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Abstract

We analyze a standard employee selection model given two institutional constraints: first, professional experience perfectly substitutes insufficient 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-Classifications: M51 (Firm Employment Decisions; Promotions), J53 (Labor-Management Relations; Jurisprudence), J78 (Labor Discrimination; Public Policy), I21 (Analysis of Education).

1 Introduction

Generally, every US employer is free to employ individuals at his will. However, selection criteria must be validated and qualification requirements must be set reasonably to avoid disparate impact charges under *Title VII of the Civil Rights Act of 1964*.[1] To the extent that members of minority groups, women, or disabled individuals have been socially excluded from obtaining the respective formal education or training, such requirements can be ruled excessively restrictive - i. e. set to preclude successful applications from these groups.[2] The *Civil Rights Act of 1991* has then introduced the right to a jury trial, extended the group of potential plaintiffs, and eased the use of statistical information as evidence. Moreover, by allowing for punitive damages in addition to back-pay the act has increased the potential costs per case.[3] Since such claims can concern wrongful non-hirings as well as non-promotions, this legal risk applies to all employee selection processes within firms.[4]

To reduce this risk, the *Equal Employment Opportunity Commission* (*EEOC*) advises to phrase qualification requirements in terms of necessary skills and abilities rather than formal educational degrees or years of experience.[5] This advice meets with a second set of rules that is rooted in the employer's duty to provide job security and career development.[6] Fair selection standards may thus require to be alternatively phrased in terms of formal educational requirements and substitute professional experience criteria. In this respect, public sector employees are additionally covered by the *Fourteenth Amendment* right to *Equal Protection*.[7] 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] This manual lists educational degree and equivalent professional

[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] In the original case - see *Griggs v. Duke Power Co.*, 401 U.S. 424 (1971) - the company required a highschool diploma and a certain score on a general aptitude test to qualify for internal promotion. The court found that these requirements disparately impact ethnic minority groups. Specifically, African-Americans were less likely to hold a highschool degree and averaged lower test scores and were, therefore, selected at a much a lower rate.

[3] Oyer and Schaefer (2002).

[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).

[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.

experience requirements for specified hierarchical positions.[9]

Following the legislative development, the disparate impact issue has received repeated attention by economists.[10] Yet, based on models of statistical discrimination, such analyses are mostly confined to addressing the effects across groups that are protected under this legislation. Nevertheless, Oyer and Schaefer (2002) already show that the distributional consequences of the *Civil Rights Act of 1991* are significant since population groups differ in their propensities to sue. However, given the above, the legal risk is job-specific as well. Thus, setting qualification requirements in recruitment processes is subject to a twofold set of constraints: 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.

Organizational and assessment psychology assumes that the human resources department maximizes the expected on-the-job ability of the group of recruits. Our theoretical model developed below then augments the standard textbook "utility analysis"[11] of personnel selection to include three predictors: educational attainment, professional experience, and test scores. Specifically, we assume that the firm perfectly substitutes 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. However, 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 further 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-

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

[10] Respective contributions to annual meetings of the American Economic Association include Welch (1981), Ashenfelter and Oaxaca (1987), Abram (1993), Coates and Loury (1993), and Betsey (1994).

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

opening, selection process, and individual applicant. The empirical analysis supports our theoretical implications.

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, this effect is stronger for jobs that require unskilled or lower-skilled labor than for skilled jobs.[12] However, the explanations offered are mostly labor-market oriented.[13] The career mobility approach developed by Sicherman and Galor (1990) constitutes the notable exception: responding to their firm's human resources development strategy, individuals enhance their career progress by accepting "underqualified work" in early career stages. To our knowledge, only Groeneveld and Hartog (2004) have so far provided an empirical test: investigating jobs sheltered within a protected internal labor market, they conclude that the overeducation effect on wages reflects such strategic behavior.

The contribution of our analysis is then threefold: first, we empirically confirm the existence of an overeducation effect on hiring probabilities. However, this effect is confined to outsider recruits. Thus, we also find evidence that the career mobility argument does not apply to our firm. Second, we therefore provide a simple but novel theoretical model to show that this selection behavior may rather be induced by institutional constraints. Since these constraints restrict the use of informative signals, the firm's outsider recruits are only seemingly overqualified - i.e. without the constraints the firm would have actually advertised higher standards. Hence, third and adding to the debate on the effects of hiring quotas derived from models of statistical discrimination, our arguments highlight the informational inefficiency induced by the threat of disparate impact charges.

The remainder of this paper is organized as follows: 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 - the latter also addressing new regulations currently emerging

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

[13] Hence, 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. See, for instance, Hartog (2000), Bauer (2002), and Chevalier (2003) for literature surveys and respective applications.

in the European educational systems.

2 The theoretic approach

2.1 Description of the institutional setting

We adapt the standard recruitment model by introducing 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 for the empirical analysis to follow.

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 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 that can later only be stretched by special consent of the *FEO*. *HR* considers the firm - by far being the largest employer in the region - to 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* advertises 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. *HR* reserves the right to reject applications for formal reasons - i.e. if the professional qualification of the candidate is obviously inadequate.

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 disparate 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.[14]

Taken to its theoretic extreme, we 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.[15] The above then implies that the respective discount factor increases 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. Appreciating the results of these tests, *DoE* makes its 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. As emphasized in our interviews, *HR* ensures 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

[14] 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.

[15] 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".

a third signal.

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 $y \in \{s, x, z\}$. Realistically, the predictors are correlated. For instance, holding age constant, the duration of formal education and professional experience should be negatively correlated.[16] However, assuming stochastic independence between signals serves to identify the economic mechanisms driving the outcome of this process of screening and testing. Hence, we assume that $Cov(s, x) = Cov(s, z) = Cov(x, z) = 0$.

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.[17] 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 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 $\psi^I(\omega^I)$. Also, all applicants whose test score satisfies $z \geq Z$ will actually be hired. Given

[16] Empirically, we can control for this effect by entering age as an explanatory variable. See Anderson et al. (2004) concerning the interaction of commonly used predictors.

[17] This assumption does not imply that the two signals are identical. Rather, they only serve equally well as ability predictors.

the institutional constraints described above, the expected ability of insider recruits can then be derived as

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

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.[18] To focus on the informational aspects of the screening process, we assume that this "discounting" of an outsider's professional experience only affects the possibility to enforce the screening criteria S and X. 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 must increasingly be accepted as a substitute for (lack of) 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

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

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

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

[18] 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 $\frac{M}{N} < 1$. The firm's objective, implemented by *HR*, is to maximize the expected ability

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

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. 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, we assume that there are only internal applications and set $\Psi^O(\Omega) = 1$ in (5) and (4) above. The respective Lagrange-function can be derived as

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

where

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

denotes an indicator function that captures the opportunity cost nature of C.

The first-order conditions can be rearranged to yield:

$$\eta(Z): E^I\{a;S,X,Z\} - C - \lim_{Z\longrightarrow-\infty} E^I\{a;S,X,Z\}\left\{\begin{matrix} = \\ \leq \end{matrix}\right\}0\ , \quad \text{if } \Phi(Z)\left\{\begin{matrix} \geq \\ = \end{matrix}\right\}0\ ; \tag{8}$$

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

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

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 r between ability and the test score should be large relative to ρ, the latter reflecting the correlation between ability and the signal content of the application documents.

Job interviews are likely to qualify in this respect.[19] For the remainder, we will therefore assume such an interior solution. In the present case, it implies

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

As expected, the testing costs induce a distortion: 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

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

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, such new recruits are only seemingly overqualified: suppose the threat of disparate impact charges would not constrain *HR* in advertising and enforcing educational requirements. Then, it would clearly require higher educational standards that would adequately account for the respective signal value. The insider-outsider difference then reflects that *HR* cannot economize on this signal value at all when dealing with the former group.

Further, recall that lower minimum educational requirements S *ceteris paribus* increase the possibility of "discounting" the professional experience of outsiders.[20] 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

[20] 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.

require rather low educational degrees result in relatively more “overqualified” new employees. Hence, it also follows:

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

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 user-names and passwords. Hence, our data covers the time period from the introduction of this system to February 2006. During this phase *HR* assigned a team to provide assistance for potential applicants. The data is further restricted to rank-and-file employee and laborer positions; recruitment processes aimed at filling executive positions are excluded. Our data set comprises 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. There were 1244 of such processes (see Table 1).

The data set contains information concerning the educational attainments of all candidates. 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 (see Table 2). The data further contains 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).

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 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. Calculated as a weighted sum of these factors, the score determines the compensation range.

Defining overqualification as possessing a higher than the advertised educational degree, Table 3 reveals 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 the outsider status.

Combining the first two of the above as web-recruitment channels (*WebRc*), they account for those 77% of the applications which doubtlessly come from outside the firm (see Table 3). 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 Definitions of variables and OLS-estimation

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*, the *EEO* code number, the *FLSA* status variable, and *Job Type* serve as explanatory variables. The characteristics of the recruitment processes are captured by the total number of job-candidates (*Applications*) per job. 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 used by a particular outsider applicant then serves to examine whether there exists a dominant form of attracting 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*).[21] Unfortunately, the data only allows to identify whether the individual possesses (1) or does not possess (0) adequate professional experiences as judged by *HR*. As usual, we also include the square of the individual's age to allow for a non-linear age-productivity profile.

Clearly, the variables reflecting 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 thus mirrors the individual's time spent in formal education. To capture a possible non-linear education-productivity relationship we also include the square of this variable. *Exact Qual* takes on the value 1 if the applicant is just qualified relative to the advertised minimum educational level. We similarly construct *Over Qual* and *Less Qual* to denote the over and less qualified applicants, respectively. To avoid multicollinearity problems, we exclude *Over Qual* from the regressions. According to our theoretical model, the insider effect on the hiring probability manifests in professional experience substituting for a lack of formal education. Thus, we include the respective interaction variables *Exp Ins.* and *Educ Ins.* between *Experience* and *Education* and the insider status.

Table 4 shows the results from performing a simple OLS regression. The probability to be recruited is lower for non-whites and older applicants where the latter effect appears to level out. Higher hiring probabilities for women likely reflect the overall dominance of administrative jobs in the sample. The negative sign for *Job Type* also 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. 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 obviously increase the probability to be hired. Further, the effects of higher

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

formal education are even stronger for insiders. Moreover, both *Exact Qual* and *Less Qual* are positive and highly significant. On first sight, being overqualified therefore does not appear to yield higher success probabilities. However, recall from the description of the institutional setting 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. While *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 applicants' qualification structure on the hiring probability. Specifically, the process of obtaining the workplace score may have induced an endogeneity problem. Moreover, following Wooldridge (2002, p. 604), our estimates will be unbiased, consistent, and asymptotically normal only if the decision to apply is random across the two groups. However, recall that entering an application requires the ability to use a computer and to set up an online account - both likely to be correlated with the individual's educational status. Hence, *HR*'s on-site assistance in filing the online application may have induced a selection problem by encouraging relatively more applications by less qualified insiders.

3.3 The IV-regression

Both the endogeneity and the selection problems discussed above warrant the use of instrumental variables. Hence, we instrument *Grade* to account for the endogeneity of the job specification mechanism. Our interviews suggest that the three *DoE*-types within the firm (i.e., central administration, *DoE* staff positions, and technical support and services), face different labor market characteristics and, consequently, determine workplace scores such as to generate attractive salary ranges. Consequently, the department-types qualify as adequate instruments. To avoid multicollinearity, technical support and services constitutes a benchmark department-type.

Furthermore, the number of applications by individuals who possess a higher than the minimum required educational degree - denoted *Overqualified* - proxies the firm's expectation concerning the scarcity of the respective personnel. Given the above, the decision to file an application should be a function of the recruiting channel reflecting an applicant's access to on-site assistance. Conditional on this covariate, the participation decisions should be independent between the two groups. Controlling for the recruiting channel in a *Two-Stage Least Squares* (*2SLS*) approach then appears sufficient to overcome this problem.

First, we perform the *Hausman* test for endogeneity to address the quality of our arguments above. 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. 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 5. 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.

Further, note that in the reduced form (i.e. the left column of Table 5) 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.[22] 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.[23] Given a partial R^2 of 0.7183 of the first-stage regression and the F-statistic above, we conclude that our instruments are strong predictors of the endogenous variable.[24]

Comparing the partial effects of our *2SLS-LPM* model (Table 5) with those derived using *OLS* (Table 4) and logit and probit (Table 6) reveals only small differences.[25] With the exception of *Grade* that is instrumented, all other coefficients of the *2SLS* regression

[22] Within our sample, *Grade* varies in between 50 and 65.Hence, one more overqualified applicant per job increases this score by 0.002 points.

[23] Following Staiger and Stock (1997), the respective F-statistic should be greater than 10.83.

[24] Baker et al. (1995). Also, we have experimented with other potential instruments and performed overidentification tests. However, the respective *Lagrange Multiplier* tests did not support the inclusion of any other instrument.

[25] We report the marginal effects using both logit and probit models mainly for comparison and robustness checks. Note, however, that interaction variables cannot be interpreted in the usual way in either logit or probit models. Following Ai and Norton (2003), the interaction effect must be calculated as $\partial^2 \Phi(\cdot) / (\partial x_1 \partial x_2) = \beta_{12} \Phi'(\cdot) + (\beta_1 + \beta_{12} x_2)(\beta_2 + \beta_{12} x_1) \Phi''(\cdot)$.

preserve their signs and magnitudes. Moreover, the switch in sign for *Grade* does not indicate a lack of robustness. Rather, the presence of overqualified applicants constitutes a strong determinant of the workplace score. This argument then clearly supports the IV-approach. As before, 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*).

Also, note that in the *2SLS* regression the coefficient on *Less Qual* becomes insignificant. Hence, accounting for the endogeneity of *Grade,* the less-qualified do not exhibit higher success probabilities relative to the overqualified applicants anymore. Further, the marginal effects after logit and probit suggest that 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 - 2). These results support our theoretical model since insiders are on average less qualified.

As is well known, heteroskedasticity will induce inconsistent estimators in both probit and logit regressions. However, according to Wooldridge (2005, p. 479), this problem only affects the latent model. Thus, the issue of inconsistent estimation of the slope parameters is practically irrelevant: probit may provide reasonable estimates of the partial effects even though logit is the correct model. In our case, the estimated partial effects are very similar for logit and probit.

3.4 Insider-outsider effects on the screening mechanism

We are further interested in the validity of hypothesis *H2*. In a next step, we therefore define dependent variables according to whether the individual is hired for a job that require a highschool diploma, a bachelor's, or a master's degree. 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.[26] Given 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

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

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 0.0085 (0.0003) 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, respectively) is strongly rejected. Thus, *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, a third set of dependent variables distinguishes 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 report the results only for the key coefficients. The highly positive and significant coefficient of the *Insiders* when the dependent variable is *LessStatus* then implies that being an insider and underqualified actually increases the chances of being hired. This aligns with previous findings in Table 4. More importantly, however, it clearly contradicts the validity of the career mobility approach within the current context.

Finally, the top entries in Table 9 report the predicted average probabilities of being hired given that an applicant is overqualified, exactly qualified, or underqualified. The LPM, logit, and probit estimates are almost identical. Therefore we only use the LPM-results to derive the average hiring probabilities conditional on the advertised educational requirement for the full sample and a sample excluding all insider observations. Clearly, across all advertised degree requirements, the induced decrease in these predicted average probabilities is largest for the underqualified applicants. Again, this observation supports that, when competing for the same job, successful outsider recruits are characterized by higher educational attainments than insiders. Yet, the latter are generally more successful in becoming hired/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 to compare observed and predicted counts of outcome events. This number of subgroups corresponds to the number of different minimum levels 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

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

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. Given that a predicted hiring is defined by a predicted probability of being hired exceeding 0.5, we compare this predicted with the actual outcome ("hired" or "not hired") for every applicant. In 96.4% of all cases the predictions are correct (see Table 11). 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*[27] draws out the sensitivity-specificity trade-off and provides a benchmark: the predictive power of a model is better the higher the curve arches above the 45-degree line. The *ROC-curve* would coincide with this line if the model would both correctly and falsely predict 50% of all recruitments for all cut-off probabilities. The area under the *ROC-curve* is 0.7960 when we include all observations. However, we also calculate this curve using "out-of-sample"-forecasts. Specifically, we randomly exclude 10% of the successful applicants and re-estimate the model. Given the newly estimated coefficients, we compute the hiring probabilities of the recruits previously excluded. The area under the respective ROC-curve then equals 0.7963. Since this value is not significantly different at a 5%-level from the one obtained for the full sample,[28] Figure 5 displays the *ROC-curve* only for this "out-of-sample"-case.

4 Summary and policy discussion

We analyze 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. The optimal selection policy then implies that the expected level of formal education is higher for outsider than for insider recruits. However, new recruits are only seemingly overqualified: in absence of these constraints restricting the signal value of education, the respective standards would be set higher and identically equal for both groups.

Moreover, the legal risk to experience disparate impact charges if educational requirements are increased is higher for low-skilled than for higher-skilled jobs. Hence, the difference in educational attainments between the two groups of recruits increases with lower educational job requirements. The insider-outsider effects are very specific to our theoretic approach and are strongly supported by our empirical results. At the same time, these results are also generally consistent with previous empirical work on the overeducation effect on the probability to be hired from the external labor market. Yet, in strong contrast with the career mobility approach as the alternative theoretic

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

[28] The value for this test statistic is 2.78 and follows a $\chi^2_{(1)}$-distribution.

framework, underqualification actually increases the hiring probability for insider recruits. Finally, our model builds upon qualitative information derived from interviews with the firm's human resources department. Hence, while unable to directly test the institutional mechanism, we offer a novel explanation that is generally supported by our empirical analysis.

Groeneveld and Hartog (2004) 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.[29] 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.[30] Currently, a new set of such regulations is emerging: the *Commission of the European Communities* (2000) and the *Council of Europe* (2001) have initiated a process to establish the formal equivalence of educational degrees and professional experience gained in occupational training programs. This policy intends to foster lifelong learning and - mirroring the US disparate impact experience - to include population groups who have been socially excluded from obtaining adequate education.

The EU member states must 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.[31] 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 a perfect university degree equivalent certificate without attending university at all.[32] 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 substitu-

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

[30] 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).

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

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

tion 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 then also diminishes the signal value of formal education. It will therefore further decrease allocative efficiency.

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Appendix A: Variables Description

- The set of dependent variables
  - Status = indicates hiring status: 1 if hired, 0 if not hired
  - Overstatus = is 1 if both hired and overqualified; 0 elsewhere; ExactStatus and LessStatus are computed in a similar manner
  - HsStatus = is 1 if both hired and the job requires a High-School Diploma; 0 elsewhere; BAStatus, and MAStatus are computed in a similar manner
- Variables which concern the recruiting channel
  - SEO = is 1 if the recruiting channel is "State Employment Office"; 0 elsewhere
  - JNU = is 1 if the recruiting channel is "A job notice sent to my organization"; 0 elsewhere
  - DCD = is 1 if the recruiting channel is "Direct contact from department"; 0 elsewhere
  - ORC = is 1 if the recruiting channel is "Other Recruiting Channels"; 0 elsewhere
  - NWAd = is 1 if the recruiting channel is print-ad type - "Newspaper Advertisement, Professional journal, newsletter, list-serve, or registry"; 0 elsewhere
  - IntReffered = is 1 if the recruiting channel is "Referred by a current employee"; 0 elsewhere
  - WebRC = is 1 if the recruiting channel is web-based; 0 elsewhere
  - Insiders = DCD & IntReffered
- Variables which concern the type of each department where job positions are opened
  - Centr. Admin. = is 1 if the job is in the Central Administration; 0 elsewhere
  - DoE Admin. = is 1 if the job is in a Department of Employment; 0 elsewhere
  - TechDept = is 1 if job is in the technical department; 0 elsewhere
- Variables which concern job specifications

- Grade = numerical value determined on the basis of six factors and it indicates the payment range of a position title. It increases with job requirements.
- EEO = stands for Equal Employment Opportunity. It has a value of 10 for executive and managerial positions and increases up to 70 for service and maintenance positions.
- FLSA = indicates the Fair Labor Standard Status; it is 1 if employees are exempt (i.e. do not get paid if they do over time work) and 0 if they are not exempt (i.e. they are paid if they work overtime)
- JobType = it is a ranking variable that takes value in between 1 and 6; 1 is the lowest ranked and corresponds to Contingent/On-Call (No Benefits) while highest job type is Regular - Full-Time (Benefits Eligible)

• Quantitative variables regarding each type and number of applicants

  - Applications = total number of applications per position title
  - Less Qual. = dummy that is 1 if less qualified; 0 otherwise
  - Exact Qual. = dummy that is 1 if exact qualified; 0 otherwise
  - Over Qual. = dummy that is 1 if over qualified; 0 otherwise
  - Overqualified = number of over qualified applicants for each position title
  - Appl.'s Rc = number of applicants per recruiting channel

• Variables which are applicants' characteristic

  - Age = Each applicant's age; Age Sq. = square of Age
  - Experience = is 1 if the applicant has work experience and 0 if he does not
  - Exp. Ins. = interaction variable between Experience and Insiders
  - Education = Ranking variable that goes from 0 (i.e. 1st grade) until the highest level of 19 (i.e. doctorate); Educ. Sq. = square of Education
  - Educ. Ins. = interaction variable between Education and Insiders.
  - Sex = 1 if Male, 0 if Female
  - NonWhite = is 1 if White/Non-Hispanic; 0 elsewhere.

Appendix B: 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: OLS regression[§]

OLS: ($R^2 = 0.0879$)		
Status	Coef	Rob. std. error
Grade	-.002***	(.001)
Applications	-.000**	(.000)
Appl.'s Rc	-.000***	(.000)
Exact Qual.	.012***	(.003)
Less Qual.	.011***	(.004)
EEO	.000	(.000)
FLSA	-.000	(.002)
Job Type	-.026***	(.002)
SEO	-.526***	(.100)
JNU	-.003	(.025)
ORC	.038***	(.012)
Web Rc.	.619***	(.093)
Insiders	.007	(.028)
Age	-.001	(.001)
Age Sq.	.000*	(.000)
Experience	.014***	(.002)
Exp. Ins.	.106***	(.012)
Education	.009***	(.003)
Educ. Sq.	-.000*	(.000)
Educ. Ins.	.005**	(.002)
Sex	-.004*	(.002)
Non White	-.018***	(.002)
Const.	.258***	(.054)

[§]Note: ***, **, * denote 1%, 5%, and 10% significance levels, respectively. For all regressions, the number of observations is $N = 33780$ obs.

Table 5: The LP-model[§]

2SLS: 1^{st}Stage			2SLS: 2^{nd} Stage		
(R^2 =0.7183)			(R^2 =0.0805)		
		Rob.			Rob.
Grade	Coef	std. error	Status	Coef.	std. error
-	-	-	Grade	.010***	(.002)
Centr. Admin.	-.765***	(.027)	-	-	-
DoE Admin.	-.684***	(.027)	-	-	-
Overqualified	.002***	(.000)	-	-	-
Applications	-.002***	(.000)	Applications	.000	(.000)
Appl.'s Rc	-0.000	(.000)	Appl.'s Rc	-.000***	(.000)
Exact Qual.	0.328***	(.021)	Exact Qual.	.010***	(.003)
Less Qual.	0.764***	(.034)	Less Qual.	0.004	(.004)
EEO	-.109***	(.001)	EEO	.001***	(.000)
FLSA	.243***	(.050)	FLSA	-.004*	(.002)
Job Type	.435***	(.008)	Job Type	-.032***	(.002)
SEO	-.371	(.290)	SEO	-.519***	(.100)
JNU	.047	(.118)	JNU	-.003	(.025)
ORC	.034	(.056)	ORC	.038***	(.012)
Web Rc.	.118	(.292)	Web Rc.	.616***	(.093)
Insiders	.164	(.131)	Insiders	.005	(.028)
Age	.047***	(.005)	Age	-.001*	(.001)
Age Sq.	-.000***	(.00006)	Age Sq.	.000**	(.000)
Experience	-.103***	(.015)	Experience	.015***	(.002)
Exp. Ins.	.066	(.047)	Exp. Ins.	.105***	(.012)
Education	-.320***	(.036)	Education	.012***	(.004)
Educ. Sq.	.015***	(.001)	Educ. Sq.	-.000***	(.000)
Educ. Ins.	-.018**	(.008)	Educ. Ins.	.005**	(.002)
Sex	.251***	(.018)	Sex	-.008***	(.003)
Non White	-.084***	(.015)	Non White	-.017***	(.002)
Const.	58.592***	(.315)	Const.	-.410**	(.168)
-	-	-	Predicted resid.	-.013***	(.003)

[§]Note: ***, **, * denote 1%, 5%, and 10% significance levels, respectively. For all regressions the number of observations is $N = 33780$ obs.

Table 6: Marginal effects - logit and probit results[§]

Logistic Regression; Pr(Status)=.021			Probit Regression; Pr(Status)=.022		
Variable	$\Delta y/\Delta x$	Std. Error	Variable	$\Delta y/\Delta x$	Std. Error
Grade	.004**	(.002)	Grade	.005**	(.002)
Applications	.000	(.000)	Applications	.000	(.000)
Appl.'s Rc	-.000***	(.000)	Appl.'s Rc	-.000***	(.000)
Exact Qual.	.009***	(.002)	Exact Qual.	.011***	(.002)
Less Qual.	.002	(.003)	Less Qual.	.002	(.004)
EEO	.001***	(.000)	EEO	.001***	(.000)
FLSA	-.001	(.001)	FLSA	-.001	(.001)
Job Type	-.011***	(.001)	Job Type	-.014**	(.001)
SEO	-.022***	(.001)	SEO	-.022***	(.001)
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	-.000	(.000)	Age	.000	(.000)
Age Sq.	.000	(.000)	Age Sq.	-.000	(.000)
Experience	.014***	(.002)	Experience	.015***	(.002)
Exp. Ins.	.057**	(.025)	Exp. Ins.	.056**	(.022)
Education	.011***	(.003)	Education	.013***	(.003)
Educ. Sq.	-.000***	(.000)	Educ. Sq.	-.000***	(.000)
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. For all regressions, the number of observations is $N = 33780$ obs.

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	(.001)
Exp. Ins.	.076***	(.005)	.014***	(.003)	.002	(.001)
Educ.	014***	(.003)	.004*	(.002)	-.004***	(.001)
Educ Ins.	-.007***	(.001)	.009***	(.001)	.004***	(.000)

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***	(.001)

[§]Note: ***, **, * denote 1%, 5%, and 10% significance levels, respectively. For all regressions, the number of observations is $N = 33780$ obs.

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

Classified	True Success (S)	True 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%

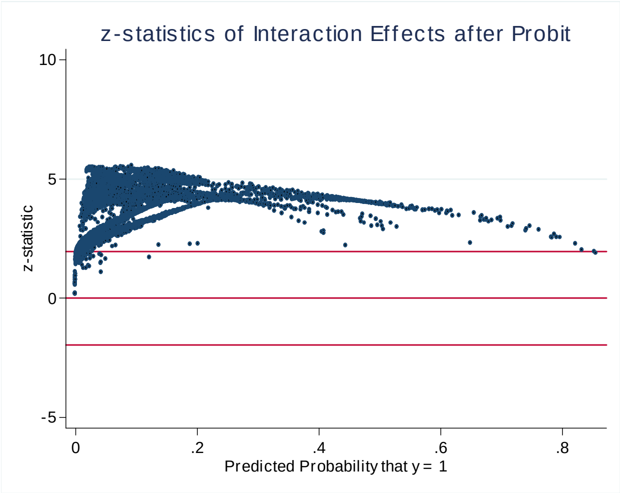

Figure 1: Significance of Marginal Effect of Insiders' Experience

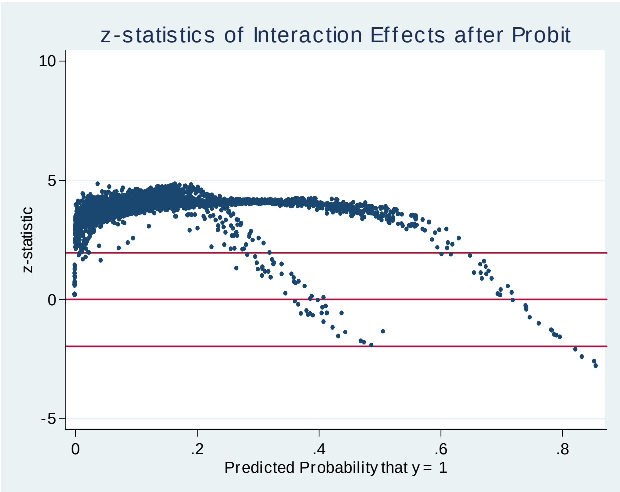

Figure 2: Significance of Marginal Effect of Insiders' Education

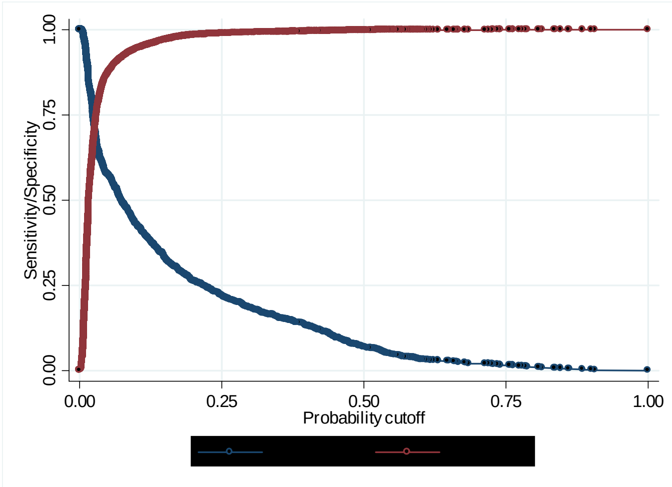

Figure 3: Sensitivity and Specificity

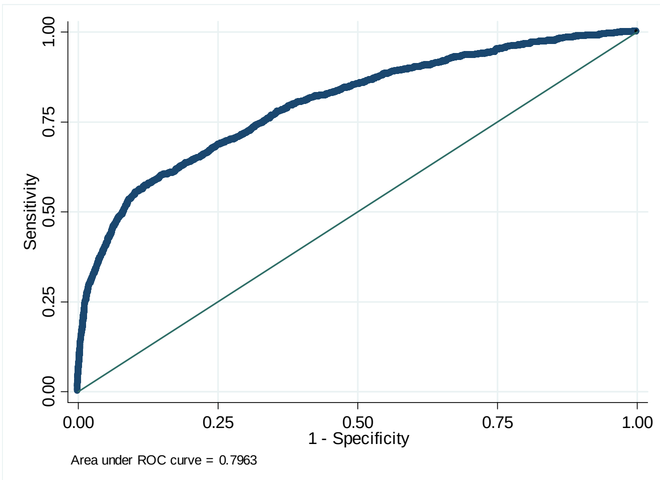

Figure 4: ROC Curve