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ABSTRACT

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We analyze a standard employee selection model given two institutional constraints: first, professional experience perfectly substitutes insuffcient formal education for insiders while this substitution is imperfect for outsiders. Second, in the latter case the respective substitution rate increases with the advertised minimum educational requirement. Optimal selection implies that the expected level of formal education is higher for outsider than for insider recruits. Moreover, this difference in educational attainments increases with lower optimal minimum educational job requirements. Investigating data of a large US public employer confirms both of the above theoretical implications. Generally, the econometric model exhibits a 'good fit'.

Keywords: employee selection, overeducation, adverse impact, insiders vs outsiders

JEL-Classfication: M51 (Firm Employment Decisions; Promotions), J53 (Labor-Management Relations; Jurisprudence), J78 (Labor Discrimination; Public Policy), I21 (Analysis of Education)

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1 Introduction

Generally, every US employer is free to employ individuals at his will. However, there are two important sets of regulations or institutional rules which affect the selection of employees. First, selection criteria must be validated and, in particular, qualification requirements must be set reasonably to avoid discrimination charges under Title VII of the Civil Rights Act of 1964.[1] To the extent that members of minority groups, women, or disabled individuals can claim to have been socially excluded from obtaining the respective formal education or training, qualification requirements can be ruled excessively high and set for the purpose of preventing successful applications from these groups. Complaints can be filed with the federal *Equal Employment Opportunity Commission* (*EEOC*) which has been established to enforce non-discriminatory employment standards.

Since 1978, the *EEOC* has been publishing *Uniform Guidelines on Employee Selection Procedures.* The above, so-called "Disparate" or "Adverse Impact" issue relates to educational as well as to experience-based selection criteria.[2] Moreover, the respective limitations in choosing minimum qualification standards apply to employee selection in general - i.e. to recruiting new personnel as well as to internal promotion decisions and, of course, to cases where internal and external applicants compete.[3] Damage claims of individual applicants can thus concern wrongful non-hirings as well as non-promotions.[4] To ensure equal treatment of current employees and of new entrants, the *EEOC* therefore generally prefers qualification requirements to be described in terms of necessary skills and abilities, rather than formal educational degrees or years of experience.[5]

This constitutional imperative to ensure equal employment opportunities combines with a second set of rules rooted in the employer's general duty to provide job security and career development given indefinite term labor contracts.[6] Fair selection standards may thus require to be alternatively phrased in terms of formal educational requirements and substitute professional experience criteria - in particular, if firms do not operate employee training programs. Public sector employees are additionally covered

[1] See Carlson (2005, p. 126 - 132) for an account of origins and consequences of non-discrimination law and precedence court decisions concerning the employee selection process.

[2] § 1607.11 in *EEOC* (1978).

[3] See, for instance, Example 14 in EEOC (2006).

[4] See Gutman (2003, 2004) for an overview of precedence cases and court decisions.

[5] See section 15-IX "Proactive Prevention" EEOC (2006).

[6] Clardy (2003).

by the Fourteenth Amendment right to Equal Protection prohibiting their employer to violate their constitutional rights in making personnel decisions.[7] Hence, civil service employees can typically demand administrative and often even judicial review of adverse employment decisions. The federal government itself has therefore committed to a set of rules laid out in the *Operating Manual: Qualification Standards for General Schedule Positions*.[8] For specified hierarchical positions, this manual lists educational degree and the corresponding substitute professional experience requirements when selecting employees for vacant jobs.

Such manuals can be found throughout the US public sector.[9] However, the respective principles are likely to be applied implicitly or explicitly in many private firms as well. Human resources departments within firms then ensure compliance during the entire recruitment process - hence, from advertising the job opening to the final contract negotiations. Consequently, setting qualification requirements in selection processes is subject to a twofold set of limitations: the standards themselves must be reasonable such as not to exclude qualified individuals. Moreover, professional experience gained in similar - typically, reflecting career tracks, hierarchically inferior - positions within the firm can substitute for a lack of formal education. Economically speaking, these rules constrain the use of informative signals in employee selection processes that combine pre-selection according to documented educational degrees and professional experience with follow-up job-interviews or other testing procedures.

Organizational and assessment psychology typically assumes that the human resources department's goal is to maximize the firm's "utility" from employee selection. Economically, this objective amounts to maximizing the expected on-the-job ability of the group of recruits.[10] Our theoretical model developed below augments the very basic, standard-textbook utility analysis of personnel selection[11] to include three stochastically

[7] See Carlson (2005, p. 753 - 756).

[8] This manual is updated and published (without publication date) by the US Office of Personnel Management, Washington D. C.

[9] The New York State Department of Civil Services' view of Knowledge-Skill-Ability-Based Minimum Qualifications - see Martin (2005) - thus provides an interesting second example since it sets out to define an "equivalence equation" to compute substitute professional experience requirements.

[10] Holling (1998) provides a survey of model structures. Schmidt and Hunter (1998) survey the origins and development of this approach.

[11] More refined recent quantitative approaches in assessment psychology focus on the risk reduction aspects of combining pre-selection and different tests to assess "utility". De Corte (2000) provides a discussion of the shortcomings of the standard approaches and the respective remedies. Also, human resources management increasingly emphasises the procedural effects in organizing "fair" employee se-

independent predictors: educational attainment, professional experience, and test scores. The aim is to investigate the economic effects induced by the above constraints on the use of signals. Specifically, we assume that the firm is committed to perfectly substitute professional experience for formal education when dealing with applications of current employees while this substitution is less than perfect for applicants from outside the firm. Due to increased legal risk, the respective substitution rate applied to outsider applications increases with higher minimum educational requirements.

Of course, with informative signals the probability of being hired monotonically increases in all three signal values. However, given the constraints above, the expected educational attainment of outsider recruits exceeds that of current employees. Further, the wedge between the two groups' expected educational levels widens as minimum educational requirements are decreased. We can then subject this selection model to empirical testing using a data set supplied by a large US public employer. The data allows to control for a number of characteristics that are specific to a particular job-opening, selection process, and individual applicant. We find that our econometric model achieves a "good fit" in describing the firm's recruitment behavior. More importantly yet, it rather strongly supports the economic mechanisms derived from our theoretical approach.

Since the seminal work of Freeman (1976) and Duncan and Hoffman (1981), numerous empirical studies for almost all developed economies have reported that overeducation increases wages and employment probabilities. Also, the overeducation effect is stronger for jobs that require unskilled or lower-skilled labor than for skilled jobs.[12] However, the explanations offered for these empirical findings have so far mostly been labor-market oriented. Emphasizing inefficient investment in ability signals, arguments derived from Spence's (1973) theory of labor market signaling and Thurow's (1975) theory of job competition compete with Sattinger's (1993) assignment theory according to which both unemployment and overeducation mirror the same problem of allocating heterogeneous labor to heterogeneous jobs.[13] Since the latter implies that overeducation may only be "perceived", measuring overeducation to obtain correct estimates of returns to educational investments becomes pivotal in the respective empirical work.[14]

lection. For an overview see Ryan and Ployhart (2000).

[12] See Groot and Maasen van den Brink (2000).

[13] Hartog (2000).

[14] The studies by Bauer (2002), Büchel and Pollmann-Schult (2003), Chevalier (2003), Meier et al. (2004), Wirtz and Atukeren (2005), and Brynin et al. (2006) are illustrative for the variety of possible econometric approaches and provide recent applications to different countries.

As is also well known, training programs of firms predominantly target the more qualified.[15] According to the career mobility approach,[16] accepting “underqualified work” in early career stages then enhances the individual’s career progress.[17] Only this latter explanatory approach therefore explicitly relates to human resources development within firms and has - to our knowledge - a single time so far been exposed to testing using firm-level data. Hence, Groeneveld and Hartog (2003) demonstrate the validity of the career mobility approach for jobs sheltered within a firm’s internal labor market. Consequently, they conclude that the overeducation effect on wages cannot be attributed to firm fixed effects but rather reflects strategic decisions of firms. The contribution of our analysis is then twofold: first, we confirm the existence of an overeducation effect on hiring probabilities in an environment in which the firm perceives itself as a labor market monopolist. Second, we show that - augmenting the career mobility approach - this selection behavior may actually be induced by institutional constraints.

The remainder of this paper is organized as follows: to begin with the next section informs about the selection process as it has been described in interviews with the firm’s human resources department. Given this description, we develop the theoretical model and derive testable hypotheses. Section 3 then provides a description of the data, develops the econometric approach, and reports our empirical findings. The paper concludes with a summary and discussion.

2 The theoretic approach

2.1 Description of the institutional setting

The theoretic model to be tested empirically adapts the standard recruitment model in two ways. First, we introduce specific assumptions concerning the sequential structure of the selection process and the binding or non-binding nature of minimum qualification requirements. These assumptions are derived from qualitative interviews with executive managers of the human resource department of the firm supplying its data. Second,

[15] See e. g. Vignoles et al. (2004) for a survey and a recent empirical investigation.

[16] Sicherman and Galor (1990).

[17] In this respect, Hersch (1991) has already noted that on-the-job training opportunities compensate for the non-pecuniary costs asscociated with job dissatisfaction. For Germany, Büchel (2000) shows that, controlling for further training, there exist no systematic effects of job dissatifaction on productivity.

statistical independence and other simplifying assumptions serve to keep the analysis clearly tractable in a multi-predictor environment and to highlight the driving economic mechanisms of the recruitment process.

This process is best described as a step-wise procedure. It begins when the firm's responsible financial executive officer (*FEO*) agrees to a job opening demanded by the (line) department of employment (*DoE*). In a first step, the human resources department (*HR*) and *DoE* must then agree on the classification of the job in terms of the bundle of tasks expected to be carried out, its hierarchical and organizational imbeddedness, and the minimum educational and professional experience requirements. This agreement determines a salary range which can later only be stretched by special consent of *FEO*. The interviews revealed that *HR* considers the firm - by far being the largest employer in the region - to virtually possess monopsony power. In fact, revisions of the salary range by *FEO* constitute very rare exceptions. Generally, the firm's salary ranges are sufficiently attractive for applicants.

In a second step, *HR* must advertise the job openings publicly - i.e. by postings and departmental mail within the firm, via newspaper ads, and on the internet. Jobs of the same classification while allocated to different *DoE*s are advertised jointly. Hence, typically a recruitment process aims at hiring a group of applicants. The advertisements communicate the job classification, salary ranges, and the minimum educational and professional requirements. Subsequently, *HR* receives applications from within and outside the firm which contain verifiable documents concerning educational attainments and professional experiences. Internal applications are motivated by the chance to negotiate a higher salary within the salary range. *HR* reserves the right to reject applications for formal reasons - e.g. if the professional qualification of the candidate is obviously inadequate.

As emphasized during the interviews, *HR* is mainly concerned with minimizing the legal costs associated with potential discrimination charges brought against the firm by unsuccessful applicants. Specifically, our firm being a public employer observes that screening applications on grounds of formal education bears the risk of "Adverse Impact" charges. Although the firm encourages its employees to enroll in further education programs and obtain formal degrees, it also accepts that professional experience can substitute for lacking educational degrees. Given the argument that educational standards may conceal discriminatory practises, the rate of substitution is perceived as increasing with minimum educational requirements.[18]

Taken to its theoretic extreme, we therefore assume that applicants who can document that the sum of their educational and professional achievements exceeds the sum of the respective two minimum requirements cannot be screened out. In principle, this rule applies to all applications. However, since job requirements and their corresponding descriptions always contain some firm-specific elements, the legal risk of screening is lower when dealing with applications from outside the firm. Theoretically, we assume that the professional experience claimed by outsiders is discounted when checking whether an application meets the minimum requirements.[19] The above then implies that the respective discount rate decreases in the advertised minimum educational standard.

In the third step of the recruitment process, all applicants who, given the difference in screening insiders and outsiders, pass the respective selection criteria are then pooled and subjected to the same set of job-specific ability tests. These tests always include job interviews with and formally evaluated by *DoE*. Conditional on the job type, other tests of cognitive abilities and/or non-cognitive skills may be added. Evaluating the results of these tests, *DoE* makes his hiring choices to be implemented by *HR*. However, before negotiations with the successful applicants begin, *HR* carries out a rationality check of *DoE*'s choices. Our interviews revealed that *HR* specifically aims to ensure that test standards have not been (re-)defined to meet a specific applicant's profile.

Summarizing, two verifiable signals - educational degree and professional experience - are available for screening applicants to be passed on to testing. However, only the sum of the two with professional experience discounted in outsider applications must meet the cut-off criterion. Testing then constitutes a costly activity which generates yet a third signal.

There clearly exists statistic correlation between these signals. For instance, holding age constant, the duration of formal education and professional experience should be negatively correlated.[20] Also, the degree of formal education and an individual's per-

[18] To put it more blankly, if a gardener's job would be advertised to require a PhD in botanics, every less educated member of a socially disadvantaged group who could prove to have experience in lawn mowing could successfully claim to have been discriminated.

[19] Hence, a top executive's secretary may be required to possess a BA-degree. However, since this requirement does not apply to secretary positions in general, internal candidates on a career track cannot be excluded. In contrast, outsiders can be screened out by claiming that the position requires firm-specific knowledge. Hence, their professional experience is "discounted".

[20] Empirically, we can control for this effect by entering age as an explanatory variable. See Anderson

formance in cognitive ability tests should be positively correlated.[21] However, assuming stochastic independence between signals serves to identify the economic mechanisms driving the outcome of this process of screening and testing.

2.2 The model

2.2.1 Basic assumptions and notations

Given the above, let on-the-job ability a be identically and independently distributed $N(\mu, \sigma_a^2)$ over the two populations of applicants denoted insiders and outsiders. Further, the degree of formal schooling s, professional experience x, and potential test scores z are known to be identically, independently, and standard normally distributed over these two populations. As usual, $\Phi(y)$ and $\phi(y)$, $y \in \{s, x, z\}$, denote the standard normal distribution and density functions.

HR has carried out pre-tests to validate that

$$a = \alpha + \beta_s s + \beta_x x + \beta_z z + \varepsilon \tag{1}$$

where $\varepsilon \sim N(0, \sigma_\varepsilon^2)$ is a measurement error with $Cov(\varepsilon, y) = 0$ for $y \in \{a, s, x, z\}$. As explained above, we also assume that $Cov(s, x) = Cov(s, z) = Cov(x, z) = 0$. In contrast, let $r_{ay} \geq 0$ denote the coefficient of correlation between ability and the predictor y, $y \in \{s, x, z\}$. Then, $\alpha = \mu$ and $\beta_y = \frac{r_{ay}\sigma_a}{\sigma_y}$. To (significantly) economize on space and notation, we assume that $r_{ax} = r_{as} = \rho$ in the following. This assumption does not imply that the two signals are identical. Rather, they only serve equally well as ability predictors. Further simplifying notations, let $r_{az} = r$.

Now, suppose that *HR* requires minimum educational qualification S and professional experience X to select an applicant for further testing. Let $\omega^I \equiv s + x$ and $\Omega \equiv S + X$. Note that $\omega^I \sim N(0, 2)$ and denote the respective distribution and density functions by $\Psi^I(\omega^I)$ and $\psi^I(\omega^I)$. Further, all applicants whose test score satisfies $z \geq Z$ will actually be hired. Given the institutional constraints described above, the expected ability of

et al. (2004) concerning the interaction of commonly used predictors.

[21] In this respect, we must assume that *HR*'s test design does not simply replicate the effects of screening inherent to educational programs.

insider recruits can then be derived as

$$
\begin{gathered}
E^I\{a;S,X,Z\} = \\
\mu+\sigma_a\left[r_{as}E\{s \mid \omega^I \geq \Omega\}+r_{ax}E\{x \mid \omega^I \geq \Omega\}+r_{az}E\{z \mid z \geq Z\}\right] = \\
\mu+\sigma_a\left[\sqrt{2}\rho\int_{\Omega}^{\infty}\omega^I\frac{d\Psi^I(\omega^I)}{(1-\Psi^I(\Omega))}+r\int_{Z}^{\infty}z\frac{d\Phi(z)}{(1-\Phi(Z))}\right].
\end{gathered} \tag{2}
$$

For outsiders let $\tau \in (0,1)$ denote the "discount" factor measuring the fraction of an outsider's documented professional experience that qualifies for the job opening advertised by the firm.[22] To focus on the informational aspects of the screening process, we assume that this "discounting" of outsiders' professional experience only affects the possibility to enforce the screening criteria S and X. Else, it bears no ("real") effects on the predictor value of professional experience. As discussed above, we specifically assume that $\tau = \tau(S)$, with $\tau'(S) > 0$, and $\lim_{S\to\infty}\tau(S) = 1$. Thus, as *HR* raises the minimum educational requirement, an outsider's professional experience increasingly serves as a substitute for lacking formal education.

Letting $\omega^O = s + \tau(S)x$, note that $\omega^O \sim N(0, 1 + (\tau(S))^2)$. Then, denote the respective distribution and density functions by $\Psi^O(\omega^O;\tau(S))$ and $\psi^O(\omega^O;\tau(S))$. Hence, the expected ability of outsider recruits can be obtained as

$$
\begin{gathered}
E^O\{a;S,X,Z\} = \\
\mu+\sigma_a\left[r_{as}E\{s \mid \omega^O \geq \Omega\}+r_{ax}E\{x \mid \omega^O \geq \Omega\}+r_{az}E\{z \mid z \geq Z\}\right] = \\
\mu+\sigma_a\left[\frac{2\rho}{\sqrt{1+(\tau(S))^2}}\int_{\Omega}^{\infty}\omega^O\frac{d\Psi^O(\omega^O;\tau(S))}{(1-\Psi^O(\Omega;\tau(S)))}+r\int_{Z}^{\infty}z\frac{d\Phi(z)}{(1-\Phi(Z))}\right].
\end{gathered} \tag{3}
$$

Obviously, the above calculations of expected abilities demand that both groups of applicants are sufficiently large. For simplicity, we further assume that they are of identical size N. Given that there are M openings, the recruitment process must then ensure that

$$
(1-\Phi(Z))\left[\sum_{A=I,O}\left(1-\Psi^A(\Omega)\right)\right] = \frac{M}{N} \tag{4}
$$

[22] Obviously, it would be more adequate to assume that an individual outsider's professional experience is subject to a discount factor t where t constitutes a random variable with expected value τ. Thus, accounting only for the expected value of discounting implies that the distribution of t is independent of the individual's signal profile (s, x, z).

where $\frac{M}{N}$ is taken to be smaller than one. The firm's objective to be implemented by *HR* is defined as maximizing the expected ability

$$E^F\{a;S,X,Z\} = \frac{\sum_{A=I,O}\left(1-\Psi^A(\Omega)\right)E^A\{a;S,X,Z\}}{,\sum_{A=I,O}\left(1-\Psi^A(\Omega)\right)} \quad (5)$$

of its new recruits net of the costs C associated with the ability tests. Following the literature on testing for recruitment, these costs are fixed and reflect *HR*'s choice of the test design.[23] Obviously, no such costs must be incurred if the recruitment decisions are based only on the educational and professional information supplied by the applicants themselves.

2.2.2 Screening and testing with only one group of applicants

Focussing on selecting recruits from only one group of applicants serves best to illustrate the economic mechanism governing this particular recruitment process. Hence, to begin with, set $\Psi^O(\Omega) = 1$ in (5) and (4) above. Thus, we assume that there are only internal applications. The respective Lagrange-function can be derived as

$$\begin{aligned}\mathcal{L}^I &= \eta(Z)\left[E^I\{a;S,X,Z\}-C\right]+(1-\eta(Z))\left(\lim_{Z\longrightarrow-\infty}E^I\{a;S,X,Z\}\right)\\ &\quad -\lambda^I\left[(1-\Phi(Z))\left(1-\Psi^I(\Omega)\right)-\frac{M}{N}\right]\end{aligned} \quad (6)$$

where

$$\eta(Z) = \begin{cases}1 & \text{if } \Phi(Z)\in(0,1]\\ 0 & \text{if } \Phi(Z)=0\end{cases} \quad (7)$$

denotes an indicator function which allows to capture the opportunity cost nature of C.

The first-order conditions can be rearranged to yield:

$$\eta(Z): E^I\{a;S,X,Z\}-C-\lim_{Z\longrightarrow-\infty}E^I\{a;S,X,Z\}\left\{\begin{array}{c}=\\ \leq\end{array}\right\}0\ , \quad (8)$$

$$\text{if } \Phi(Z)\left\{\begin{array}{c}\geq\\ =\end{array}\right\}0\ ;$$

[23] This assumption does not conflict with the fact that "testing" may only consist of job interviews. The time that *DoE*-managers will have to spend on such interviews is prearranged and reserved by *HR*. The number of applicants then only affects the duration of the average interview and, thus, the quality r of the respective information.

$$Y \in \{S, X\}: \qquad \lambda^I (1 - \Phi(Z)) + \frac{\eta(Z)}{\psi^I(\Omega)} C = \tag{9}$$
$$\frac{\sigma_a \sqrt{2}\rho}{(1 - \Psi^I(\Omega))} \left[\Omega - \int_\Omega^\infty \omega^I \frac{d\Psi^I(\omega^I)}{(1 - \Psi^I(\Omega))} \right] ;$$

$$Z \quad : \qquad \lambda^I \left(1 - \Psi^I(\Omega)\right) = \tag{10}$$
$$\frac{\sigma_a r}{(1 - \Phi(Z))} \left(Z - \int_Z^\infty z \frac{d\Phi(z)}{(1 - \Phi(Z))} \right) \text{, if } \eta(Z) = 1 .$$

These conditions immediately reveal two important properties. First, according to (9), *HR* will never set separate educational and professional minimum requirements if applications can only come from within the firm. Second, only if *HR* decides on additional testing, an optimum recruitment policy may be characterized by balancing the marginal returns from setting application and testing standards. Otherwise, expected ability is simply determined by choosing Ω such as to satisfy (4) for $\Phi(Z) = 0$.

Investigating (8) then reveals

$$\Delta E^I \equiv E^I\{a; S, X, Z\} - C - \lim_{Z \longrightarrow -\infty} E^I\{a; S, X, Z\} = \tag{11}$$
$$-C + \sigma_a r \int_Z^\infty z \frac{d\Phi(z)}{(1 - \Phi(Z))} - \sigma_a \sqrt{2}\rho \int_\Omega^{\widetilde{\Omega}} \omega^I \frac{d\Psi^I(\omega^I)}{\Psi^I\left(\widetilde{\Omega}\right) - \Psi^I(\Omega)}$$

where $\widetilde{\Omega}$ is defined by $\left(1 - \Psi^I(\widetilde{\Omega})\right) = \frac{M}{N}$. Accounting for (4) given the above assumption that $\Psi^O = 1$, $\lim_{Z \longrightarrow -\infty} \Delta E^I = -C < 0$. Additional testing can thus be optimal if the respective costs are low. Also, the coefficient of correlation between ability and the test score r should be large relative to ρ which reflects the correlation between ability and the signal content of the application documents. Job interviews are likely to qualify in this respect.[24]

For the remainder, we will assume such an interior solution. In the present case, it implies

$$\frac{r \left[Z - \int_Z^\infty z \frac{d\Phi(z)}{(1 - \Phi(Z))} \right]}{\rho \left[\Omega - \int_\Omega^\infty \omega^I \frac{d\Psi^I(\omega^I)}{(1 - \Psi^I(\Omega))} \right]} = 1 - \frac{C\left(1 - \Psi^I(\Omega)\right)}{\psi^I(\Omega)\, \sigma_a \left[\Omega - \int_\Omega^\infty \omega^I \frac{d\Psi^I(\omega^I)}{(1 - \Psi^I(\Omega))} \right]} > 1. \tag{12}$$

[24] See e. g. Dakin and Armstrong (1989) and, distinguishing selection criteria in great detail, Robertson and Smith (2001).

As expected, the testing costs induce a distortion. In consequence, selection according to test scores is "over"-restrictive.

Setting $\Psi^{I}(\Omega) = 1$ in (5) and (4), then allows to characterize the alternative scenario of hiring only from a pool of outsiders. Only switching superscripts, the first-order conditions with respect to $\eta(Z)$ and Z restate (8) and (10) from above. Yet, (9) is replaced by,

$$X: \qquad \lambda^{O}\left(1-\Phi\left(Z\right)\right)+\frac{\eta(Z)}{\psi^{O}\left(\Omega\right)}C = \tag{13}$$

$$\frac{2\sigma_{a}\rho}{\left(1-\Psi^{O}\left(\Omega\right)\right)\sqrt{1+\left(\tau(S)\right)^{2}}}\left[\Omega-\int_{\Omega}^{\infty}\omega^{O}\frac{d\Psi^{O}\left(\omega^{O}\right)}{\left(1-\Psi^{O}\left(\Omega\right)\right)}\right];$$

$$S: \qquad \lambda^{O}\left(1-\Phi\left(Z\right)\right)+\frac{\eta(Z)}{\psi^{O}\left(\Omega\right)}C = \tag{14}$$

$$\frac{2\sigma_{a}\rho}{\left(1-\Psi^{O}\left(\Omega\right)\right)\sqrt{1+\left(\tau(S)\right)^{2}}}\left[\Omega-\int_{\Omega}^{\infty}\omega^{O}\frac{d\Psi^{O}\left(\omega^{O}\right)}{\left(1-\Psi^{O}\left(\Omega\right)\right)}\right]$$

$$+\frac{2\sigma_{a}\rho\tau'(S)\tau(S)}{\psi^{O}\left(\Omega\right)\left(1+\left(\tau(S)\right)^{2}\right)^{\frac{3}{2}}}\int_{\Omega}^{\infty}\omega^{O}\frac{d\Psi^{O}\left(\omega^{O}\right)}{\left(1-\Psi^{O}\left(\Omega\right)\right)},$$

where we have made use of the properties of the normal distribution to obtain (14).

Taking the limits $S\rightarrow\infty$ of the RHS of (13) and (14), this corner solution violates (4) since all applicants would be screened out. Further, taking the respective limits $S\rightarrow-\infty$ implies that the expected signal values are zero. Hence, the applicants' documents would not be used for screening at all. However, since this information is costless for the firm, this corner solution can also be ruled out. Again, an interior solution is ensured if it is optimal to test the applicants. The preceding arguments then imply that this solution must be characterized by $0<\tau(S)<1$.

Comparing (13) and (14) with (9) reveals that the interior solution implies distinctly separate minimum educational and professional experience requirements in the outsider-recruitment case. From a purely informational economics perspective, "discounting" the professional experience of outsiders increases the precision of the signal ω^{O} which is subjected to the cut-off criterion Ω.

Two effects then determine an optimal increase in precision. First, as $\tau(S)$ decreases, the two signals x and s contained in ω^{O} can increasingly be used separately to predict on-the-job ability. Yet, the positive effect of this signal separation on the precision of ω^O is traded-off against the fact that professional experience also receives less weight as a predictor of ability. In the extreme, for $\tau(S) = 0$, experience is not used for screening at all.

2.2.3 Recruiting from two independent pools of insiders and outsiders

Given the description of the institutional setting with mandatory public job advertisements, *HR* organizes the recruitment process to maximize (5) subject to (4). Yet, characterizing the solution does not add further analytic insights. The respective first-order conditions with respect to the minimum educational and professional experience requirements, S and X, merely contain weighted sums of the terms in (13), (14), and (9). The weights are given by $\sum_{A=I,O} \psi(\Omega) / \sum_{A=I,O} \left(1 - \Psi^A(\Omega)\right)$.

Hence, the characterizations above carry over in the sense that, if - given the costs of testing - the test scores are used for selection, the solution balances the marginal returns from using all three signals for recruitment. Separate educational and professional experience standards will then be advertised but only enforced in screening outsider applications. These analytic conclusions imply the following hypotheses for empirical testing:

H1: Outsider recruits are characterized by higher educational levels than insider recruits.

Since insider applications resemble the current structure of educational attainments in the firm's labor force, new employees therefore appear to be "overqualified". However, empirical support for *H1* could also reflect the career mobility approach. In contrast, the following specifically addresses the screening mechanism inherent to the recruitment model above:

H2: The "overqualification" effect on the group of outsider recruits increases with lower minimum educational standards set for successful applicants.

As explained above, lower minimum educational requirements S *ceteris paribus* increase the possibility of "discounting" the professional experience of outsiders.[25] This policy is optimal because it increases the precision of the screening process. Since the effect only applies to outsider applications, recruiting for jobs which are advertised to require rather low educational degrees should result in relatively more "overqualified" new employees.

3 Empirical analysis

3.1 The data

In May 2003, the firm - a large US public employer - introduced an online recruiting system. Starting with this date, all job applicants were required to (also) file an electronic application and obtain log-in usernames and passwords. Hence, our data covers the time period from the introduction of this system to February 2006. It is further restricted to rank-and-file employee or laborer positions; recruitment processes aimed at filling executive positions are excluded. Our data set comprises of 33780 observations of individuals who (a) filed complete applications during this time-span and (b) entered a recruitment process which had reached a final decision by the end of our observation period. As can be seen from Table 1, there were 1244 of such processes.

The data set contains information concerning the educational attainments of all candidates whose application was forwarded to the *DoE*s. As can be verified from Table 2, all possible US degrees - i.e. doctorate, master, bachelor, some college education, high school degree, highschool equivalent degree (*GED*), and only some high school education - can be found among both the applicants and the recruits. The online recruitment system further requires to enter the applicant's work experience, age, gender, race, and the recruitment channel by which she had been attracted. Each application is linked to a job-opening for which the data set provides the expected date of commencing work, position title, *DoE*, and type of appointment (*Job Type*). The latter ranges from 1 for Contingent/On-Call Labor (no benefits) to 6 for Regular/Full-Time Employee (eligible for benefits).

[25] Within the current framework, the typical "ceteris paribus" clause particularly implies that other job characteristics (technical vs. administrative, superior vs. inferior hierarchical position etc.) are held constant.

Upon our request, *HR* also supplied the respective advertised required levels of education, the Equal Employment Opportunity (*EEO*) code numbers which increase in steps of 10 points from 10 (executive, administrative and managerial positions) to 70 (service and maintenance positions), the Fair Labor Standards Act status (*FLSA*) which takes on the value 1 if the job is exempt (no overtime pay) and zero otherwise, and the workplace scores (*Grade*). The latter reflect expectations concerning the necessary skills and experience, the complexity of the tasks and creativity required in exercising them, the job's impact on the firm's mission, exposure to internal and external contacts, the degree of discretion in decision making, physical stress, and working conditions. The weights associated with these factors are determined consensually by *HR* and the *DoE* prior to advertising the job opening. The respective score calculated as a weighted sum of these factors then determines the compensation range.

Defining overqualification as possessing a higher than the advertised educational level, the first entries in the bottom part of Table 3 reveal that the majority of the recruits - i.e. 58% - were *overqualified*, while 34% actually possessed just the minimum required educational degree (*exactly qualified*). If the applications were forwarded by direct contact from a *DoE* (*DCD*) or other internal reference (*IR*), we classify the respective applicants as insiders. They constitute 11.4% of all applicants. All other recruitment channels - i.e. initiated by web-based job posting board, the firm's own website, newspaper advertisements (*NwAd*), job notices sent to colleges or universities (*JNU*) or to the state employment office (*SEO*), and other (*ORC*) - in sum define outsider applications. We combine the first two of the above to be classified as web-recruitment channels (*WebRc*).

As shown in Table 3, they account for those 77% of the applications which doubtlessly come from outside the firm. Insiders (*IR&DCD*) then form the largest group among recruits who are *underqualified*. In contrast, outsiders constitute the largest group among the hired *overqualified* applicants. This observation clearly suggests that insider and outsider applications receive rather different appraisals during the recruitment process.

3.2 The econometric model

The dependent variable *Status* in the regression reported in Table 4 takes on the value 1 if the applicant is hired and zero otherwise. Characterizing the particular job opening, *Grade*, three department-types within the firm (the central administration, the *DoE* administration, and technical support and services), the *EEO* code number, the *FLSA* status variable, and *Job Type* serve as dependent variables. The characteristics of the particular recruitment processes are captured by the number of applications of individuals who possess a higher than the minimum required educational degree (*Overqualified*) and the total number of job-candidates (*Applications*). In addition, the number of applications which used the same recruitment channel (*Appl.'s Rc*) reflects the individual's competitive environment.

As explained above, an insider application is defined by the use of internal references. Including the recruitment channel which has attracted a particular outsider applicant then serves to examine whether there exists a dominant form of attracting potentially successful candidates from outside the firm. Other variables characterizing the individual applicant are *Age*, *Sex* (equal to 1 if the applicant is male), professional *Experience*, and the minority status (*Non-White*).[26] Unfortunately, the data only allows to identify whether the individual possesses (1) or does not possess (0) adequate professional experiences judged by *HR*. As usual, we also include the square of the individual's age to allow for a non-linear age-productivity profile. As discussed by Wooldridge (2002, p. 546), including both the individuals's age and experience in the regression serves to identify a potential age-discrimination effect.

Clearly, the variables characterizing the applicant's educational background are of key interest. The variable *Education* ranges from 0 for completed first grade to 19 for a doctorate degree. This coding of educational attainments used by *HR* also mirrors the individual's time spent in formal education. *Qualification* takes on the value 2 (1, 0) if the applicant is overqualified (exactly qualified, underqualified) relative to the advertised minimum educational level. To capture a possible non-linear education-productivity relationship we also include the respective squares of these two variables. Recall that our theoretical model predicts that the insider effect on the hiring probability manifests in professional experience substituting for a lack of formal education. Thus, we finally include the respective interaction variables *Exp. Ins.*, *Educ. Ins.*, and *Qual. Ins.* between *Experience*, *Education* and *Qualification* and the insider status.

From the description of the institutional setting also recall that *HR* and *DoE* agree on the specification of the job opening in the first step of the recruitment process. This specification is used to calculate the workplace score (*Grade*) and is publicly advertised. In the second step, the firm seeks to fill every job opening with the best available appli-

[26] More detailed ethnic classifications did not prove statistically significant.

cant. Although *HR* strictly oversees that the job specifications are not revised during the selection process, expectations concerning the relative scarcity of qualified applicants may nevertheless affect *DoE*'s efforts to negotiate a higher score. Since a higher score implies a more generous salary range, there may therefore exist a second indirect effect of the qualification structure within the group of applicants on the hiring probability.

Hence, we choose a *Two-Stage Least Squares* (*2SLS*) regression approach. Specifically, *Grade* is instrumented to account for endogeneity. The three department-types proved to constitute adequate instruments. To avoid multicollinearity, technical support and services constitutes a benchmark department-type. As explained above, the fourth instrument is the number of overqualified applicants. Recalling our theoretical model, the presence of insiders should induce a higher risk of legal costs. Consequently, the firm would lower the advertised required minimum educational and experience levels without altering its policy to compute the workplace scores.

As is well known, heteroskedacity will induce inconsistent estimators in both probit and logit regressions. Hence, we implement Murphy and Topel's (2002) approach to correct the standard errors and report the results for the linear probability model (*LPM*) in Table 4. Following Wooldridge (2002, p. 479), we further use a heteroskedacity-robust covariance-matrix regression throughout the remaining analysis. Only for comparison and robustness checks, we also report the marginal effects using both logit and probit models in Table 6.

3.3 The regression results

First, we address the quality of our estimate reported in Table 4 and begin by carrying out the *Hausman* test for endogeneity. Following Wooldridge (2002, p. 361 and p. 471), we insert the predicted residuals from the reduced form into the main regression equation and test whether the respective coefficient is statistically different from zero. The respective F-statistic attains the value 17.13. Thus, we strongly reject the null of no endogeneity. This result generally confirms the adequacy of the *2SLS*-approach to capture the specific features of the firm's recruitment process.

Note that the coefficient on the number of overqualified applicants is positive and highly significant. This finding confirms that *HR* and *DoE* agree on higher workplace scores when they expect more highly qualified job candidates. Specifically, one more overqualified applicant per job increases this score by .002 points.[27] However, to achieve a correct inference in the 2SLS framework, we check the correlation between the endogenous variable and the instruments. The F-test for the null-hypothesis on the coefficients of *Central Dept., DoE Dept*, and *Overqualified* reveals a value of 376.92. Since this statistic follows a χ^2-distribution with three degrees of freedom, the null hypothesis is strongly rejected.[28] Given a partial R^2 of .7183, a rather large sample size of 33780 observations, and the F-statistic above, we conclude that there is no "weak-instrument"-problem.[29]

Further, we carry out an over-identification test. We obtain the predicted residuals from the regression of *Status* on the list of explanatory variables including the four instruments. In the second step, we regress the predicted residuals on all instruments and obtain the respective R^2. The respective results of this procedure are reported in Table 5. The *Lagrange Multiplier* test uses that $nR^2 \sim \chi^2$ where n is the number of observations. The degrees of freedom are equal to the number of overidentifying instruments. The respective statistic attains the value 6.756 in our model. With two degrees of freedom, the p-value is .034 which indicates significance only at the 5% level. Yet, since we test the null-hypothesis that the instruments are valid at the 1% level, we conclude that our instruments are in fact exogenous. Finally, recall that our interviews with *HR* suggested the existence of an endogeneity problem. Given that in a situation of weak identification the attraction to the regression coefficient implied by the presence of strong endogeneity is far greater for OLS than it is for IV-estimations, we conclude that the results above support our model specification.[30]

Comparing the partial effects of our 2SLS-LPM model (Table 4) with those derived using logit and probit (Table 6) reveals only small differences.[31] Our qualitative results therefore appear robust. The probability to be recruited is thus lower for men, non-whites, and older applicants where the latter effect appears to level out. Higher probabilities for women likely reflect the overall dominance of administrative jobs in the

[27] Within our sample, the *Grade* varies in between 50 and 65.

[28] Following Staiger and Stock (1997), the respective F-statistic should be greater than 10.

[29] Baker et al. (1995).

[30] See Phillips (2005). Of course, we have experimented with other potential instruments. Yet, carrying out the respective exogeneity tests did not support their inclusion. Moreover, according to Han and Phillips (2005), selecting more but weak instruments actually leads to consistent estimates under certain regularity conditions .

[31] Note, however, that interaction variables cannot generally be interpreted in the usual way in either logit or probit models. For instance, in a probit model, most applied economists compute the marginal effect of the interaction term as $\partial\Phi(\cdot)/\partial(x_1x_2) = \beta_{12}\Phi'(\cdot)$. However, Ai and Norton (2003) show that the correct interaction effect is written as $\partial^2\Phi(\cdot)/(\partial x_1\partial x_2) = \beta_{12}\Phi'(\cdot) + (\beta_1+\beta_{12}x_2)(\beta_2+\beta_{12}x_1)\Phi''(\cdot)$.

sample. Having accounted for the recruiter's expectation of scarcity of adequate applicants, *Grade* - measuring that the job becomes more attractive in terms of income - exhibits a positive sign. Since we regress on the probability to be hired, salary ranges therefore still seem slightly below the level considered competitive by the most-qualified applicants for a job.

This conclusion is supported by the negative sign for *Job Type* which meets our expectations since the value of this variable decreases with more attractive hierarchical positions. More competition for the job - as measured by *Applications* and *Applicant's Rc* - decreases the probability to be hired. The former, however, enters via the recruiter's expectation when determining the workplace score (*Grade*). Among the recruitment channels for outsiders, web-based applications exhibit a strong positive impact, while being sent by the state employment agency decreases the hiring probability. Clearly, the former signals more and the latter less intense private efforts in finding a job.

Focussing on the key qualification variables, both better education and professional experience which is judged to be adequate by *HR*, obviously increase the probability to be hired. The marginal effects appear even increasing in the attained qualification levels. Moreover, there exists a distinct overqualification effect. Thus, possessing an educational degree which is higher than the minimum required level enhances the probability to be hired *per se*. The effects of higher formal education and professional experience are even stronger for insiders. The marginal effects of the interaction variables are highly significant (see Figures 1-3 for details). These results rather support our theoretical model since, recalling the above, insiders are on average less qualified.

3.4 Insider-Outsider Effects on the Screening Mechanism

While our theoretical approach and the econometric model seems adequate, we want to investigate the screening mechanism in greater detail. Specifically, we are interested in whether the hypothesis *H2* can be supported as well. Recall that lower minimum educational requirements increase the possibility of "discounting" the professional experience of outsiders. Hence, incidences of hiring overeducated outsiders should increase with lower advertised educational requirements.

Thus, we construct a new set of dependent variables based on three distinct required educational levels for a job: jobs which require a High School diploma, a Bachelor's and a Master's degree respectively. Each variable takes a value 1 if the statement is true and the applicant is hired, and zero otherwise. Testing for differences on the coefficients of *Experience* and *Education* across these three subgroups, we use a simultaneous system of equations of the Seemingly Unrelated Regression (*SUR*) type.[32] To solve the endogeneity problem we therefore perform a Three Stage Least Squares Regression (3SLS).

To save space, we only report the estimates for the key variables in Table 7. The coefficients on both *Experience* and *Education* are decreasing with increasing minimum educational requirements. Confirming our former findings, the F-test for the null hypothesis that the coefficients on *Education* are all zero yields the value 40.51 which is significantly higher than the critical value given a χ^2-square distribution with two degrees of freedom. We also perform pairwise tests of equality among coefficients. With p-values of .0085 (.0003) the null-hypotheses that the coefficients of *Education* are identical whether the firm hires a candidate with highschool or bachelor degree (bachelor or master degree) is strongly rejected. Thus, hypothesis *H2* appears to be confirmed as well.

However, focussing on *Educ. Ins.,* there appears to be no clear pattern within the group of insiders. Thus, we proceed by constructing still a third set of dependent variables only accounting the *Qualification* status of a hired applicant. Hence, we distinguish whether a recruit possesses a higher educational degree than advertised as required (*OverStatus*), is exactly qualified (*ExactStatus*), or underqualified (*LessStatus*). In Table 8 we again only report the results only for the key coefficients.[33] Being an insider and underqualified can be verified to actually increase the chances of being hired.

The top entries in Table 9 report the predicted average probability of being hired given that an applicant is overqualified, exactly qualified, and underqualified. Notice that the LPM, logit, and probit estimates are almost identical. In the following, we therefore choose only the LPM-approach to estimate the average probabilities to be hired conditional on the advertised educational requirement for the full sample and a sample excluding all *insider* observations. Clearly, the decrease in these predicted average probabilities as we exclude insider observations is largest for the underqualified applicants across all advertised degree requirements. Again, this observation supports that, when competing for the same job, successful *outsider* recruits are characterized by

[32] Hence, we can also exploit the information contained in the variance/covariance matrix across jobs with different educational requirements.

[33] For the estimates we retain all other control variables except *Qualification*.

higher educational attainments than *insiders* who succeed in becoming promoted.

3.5 Goodness of fit

Since we are using firm-level data, an immediate question concerns whether our empirical results are also descriptive for the *HR*'s activities and choices. Hence, we carry out the Hosmer-Lemeshow (1982) *goodness-of-fit* test. We divide our sample into six subsamples in order to compare observed and predicted counts of outcome events. This number of subgroups corresponds to the number of groups that would result using the minimum level of education advertised: jobs which require (1) the ability to read and write, (2) a highschool diploma, (3) a post-secondary (i.e. two-year college) degree, (4) a bachelor's degree, (5) a master degree, and (6) a doctorate degree.

Thus, the first sextile in Table 10 corresponds to the 1/6-sample of applicants who are characterized by the lowest while the sixth sextile is defined for the subgroup with the highest probability to be hired. The Hosmer-Lemeshow (HL) statistic is then computed as

$$HL = \sum_{i=1}^{6} \left[\frac{(\text{observed counts } (i) - \text{predicted counts } (i))^2}{\text{predicted counts } (i)} \right] . \tag{15}$$

If the null hypothesis of a "good fit" is true, this statistic is distributed χ^2 with four degrees of freedom. Columns *OBS_1* and *EXP_1* in Table 10 list the observed and predicted hiring cases while columns *OBS_0* and *EXP_0* contain the observed and predicted non-hiring cases. The overall value of HL can be calculated as 4.77 implying that the null hypothesis of a "good fit" cannot be rejected with reasonable statistical significance.

Although the model therefore seems to "fit well", there may still be a large number of cases where it fails to predict individual outcomes correctly. Thus, a predicted hiring is defined by a predicted probability of being hired exceeding .5 in the classification table (Table 11). For every applicant we compare this predicted with the actual outcome (hired or not hired). In 96.4% of all cases the predictions are correct. For non-hiring cases, this probability even attains 99.82%. However, a hiring decision is correctly predicted in only 6.75% of the respective cases.

Of course, this percentage of correctly predicted hirings can be increased by lowering the cut-off probability defining this incidence. The functional relationship between the percentage of correctly predicted recruitments and the cut-off probability is denoted *sensitivity*. Yet, increasing the cut-off probability comes at the expense of increasing the probability of predicting a hiring when the actual outcome is "not hired". The respective functional relationship between the percentage of falsely predicted recruitments and the cut-off probability is denoted *1-specificity*. Thus, Figure 4 depicts sensitivity as a decreasing and specificity as an increasing curve of the cut-off probability which defines a predicted hiring.

The so-called *ROC-curve*[34] in Figure 5 then draws out the sensitivity-specificity trade-off. The 45-degree line in the figure would result if the model would both correctly and falsely predict 50% of all recruitments for all cut-off probabilities. Thus, it provides a benchmark: the predictive power of a model is better if the ROC-curve arches higher above this line. In our case, the area under the ROC-curve is .7960 which is generally considered to indicate rather high predictive power.

4 Summary and policy discussion

We have theoretically analyzed a standard employee selection model given two stylized institutional constraints: first, professional experience can perfectly substitute for a lack of formal education for insiders while this substitution is imperfect for applications from outside the firm. Second, due to increased legal risk, the respective "discount rate" applied to professional experience when dealing with outsider applications increases with the advertised minimum educational requirement. Given these constraints, the optimal selection policy implies that the expected level of formal education is higher for outsider than for insider recruits. Moreover, this difference in educational attainments between the two groups of recruits increases with lower optimal minimum educational job requirements.

Designing an appropriate econometric model to investigate employee selection data of a large US public employer both of the above theoretical implications can be confirmed empirically. Yet, this fact alone is certainly not sufficient to claim that the theoretical

[34] I. e. the "Receiver Operating Characteristic" curve. See DeLong et al. (1988) for a discussion.

model has been successfully tested. Hence, recall that previous explanations found in the literature have predominantly emphasized inefficient investments in signaling through educational attainment or matching problems in imperfect labor markets. Following the same line of arguments as Groeneveld and Hartog (2003), however, such explanations cannot apply when investigating the recruitment behavior of a single monopolistic employer. Moreover, the career mobility approach as the alternative theoretic framework cannot explain that the wedge between the expected educational levels of outsider and insider recruits widens with lower advertised minimum requirements. Finally, our model builds upon qualitative information derived from interviews with the firm's human resources department. Hence, at the very least we succeed in offering a novel institutional economics explanation.

Groeneveld and Hartog (2003) investigate internal promotions of a large, only recently deregulated European energy and telecommunications company. In contrast, our case concerns employee selection with competing outsider and insider applications by a large US public employer.[35] Clearly, US firms enjoy more legal protection of their rights to hire at will. However, the personnel policies of public employers - subjected to constitutional restraints and self-regulated by manuals of "fair" employment practises - appear rather similar to those of large European corporations which face a considerably broader set of legal constraints.[36] Currently, a new set of such regulations may then be emerging: pursuing the goals of fostering lifelong learning and the inclusion of population groups who have been socially excluded from obtaining adequate education, the *Commission of the European Communities* (2000) and the *Council of Europe* (2001) have initiated a process that aims at establishing formal equivalence of educational degrees and professional experience gained in occupational training programs.

The EU member states are called upon to establish systems of *Accreditation of Prior Learning* (*APEL*) by involving all relevant parties - including providers of informal training and non-governmental organizations representing socially excluded groups.[37] The current states of implementation vary widely across the European countries. In France, however, the *Validation des Acquis Professionneles* (*VAP*) and the *Validation des Acquis de l'Experience* (*VAE*) decrees have already achieved that individuals can obtain

[35] Obviously, we also agree with our colleagues who caution that, unless reconfirmed regularly, case study results should not be generalized.

[36] In fact, economic institutionalism holds that labor law to a considerable extent reflects and standardizes employment practises developed in the respective economies. See Godard (2002). For an empirical study on this claim see Chor and Freeman (2005).

[37] See Davies (2003) for an overview of the origins and implemenation steps of this action plan.

a perfect university degree equivalent certificate without attending university at all.[38] Once put into law such equivalence rules ultimately constitute binding constraints on employee selection processes in all firms, public and private. Consequently, the rate of substitution between formal education and professional experience should tend to be equalized between insider and outsider applicants - thus, reducing the overqualification effect in employee selection processes. However, this development will then also diminish the signal value of formal education. Given our approach based on informative signaling, it will therefore further decrease allocative efficiency.

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[38] In contrast, the development in the United Kingdom is still much in the state of an initiating political debate, for instance. For this reason, it may be particularly interesting, however, to refer to a combined French and Anglo-Saxon source for further insights. Hence, see Gallagher and Feutrie (2003).

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Appendix: Tables and Figures

Table 1: Descriptive statistics of the online-recruitment system

Total number of applications	33780	100%
Qualified applicants forwarded to departments	26641	78.86%
Disqualified applicants	4469	13.22%
Applications cancelled	828	2.45%
Applications withdrawn	837	2.47%
Applications filed but failed to maintain contact	1005	2.97%
Number of jobs filled using on-line system	1244	3.68%

Table 2: Educational attainments of applicants and recruits

Year	Doct.	Mast.	Bach.	Some Coll.	Highsch.	Some High.	GED	n.a.	Total
	All applicants								
2003	135	883	2208	2615	789	42	116	13	6801
2004	274	2068	4031	3850	1031	55	165	9	11483
2005	410	2271	4648	4804	1338	30	156	9	13666
2006	30	255	714	589	201	8	32	1	1830
	Recruits								
2003	7	24	51	84	29	1	3	0	199
2004	13	73	158	143	57	2	6	0	452
2005	19	84	181	180	50	1	7	0	522
2006	1	16	29	20	5	0	0	0	71

Table 3: Insider-outsider distinction

Use of recruitment channels				
DCD	1.38%			
IR	10.02%			
WebRc	77.2%			
NwAd	7.76%			
JNU	0.39%			
SEO	0.24%			
ORC	3.00%			
Recruits: Outsiders vs Insiders				
Hired applicants	% of all hired	IR (%)	DCD(%)	IR & DCD (%)
Less qualified	8.03	20	31	51
Exactly qualified	33.52	15.58	24.7	40.28
Over qualified	58.44	13.75	29.02	42.77

Table 4: 2SLS regression - LPM§

1^{st} Stage Regression (R^2 =0.7183)			2^{nd} Stage Regression (R^2 =0.0805)		
Grade	Coef	Rob. std. error	Status	Coef.	Rob. Std. Error
Centr. Admin.	-.765***	(.027)	Grade (pred.)	.009***	(.002)
DoE Admin.	-.684***	(.027)	-	-	-
Overqualified	.002***	(.0001)	-	-	-
Applications	-.002***	(.0001)	Applications	7.72e-07	(5.76e-07)
Appl.'s Rc	-5.46e-06	(.00001)	Appl.'s Rc	-.00002***	(3.61e-06)
Qualification	-.496**	(.046)	Qualification	.012**	(.005)
Qual. Sq.	.054***	(.018)	Qual. Sq.	-.007***	(.002)
Qual. Ins.	.043	(.033)	Qual. Ins.	.008	(.007)
EEO	-.109***	(.001)	EEO	.001***	(.0003)
FLSA	.243***	(.050)	FLSA	-.003*	(.002)
Job Type	.435***	(.008)	Job Type	-.031***	(.002)
SEO	-.371	(.290)	SEO	-.520***	(.099)
JNU	.047	(.118)	JNU	-.002	(.025)
ORC	.034	(.056)	ORC	.038***	(.011)
Web Rc.	.118	(.292)	Web Rc.	.619***	(.093)
Insiders	.164	(.131)	Insiders	-.002	(.029)
Age	.047***	(.005)	Age	-.001*	(.0007)
Age Sq.	-.0003***	(.00006)	Age Sq.	.00002**	(9.33e-06)
Experience	-.103***	(.015)	Experience	.014***	(.002)
Exp. Ins.	.066	(.047)	Exp. Ins.	.104***	(.011)
Education	-.320***	(.036)	Education	.011***	(.003)
Educ. Sq.	.015***	(.001)	Educ. Sq.	-.0003***	.0001
Educ. Ins.	-.018**	(.008)	Educ. Ins.	.004**	(.002)
Sex	.251***	(.018)	Sex	-.007***	(.002)
Non White	-.084***	(.015)	Non White	-.016***	(.002)
Const.	58.592***	(.315)	Const.	-.410**	.170

§Note: ***, **, * denote 1%, 5%, and 10% significance levels, respectively.

Table 5: Testing for exogeneity of the instruments§

IV regression: First Step (R^2 =0.0805)			Second Step (R^2 =0.0002)		
Status	Coef	Rob. std. error	Pred. residuals	Coef	Rob. Std. Error
-	-	-	Centr. Adm.	.0001	(.003)
-	-	-	DoE Admin.	.005	(.003)
Grade	.009**	(.002)	Overqualified	7.52e-06	(9.78e-06)
Applications	7.72e-07	(5.76e-07)	Applications	-6.51e-06	(8.13e-06)
Appl.'s Rc	-.00002***	(3.61e-06)	Appl.'s Rc	4.23e-08	(3.61e-06)
Qualification	.012**	(.005)	Qualification	.0001	(.005)
Qual. Sq.	-.007***	(.002)	Qual. Sq.	.0001	(.002)
Qual. Ins.	.008	(.007)	Qual. Ins.	.00006	(.007)
EEO	.001***	(.0003)	EEO	-.00006	(.0001)
FLSA	-.003*	(.002)	FLSA	.00003	(.002)
Job Type	-.031***	(.002)	Job Type	.00003	(.001)
SEO	-.520***	(.099)	SEO	.001	(.099)
JNU	-.002	(.025)	JNU	-.00001	(.025)
ORC	.038***	(.011)	ORC	-.00005	(.011)
Web Rc.	.619***	(.093)	Web Rc.	-.001	(.093)
Insiders	-.002	(.029)	Insiders	.001	(.029)
Age	-.001*	(.0007)	Age	-.00003	(.0007)
Age Sq.	.00002**	(9.33e-06)	Age Sq.	3.06e-07	(9.34e-06)
Experience	.014***	(.002)	Experience	-.00008	(.002)
Exp. Ins.	.104***	(.011)	Exper. Ins.	.00005	(.011)
Education	.011***	(.003)	Education	.0002	(.003)
Educ. Sq.	-.0003***	(.0001)	Educ. Sq.	-.00001	(.0001)
Educ. Ins.	.004**	(.002)	Educ. Ins.	-.0001	(.002)
Sex	-.007***	(.002)	Sex	.0007	(.002)
Non White	-.016	(.002)	Non White	-.0001	(.002)
Const.	-.410**	(.170)	Const.	.0004	(.032)

§Note: ***, **, * denote 1%, 5%, and 10% significance levels, respectively.

Table 6: Marginal effects - logit and probit results§

Logistic Regression; Pr(Status)=.021			Probit Regression; Pr(Status)=.021		
Variable	$\Delta y/\Delta x$	Std. Error	Variable	$\Delta y/\Delta x$	Std. Error
Grade	.004**	(.002)	Grade	.005**	(.002)
Applications	2.71e-07	(.0000)	Applications	5.83e-07	(.0000)
Appl.'s Rc	-.00001***	(.0000)	Appl.'s Rc	-.00001***	(.0000)
Qualification	.013***	(.004)	Qualification	.016***	(.005)
Qual. Sq.	-.007***	(.001)	Qual. Sq.	-.008***	(.001)
Qual. Ins.	.024*	(.015)	Qual. Ins.	.022*	(.013)
EEO	.0008***	(.0002)	EEO	.001***	(.0002)
FLSA	-.001	(.0009)	FLSA	-.001	(.001)
Job Type	-.011***	(.001)	Job Type	-.014**	(.001)
SEO	-.022***	(.0008)	SEO	-.022***	(.0009)
JNU	.012	(.012)	JNU	.001	(.010)
ORC	.038***	(.011)	ORC	.027***	(.009)
Web Rc.	.305***	(.047)	Web Rc.	.375***	(.048)
Insiders	.037*	(.020)	Insiders	.032*	(.020)
Age	-.00001	(.0003)	Age	.0003	(.0004)
Age Sq.	2.84e-06	(.0000)	Age Sq.	-8.15e-07	(9.33e-06)
Experience	.014***	(.002)	Experience	.015***	(.002)
Exp. Ins.	.057**	(.025)	Exp. Ins.	.056**	(.022)
Education	.011***	(.003)	Education	.013***	(.003)
Educ. Sq.	-.0003***	(.0001)	Educ. Sq.	-.0004***	(.0001)
Educ. Ins.	.058***	(.018)	Educ. Ins.	.043***	(.012)
Sex	-.003**	(.001)	Sex	-.004**	(.001)
Non White	-.011***	(.001)	Non White	-.013***	(.001)
Le	-.006***	(.002)	Pe	-.008***	(.002)

§Note: ***, **, * denote 1%, 5%, and 10% significance levels, respectively.

Table 7: 3SLS regression - coefficient estimates for the qualification variables[§]

Variable	HsStatus		BAStatus		MAStatus	
	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
Exp.	.008***	(.001)	.004***	(.001)	.0005	(.0006)
Exp. Ins.	.076***	(.005)	.014***	(.003)	.002	(.001)
Educ.	014***	(.003)	.004*	(.002)	-.004***	(.001)
Educ Ins.	-.007***	(.0009)	.009***	(.0006)	.004***	(.0003)

Table 8: Insider effects on the probability to be hired[§]

Variable	OverStatus		ExactStatus		LessStatus	
	Coeff.	Std. Error	Coeff.	Std. Error	Coeff.	Std. Error
Insiders	-.017	(.020)	-.016	(.019)	.039***	(.010)
Educ.	.016***	(.003)	-.014***	(.002)	.007***	(.001)
Educ. Ins.	.003**	(.001)	.003**	(.001)	-.002***	(.0007)

[§]Note: ***, **, * denote 1%, 5%, and 10% significance levels, respectively.

Table 9: Predicted probabilities to be hired with and without insiders

Hiring Prob.	OverStatus	ExactStatus	LessStatus
LPM	3.73%	3.80%	2.97%
Logit	3.73%	3.80%	2.97%
Probit	3.72%	3.83%	2.95%
With insiders taken into account			
High-School Diploma required	3.02%	1.19%	0.03%
Bachelors required	0.42%	1.78%	0.89%
Masters required	0.04%	0.65%	0.32%
Without insiders taken into account			
High-School Diploma required	1.99%	0.87%	0.01%
Bachelors required	0.23%	1.09%	0.40%
Masters required	0.02%	0.41%	0.16%
Δ% Change			
Δ% High-School	-34.17%	-27.25%	-51.62%
Δ% Bachelors	-45.10%	-38.32%	-55.24%
Δ% Masters	-42.70%	-37.10%	-50.72%

Table 10: Sextiles of estimated probabilities to be hired

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.0096	35	40.5	5595	5589.5	5630
2	0.0135	68	65.4	5562	5564.6	5630
3	0.0179	91	87.2	5539	5542.8	5630
4	0.0260	139	122.1	5491	5507.9	5630
5	0.0433	169	184.6	5461	5445.4	5630
6	0.9072	742	744.2	4888	4885.8	5630

Table 11: The classification table

	True		
Classified	Success (S)	Failure (F)	Total
Positive prediction (+)	84	59	143
Negative prediction (-)	1160	32477	33637
Total	1244	32536	33780
Classified + if predicted Pr(S) $\geq$ .5			
True S defined as status $\neq$ 0			
Sensitivity	Pr(+| S)		6.75%
Specificity	Pr(-| F)		99.82%
Positive predictive value	Pr(S| +)		58.74%
Negative predictive value	Pr(F| -)		96.55%
False + rate for true F	Pr(+| F)		0.18%
False - rate for true S	Pr(-| S)		93.25%
False + rate for classified +	Pr(F| +)		41.26%
False - rate for classified -	Pr(S| -)		3.45%
Correctly classified			96.39%

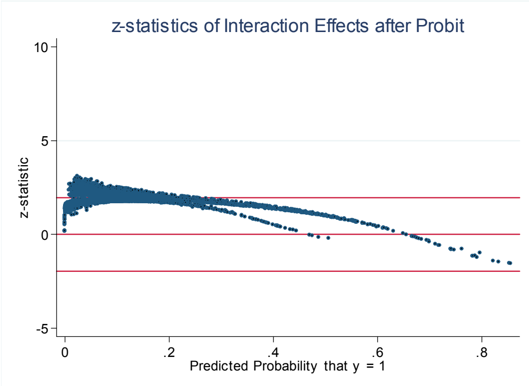

Figure 1: Significance of Marginal Effect of Insiders' Qualification

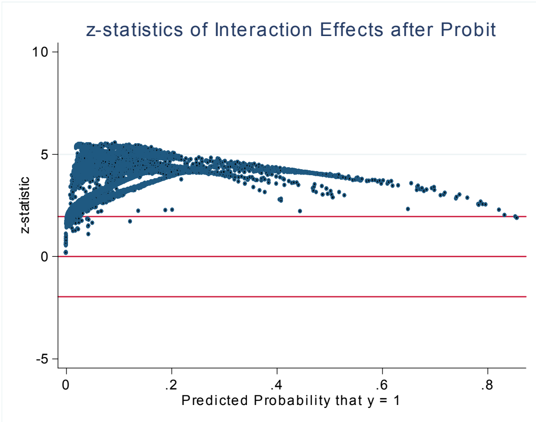

Figure 2: Significance of Marginal Effect of Insiders' Experience

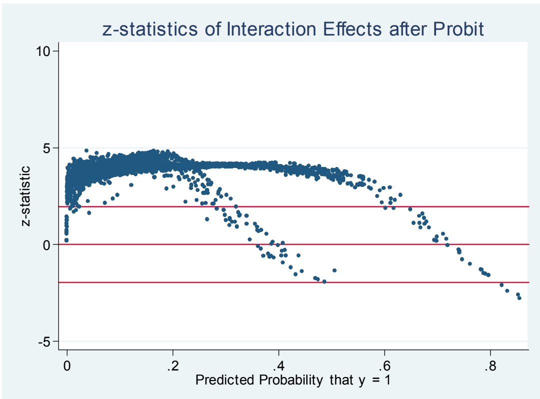

Figure 3: Significance of Marginal Effect of Insiders' Education

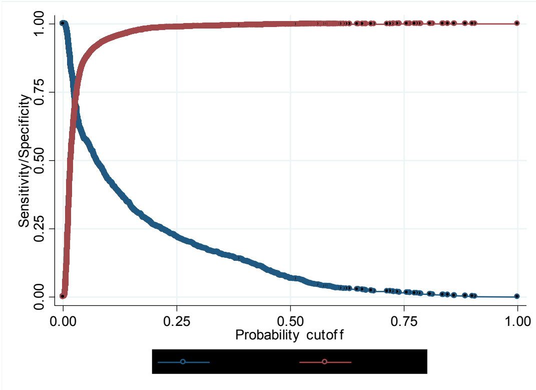

Figure 4: Sensitivity and Specificity

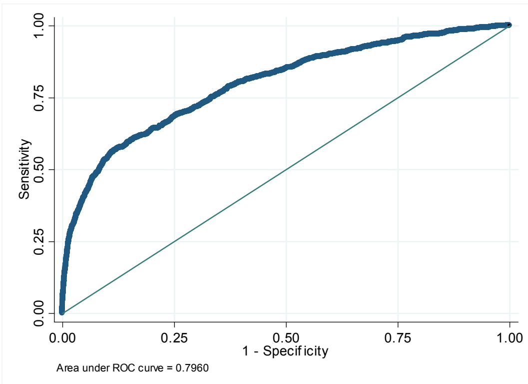

Figure 5: ROC Curve

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