (0.30)	0.09 (0.01)
West Midlands	0.11 (0.31)	0.09 (0.01)
East Midlands	0.07 (0.26)	0.07 (0.01)
York/Humbershire	0.10 (0.30)	0.09 (0.01)
North West	0.12 (0.32)	0.12 (0.01)
North	0.10 (0.29)	0.04 (0.00)
Wales	0.09 (0.29)	0.05 (0.00)
Scotland	0.10 (0.30)	0.09 (0.01)
Establishments by number of engagements		
One	0.15 (0.35)	0.29 (0.01)
Two	0.13 (0.34)	0.20 (0.01)
Three	0.14 (0.35)	0.14 (0.01)
Four	0.20 (0.40)	0.16 (0.01)
Five	0.38 (0.48)	0.21 (0.01)

Standard erros in paretheses
1. routine, unskilled, operatives and assembly workers
2. professional and technical associates, professionals, managers and administrators
Source: Survey of Employers Recruitment Practices, 1992

Table 3: Descriptive statistics for the sample of recruits

	unweighted		weighted	
	Mean (sd)	valid obs.	Mean (sd)	valid obs.
The vacancy				
supervisory job	0.18 (0.38)	14609	0.16 (0.01)	10980
non permanent contract[3]	0.21 (0.41)	14609	0.35 (0.02)	10980
Occupation				
Routine, unskilled	0.15 (0.35)	14609	0.15 (0.01)	10980
Operatives and assembly	0.14 (0.34)	14609	0.21 (0.01)	10980
Sales	0.11 (0.31)	14609	0.06 (0.01)	10980
Protective/Personal service	0.07 (0.26)	14609	0.07 (0.01)	10980
Craft/Skilled service	0.09 (0.29)	14609	0.06 (0.01)	10980
Clerical and secretarial	0.20 (0.40)	14609	0.21 (0.01)	10980
Professional and technical associates	0.09 (0.28)	14609	0.10 (0.01)	10980
Professional	0.08 (0.27)	14609	0.10 (0.01)	10980
Management/administration	0.08 (0.27)	14609	0.04 (0.00)	10980
The succesful applicant				
female	0.50 (0.50)	14609	0.54 (0.02)	10980
Age				
16 - 18	0.08 (0.27)	14609	0.06 (0.01)	10980
19 - 24	0.25 (0.43)	14609	0.27 (0.02)	10980
25 - 34	0.34 (0.47)	14609	0.39 (0.02)	10980
35 - 44	0.21 (0.40)	14609	0.19 (0.01)	10980
45 - 54	0.10 (0.30)	14609	0.07 (0.01)	10980
55 or over	0.03 (0.16)	14609	0.01 (0.00)	10980
Ethinc group				
White	0.96 (0.21)	14609	0.92 (0.01)	10980
Black, etc	0.02 (0.12)	14609	0.03 (0.01)	10980
Asian	0.02 (0.15)	14609	0.05 (0.01)	10980
Other	0.01 (0.08)	14609	0.01 (0.00)	10980
disable	0.02 (0.13)	14609	0.02 (0.01)	10980
Outcome variables				
Hourly pay (gross)	5.31 (3.52)	14609	5.60 (0.11)	10980
Satisfaction				
not at all satisfied	0.01 (0.11)	14609	0.01 (0.00)	10980
not very satisfied	0.02 (0.15)	14609	0.01 (0.00)	10980
fairly satisfied	0.26 (0.44)	14609	0.25 (0.01)	10980
very satisfied	0.62 (0.49)	14609	0.47 (0.02)	10980
too ealy to say	0.09 (0.29)	14609	0.26 (0.02)	10980
number of applications received[2]	43.75 (98.62)	1855	59.32 (9.81)	2338
The labour market				
Labour market tightness[3] (*100)	4.79 (1.80)	14609	4.68 (0.06)	10980

1. Temporary, casual, part-time contracts

2. This question is only asked for the most recent engagement and only when contact with the successful applicant was made through a formal recruitment method (i.e. newspaper advertisment, notices, agencies)

3. Ratio between unfilled vacancies and unemployment benefit claimants in the quarter in which the recruit started working. (Source: Nomis)

Source: Survey of Employers Recruitment Practices, 1992.

Table 4: Turnover by Occupational Groups

% of existing employees who have been working for the same organisation continuously over the past 12 months

	Routine, unskilled	Operatives and assembly	Sales	Protective & Personal service	Craft & Skilled service	Clerical and secretarial	Professional & technical associates	Professional	Management & administration
0%	0.59	0.57	1.34	1.48	0.95	0.49	0.82	0.83	1.49
1% - 9%	1.34	0.93	0.71	1.14	1.38	0.90	1.31	0.71	0.86
10% - 19%	0.32	0.51	0.79	0.60	0.29	0.86	2.13	1.51	0.57
20% - 39%	3.68	1.12	5.92	1.77	0.84	1.16	1.14	2.16	1.02
40% - 59%	14.45	5.02	8.93	3.31	1.83	2.55	4.09	2.62	0.71
60% - 79%	16.57	10.04	15.68	23.52	5.33	12.52	14.65	18.33	4.10
80% - 89%	17.24	16.91	22.45	28.68	11.44	24.68	23.19	20.06	10.42
90% or over	40.20	62.99	42.04	34.51	75.83	50.56	48.33	49.30	77.26
not stated	5.61	1.92	2.14	5.00	2.12	6.28	4.34	4.48	3.57
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Estimated turnover[1]	27.60	16.05	24.19	24.46	13.41	20.72	21.67	21.42	14.25

1. The overall % of employees with tenure longer than 12 months is computed by taking the mid point in each band. Estimated turnover is 100 minus this overall estimate.

Source: Survey of Employers Recrutiment Practices, 1992

Table 5: Correlation between intensive and extensive recruitment

Dependent variable	# of methods used				cost effectiveness of first method used[1]			
Estimation method	ord. probit	ord. probit	ord. probit	FE	OLS	OLS	OLS	FE
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
length of recruitment (days)[2]	0.005***	-	-	-	-0.001***	-	-	-
	(0.001)				(0.000)			
# of formal screening procedures[3]	-	0.195***	-	-	-	0.009**	-0.512***	-
		(0.010)				(0.005)	(0.017)	
"Accuracy" of successful method[4]	-	-	-0.346***	-0.151***	-	-	-	-0.469***
		-	(0.028)	(0.019)				(0.016)
Labour market tightness (v/u)[5]	2.146	2.191	2.428	2.485**	3.209**	2.210**	1.691*	1.469
	(2.676)	(1.753)	(1.739)	(1.256)	(1.241)	(0.925)	(0.879)	(1.093)
Regional dummies	yes	yes	yes	yes	yes	yes	yes	no
Additional controls[6]	yes	no	no	no	yes	no	no	no
Establishment fixed-effects	no	no	no	yes	no	no	no	yes
Observations	3435	14520	14520	10489	3435	14520	14520	10489
Number of establishments	3435	4658	4658	3990	3435	4658	4658	3990
Log Likelihood	-3423.65	-13204.21	-13443.88	-7310.47	-3192.86	-14444.68	-13418.84	-5848.95

1. Average employers' evaluation of the cost effectiveness of recruitment methods (see text and figure 3).
2. # of days between the first contact is made with the successful applicant and his/her first day of work
3. Formal procedures include: use of application forms, short-listing procedures, interviews, selection procedures (medical, security checks, tests, references, trial periods, etc.), other procedures.
4. Average employers' evaluation of the accuracy of recruitment methods (see text and figure 4).
5. Ratio between unfilled vacancies and unemployment benefit claimants in the month in which the recruit started working. (Source: Nomis)
6. These include a set of dummies for the employment status of the successful candidate (employed, unemployed, inactive, student, etc.) and for the status of the vacancy (vacant, filled by previous worker, etc.) at the time of recruitment.

Robust standard errors in parentheses (clustered at the establishment level in columns [2], [3], [6], [7] and the regional level in columns [1] and [5]).
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: The determinants of screening intensity (I)

Dependent variable	lenght of recrutiment (days)[1]	# of formal screening procedures[2]	"Accuracy" of successful method[3]	
Estimation method	OLS	Ordered probit	OLS	FE
Mean of dep. variable	19.3	2.9	6.0	6.0
	[1]	[2]	[3]	[4]
Occupational category[4]				
operatives & assembly	0.405	0.384***	0.013	0.040*
	(0.951)	(0.114)	(0.016)	(0.022)
sales	6.130***	0.333***	0.060***	0.109***
	(1.305)	(0.104)	(0.017)	(0.024)
protective/personal services	6.894***	0.628***	0.022	0.039
	(1.973)	(0.173)	(0.018)	(0.026)
craft/skilled service	5.080**	0.140	-0.011	-0.013
	(1.972)	(0.176)	(0.017)	(0.023)
clerical & secretarial	7.337***	0.569***	0.074***	0.069***
	(1.291)	(0.128)	(0.014)	(0.020)
prof. ass. & techinical	15.957***	0.438***	0.197***	0.204***
	(1.626)	(0.158)	(0.019)	(0.024)
professional	34.095***	0.646***	0.382***	0.362***
	(3.271)	(0.106)	(0.020)	(0.025)
management/administration	21.927***	0.148	0.293***	0.297***
	(4.156)	(0.297)	(0.021)	(0.027)
Type of job				
supervisory	0.380	-	0.067***	0.078***
	(1.009)		(0.013)	(0.016)
non-permanent	-7.577***	-	0.060***	0.044***
	(0.776)		(0.011)	(0.016)
Regional labour market tightness (v/u)[5]	-175.870	-	-1.150*	0.468
	(102.074)		(0.603)	(0.795)
Establishment's size				
# of employees	0.736***	0.061***	0.003**	-
	(0.195)	(0.008)	(0.001)	
# of employees^2	-0.008**	-0.001***	-0.000	-
	(0.003)	(0.000)	(0.000)	
Recruit's characteristics[6]	yes	no	yes	yes
Job's characteristics[7]	yes	no	yes	yes
Establishment's characteristics[8]	yes	yes	yes	no
Establishment's fixed effects	no	no	no	yes
Regional dummies	yes	yes	yes	no
Additional controls[9]	yes	no	no	no
Observations	3435	-	14520	10489
Establishments	3435	3985	4658	3990
Log Likelihood	-16356.77	-4783.24	-8621.87	-2458.32

1. # of days between the first contact is made with the successful applicant and his/her first day of work
2. Formal procedures include: use of application forms, short-listing procedures, interviews, selection procedures (medical, security checks, tests, references, trial periods, etc.), other procedures.
3. Average employers' evaluation of the accuracy of recruitment methods (see text and figure 4).
4. The reference group is *routine & unskilled workers.*
5. Ratio between unfilled vacancies and unemployment benefit claimants in the month in which the recruit started working. (Source: Nomis)
6. Gender dummy, age dummies, ethnic group dummies, disable dummy, employment status at the time of recruitment (employed, unemployed, inactive, student, etc.).
7. Dummies for supervisory and non-permanent jobs, status of the vacancy (vacant, filled by previous worker, etc.) at the time of recruitment.
8. Establishment's size (linear and squared), occupational composition of the workforce, labour intensity (% of labour costs over total costs), capital utilization (below full capacity, overloaded), activity trend (expanding vs. contracting), a dummy for change of ownership in the past 3 years, dummies for company type (limited, partnership, charity, et.), dummies for establishment type (administrative vs. production, headquarter vs. non-headquarter), industry dummies.
9. These include a set of dummies for the employment status of the successful candidate (employed, unemployed, inactive, student, etc.) and for the status of the vacancy (vacant, filled by previous worker, etc.) at the time of recruitment.

Robust standard errors in parentheses (clustered by region in column [1] and by establishment in column [2], [3], [4]).
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: The effects of extensive recruitment

Dependent variable	# of applications received[1]		
Estimation method	poisson regression		
Mean of dep. Variable	43.7		
	[1]	[2]	[3]
# of recruitment methods used	0.231***		
	(0.045)		
2 methods used	-	0.165**	-
		(0.070)	
3 methods used	-	0.297***	-
		(0.100)	
4 methods used	-	1.080***	-
		(0.165)	
5 methods used	-	-0.005	-
		(0.414)	
6 methods used	-	0.777	-
		(0.748)	
Cost effectiveness of first method used[2]	-	-	-0.097
			(0.186)
Regional labour market tightness (v/u)[3]	6.044	6.537	5.533
	(9.665)	(9.624)	(10.287)
Type of job			
supervisory	-0.319*	-0.352**	-0.306*
	(0.185)	(0.178)	(0.169)
non-permanent	-0.053	-0.046	-0.094
	(0.136)	(0.131)	(0.134)
Establishment's size			
# of employees	0.113***	0.107***	0.125***
	(0.026)	(0.025)	(0.028)
# of employees^2	-0.003***	-0.003***	-0.004***
	(0.001)	(0.001)	(0.001)
Occupational dummies	yes	yes	yes
Establishment's characteristics[4]	yes	yes	yes
Regional dummies	yes	yes	yes
Observations	1855	1855	1855
Individuals	1855	1855	1855
Log Likelihood	-71577.71	-70618.82	-73366.60

1. The sample is restricted to vacancies filled through a "formal" recruitment method (i.e. the successful applicant is first contacted through newspaper advertisement, internal or external notices, recruitment agencies, both public and private).
2. Average employers' evaluation of the cost effectiveness of recruitment methods (see text and figure 3).
3. Ratio between unfilled vacancies and unemployment benefit claimants in the month in which the recruit started working. (Source: Nomis)
4. Composition of the workforce (% of employees in each occupational group), labour intensity (% of labour costs over total costs), capital utilization (below full capacity, overloaded), activity trend (expanding vs. contracting), a dummy for change of ownership in the past 3 years, dummies for company type (limited, partnership, charity, et.), dummies for establishment type (administrative vs. production, headquarter vs. non-headquarter), industry dummies, regional dummies.
Robust standard errors (clustered by regions) in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8: Intensive recruitment and the quality of the match

Dependent variable	1=very satisfied with the recruit			(log) initial wage[1]			Tenure (weeks)		
Estimation method	logit	logit	conditional logit	OLS	OLS	FE	proportional hazard		
Mean of dep. Variable	0.67	0.68	0.69	1.47	1.50	1.53	20.31[2]	20.45[2]	20.45[2]
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
length of recruitment (days)[3]	-0.000	-	-	0.001***	-	-	0.000	-	-
	(0.001)			(0.000)			(0.002)		
# of formal screening procedures[4]	-	0.081***	-	-	0.013***	-	-	0.050*	-
		(0.017)			(0.003)			(0.029)	
"Accuracy" of successful method[5]	-	-	0.591***	-	-	0.082***	-	-	-0.405***
			(0.093)			(0.008)			(0.100)
Regional labour market tightness (v/u)[6]	1.164	1.851	1.404	-0.562	-0.935**	-1.467***	-5.458	-0.135	-33.456***
	(6.191)	(3.070)	(5.471)	(0.675)	(0.422)	(0.487)	(14.074)	(0.650)	(5.566)
Occupational dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Recruit's characteristics[7]	yes	yes	yes	yes	yes	yes	yes	yes	yes
Job's characteristics[8]	yes	yes	yes	yes	yes	yes	yes	yes	yes
Establishment's characteristics[9]	yes	yes	no	yes	yes	no	yes	yes	yes
Establishment's fixed effects	no	no	yes	no	no	yes	no	no	no
Regional dummies	yes	yes	no	yes	yes	no	yes	yes	no
Additional controls[10]	yes	no	no	yes	no	no	yes	no	no
Duration dependence[11]	-	-	-	-	-	-	yes	yes	yes
Observations	2910	13168	9493	3557	14520	10489	11713	65327	65327
Establishments	2910	4529	3857	3557	4658	3990	3251	14332	14332
Log Likelihood	-1714.56	-7867.12	-	-	-	-	-313.12	-1898.67	-1889.73

1. Gross and hourly.
2. Most observations (95%) are right censored, the mean is heavily underestimated.
3. # of days between the first contact is made with the successful applicant and his/her first day of work
4. Formal procedures include: use of application forms, short-listing procedures, interviews, selection procedures (medical, security checks, tests, references, trial periods, etc.), other procedures.
5. Average employers' evaluation of the accuracy of recruitment methods (see text and figure 4).
6. Ratio between unfilled vacancies and unemployment benefit claimants in the month in which the recruit started working. (Source: Nomis)
7. Gender dummy, age dummies, ethnic group dummies, disable dummy, employment status at the time of recruitment (employed, unemployed, inactive, student, etc.).
8. Dummies for supervisory and non-permanent jobs, status of the vacancy (vacant, filled by previous worker, etc.) at the time of recruitment.
9. Establishment's size (linear and squared), occupational composition of the workforce, labour intensity (% of labour costs over total costs), capital utilization (below full capacity, overloaded), activity trend (expanding vs. contracting), a dummy for change of ownership in the past 3 years, dummies for company type (limited, partnership, charity, et.), dummies for establishment type (administrative vs. production, headquarter vs. non-headquarter), industry dummies.
10. These include a set of dummies for the employment status of the successful candidate (employed, unemployed, inactive, student, etc.) and for the status of the vacancy (vacant, filled by previous worker, etc.) at the time of recruitment.
11. To control for the specific design of the tenure data, duration dummies for each possible exit time (from week 1 to week 24) have been included. See text for details.
Robust standard errors (clustered by region in columns [1] and [4]) in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%