American Economic Review 2009, 99:1, 472–485
http://www.aeaweb.org/articles.php?doi=10.1257/aer.99.1.472

Diversity in the Workplace

By John Morgan and Felix Várdy*

High unemployment in the European Union (EU), often attributed to labor market rigidities, affects immigrant populations particularly severely: minorities consistently suffer higher unemployment than do nonminorities.[1] What accounts for this disparity? Skill and age differences are surely part of the explanation. Minority populations are, on average, less educated and younger than the majority, and unemployment rates tend to be higher among the low-skilled and the young. Nevertheless, differences in education and age cannot fully explain the unemployment gap.[2] Of course, it may be that employers simply have a taste for discrimination and that minority underrepresentation reflects the strength of these tastes. While this is hard to rule out, if true, one would expect to see the gap shrink with increased global competition. In fact, the opposite has occurred in, for example, the Netherlands (Dagevos 2006).

An alternative explanation suggested by the sociolinguistics literature is that differences in "discourse systems" are responsible for minorities' relative lack of success in the job market.[3] Under this view, minority job candidates convey signals—verbal and nonverbal—that (majority) employers find difficult to interpret. As a consequence, employers may remain unconvinced of a minority candidate's ability, even when the candidate is perfectly competent. Majority job candidates do not suffer from this problem when interviewing since they share the same discourse system as employers.

This hypothesis raises several questions. Can differences in discourse systems help to explain the unemployment gap, absent any differences in the underlying abilities of the two populations? If so, what policy prescriptions could remedy this? Should employment protections be increased or decreased? What about other rigidities—are these helpful or harmful to workplace diversity?

To examine these questions, we study a model where an employer tries to fill a vacancy by sequentially interviewing job candidates from a pool of potential employees. The pool is made up of two populations. One population consists of majority candidates while the other consists of minority candidates. The employer has no inherent taste for discrimination and cares only whether a candidate can do the job. On average, candidates from both populations are equally likely to be competent but differ in their discourse systems. Borrowing from the statistical discrimination literature, we model this by assuming that interviews of minority candidates produce noisier signals of ability than do interviews of majority candidates.[4]

* Morgan: Department of Economics and Haas School of Business, University of California, Berkeley, CA 94720 (e-mail: morgan@haas.berkeley.edu); Várdy: International Monetary Fund, 700 19th Street, NW, Washington, DC 20431 (e-mail: fvardy@imf.org). We would like to thank the editor, two anonymous referees, Mary Amiti, Andreas Billmeier, Bob Feldman, Andrew Feltenstein, Harold Houba, Sunil Sharma, Keith Takeda, and, especially, Johan Walden for extremely useful comments. The first author gratefully acknowledges the financial support of the National Science Foundation. The views expressed in this paper are those of the authors and should not be attributed to the International Monetary Fund, its Executive Board, or its management.

[1] See International Centre for Migration Policy Development (2003).

[2] See Paul Tesser, Ans Merens, and Carlo van Praag (1999) and Jaco Dagevos (2006).

[3] See, for instance, Ronald Scollon and Suzanne Scollon (2001).

[4] This modeling strategy first appears in Edmund M. Phelps (1972) and is explored more extensively in Dennis J. Aigner and Glen G. Cain (1977). It is also used by Shelly J. Lundberg and Richard Startz (1983), as well as by Bradford Cornell and Ivo Welch (1996), among others.

We show that, when employers are "selective," equilibrium always entails underrepresentation of minorities in the permanent workforce. "Selective" means that employers hire candidates only if the post-interview probability that a candidate can do the job exceeds the prior. More surprisingly, when employers are sufficiently "unselective," equilibrium entails *over*representation of minorities. Sufficiently "unselective" means that a candidate is hired provided he does not disappoint too much during the interview. Regardless of selectivity, minorities are always fired at greater rates than majorities.

The intuition for our results may be seen in the following example. Suppose that the employer's prior belief is that 50 percent of candidates are competent. Suppose, further, that the employer chooses to hire a candidate if and only if, after the interview, he is at least 95 percent certain that the candidate can do the job. (Such a high threshold is optimal when firing is very costly.) In that case, the relative uninformativeness of a minority candidate's signal makes it extremely hard to change the employer's 50 percent prior belief of "success" to a posterior belief of at least 95 percent. Therefore, it is very unlikely that a minority candidate is going to fill the position. As a result, selective hiring practices lead to severe underrepresentation of minorities, even though minorities are equally competent and employers are not prejudiced.

On the other hand, suppose the employer is not selective, such that any candidate who has at least a 5 percent chance of success is hired. Then the relative uninformativeness of a minority candidate's signal is an advantage: it makes it virtually impossible for the posterior to fall below 5 percent as a result of the interview. In that case, virtually all minority candidates are hired and retained if they turn out to be good. In contrast, relatively many majority candidates—some of them competent—are turned away at the gate, because the informativeness of their signals does make significant belief revisions possible. This leads to *reverse discrimination*: minorities will be overrepresented in the permanent workforces of unselective employers.

For similar reasons, the model predicts that workplace diversity depends on the prior probability that a random candidate can do the job. Specifically, minorities will be most severely underrepresented in positions that demand rare skills, and overrepresented in positions that nearly anyone can do.

The model also predicts that minority underrepresentation will vary over the business cycle: if employers are selective, diversity is procyclical. When the economy is booming, recruiting job candidates is more costly and the opportunity cost of leaving a position unfilled is higher. Both effects make the employer less picky, encouraging employers to "take a chance" on job candidates whose quality is uncertain. This reduces minority underrepresentation. This prediction is roughly consistent with the Dutch experience over the last decade. During the second half of the 1990s, a period of rapid economic expansion, unemployment among Muslim minorities fell from over 30 percent in 1995 to 9 percent by 2001. During the same period, the unemployment rate among nonimmigrant Dutch fell from 6.5 percent to 3 percent. Since then, the trend has largely reversed. By 2005, unemployment among Muslims was again as high as 24 percent, while unemployment among nonimmigrant Dutch had risen to only 6 percent. (See Figure 1 in Dagevos 2006.)

While discourse systems differ by culture, they also differ by gender. Thus, our model may also help to explain the underrepresentation of women in certain fields of academia. When a selective, male-dominated department has a harder time assessing female candidates, this reduces the chance that women will be hired. The model implies that underrepresentation will be most pronounced at the most selective departments.[5]

Finally, we turn to policy solutions to the minority underrepresentation problem. Our main finding is that worker protections are counterproductive. Intuitively, protections that raise the

[5] We are grateful to an anonymous referee for suggesting this example.

cost of firing lead the employer to guard more vigilantly against type II error (hiring of incompetent candidates). The employer achieves this by becoming more selective, which exacerbates the underrepresentation problem. This suggests that labor market rigidities such as high firing costs contribute to the economic and social exclusion of Muslim minorities in Europe.

Related Literature.—There exists a large economics literature on discrimination (see Kenneth J. Arrow 1998 for an overview). Part of this literature seeks to explain why minorities receive lower wages. One theory, first suggested by Phelps (1972), uses statistical arguments. Here, populations do not differ in average productivity, but minorities have noisier productivity signals. Aigner and Cain (1977) show that this difference alone does not produce average wage differentials across populations when employers are risk-neutral, but does when employers are risk-averse or when the average productivities of the populations differ. Lundberg and Startz (1983) show how such productivity differences can arise when human capital acquisition is endogenous.[6]

Another part of the literature focuses on discrimination in job assignments. One theory, introduced by Arrow (1973) and expanded upon by Stephen A. Coate and Glenn Loury (1993), suggests that (negative) employer beliefs lead to minorities being disproportionately assigned to low skill jobs.[7] Language-based theories suggest that discrimination in job assignments can also arise when inter-worker communication is critical (see, e.g., Finis Welch 1967; Kevin Lang 1986; Susan Athey, Christopher Avery, and Peter Zemsky 2000).

Other papers focus more on search-theoretic explanations. Dan Black (1995) studies wage differences when some employers have a taste for discrimination and job applicants engage in optimal sequential search as in John J. McCall (1970). Cornell and Welch (1996) study job assignments when minorities have noisier productivity signals and employers use fixed-sample search as in George Stigler (1961). Finally, Lundberg and Startz (2007) use one- and two-sided search models to explain racial segregation in the choice of trading partners.[8]

In this paper, we study discrimination in job assignments (hiring) when minorities convey noisier signals of ability than other job candidates, and employers engage in optimal sequential search. While abstracting from wages, this framework allows us to study differences in retention, as well as in initial hiring. That is, we can explicitly analyze what Cornell and Welch (1996) call "ex ante screening" versus "on-the-job performance measurement."

I. Model

In order to fill a vacancy, an employer interviews randomly drawn candidates from a countably infinite pool at a cost $k \geq 0$ per interview. Each candidate has two characteristics: the population he belongs to, which is observable to the employer at the time of the interview, and whether he can do the job, which becomes observable only if the candidate is actually hired. We shall refer to the former characteristic as a candidate's *kind* and the latter as a candidate's *type*.

A candidate's kind is denoted by $\gamma \in \{A, B\}$. A fraction m_A of the candidates are from population A, which consists of members of the "dominant" culture—i.e., candidates with the same discourse system as the employer. The remaining fraction $m_B = 1 - m_A$ are from population B, which consists of members not belonging to the dominant culture. As a shorthand for differences between the dominant and nondominant cultures, we shall refer to candidates of kind A as "majority" candidates and candidates of kind B as "minority" candidates.

[6] An alternative theory, pioneered by Gary S. Becker (1957) and Arrow (1972), suggests that employers' tastes for discrimination can account for wage differentials.

[7] Asa Rosen (1997) offers a model where self-fulfilling beliefs lead to discrimination in a search-matching context.

[8] See also Lundberg and Startz (1998) for an endogenous growth model of racial segregation.

A candidate's type, denoted by θ, equals one if he can do the job and zero if he cannot. Let p_γ denote the probability that a randomly drawn candidate of kind γ can do the job; that is, $p_\gamma \equiv \Pr(\theta = 1|\gamma)$. We assume that the two populations are equally qualified, that is, $p_A = p_B = p$.

In advance of the interview, the employer does not know or does not act upon information as to the candidate's kind.[9] At the interview stage, however, a candidate's kind—*A* or *B*—is perfectly revealed to the employer through some observable characteristic such as dialect, gender, or skin color. In addition, the employer receives a signal S_γ as to the competence of the candidate. The signal $S_\gamma = \theta + \varepsilon_\gamma$ is equal to the candidate's type θ plus an error term ε_γ. The error term is assumed to be Normally distributed with zero mean and variance σ_γ^2. The employer finds it easier to assess the competence of candidates with the same discourse system. To model this, we assume that $\sigma_B > \sigma_A$; that is, from the perspective of the employer, minorities convey noisier signals of competence.

The timing is as follows. In period 1, the employer draws a random candidate and conducts the interview. On the basis of the candidate's interview signal, *s*, and taking into account his kind, γ, the employer forms a posterior belief, *q*, about the candidate's "success probability" (i.e., the probability that the candidate can do the job). The employer then decides whether to hire the candidate, and period 1 ends.

In period 2 and all subsequent periods, if the employer did not hire in the previous period, he interviews a new candidate and the process proceeds as before. If the employer did hire in the previous period, the employee's type θ is revealed to the employer. If the employee can do the job, i.e., $\theta = 1$, he is retained forever and all search ceases. In that case, the employer enjoys a payoff with a net present value of $v > 0$. If, however, the employee cannot do the job, i.e., $\theta = 0$, then, by retaining the employee, the employer earns a payoff with a net present value of $-w < 0$. Alternatively, the employer can fire the employee and incur a cost of $c > 0$. Throughout, we assume that $c < w$; hence it is always optimal to fire incompetent employees. Finally, we assume that the employer is risk-neutral and has a discount factor $\delta \in (0,1)$.

A. *Posterior Beliefs*

As we shall see, the employer's optimal strategy is to impose a uniform success probability threshold, $\underline{q}^*$, when deciding whether to hire a candidate. The optimal threshold depends on the distribution of posterior beliefs that an employer might hold following the interview. Define $q_\gamma(s)$ as the employer's posterior belief that a candidate of kind γ with signal *s* can do the job; that is, $q_\gamma(s) \equiv \Pr(\theta = 1|S_\gamma = s)$. By Bayes's rule, we can rewrite this expression as

$$q_\gamma(s) = \frac{\phi[(s-1)/\sigma_\gamma]p}{\phi[(s-1)/\sigma_\gamma]p + \phi(s/\sigma_\gamma)(1-p)},$$

where $\phi(\cdot)$ denotes the probability density of a standard Normal random variable.

It will sometimes be useful to determine the signal realization *s* corresponding to a given success probability *q*, which we shall denote by $s_\gamma(q)$. Since $q_\gamma(s)$ is a monotone function, it is invertible in the extended reals and $s_\gamma(q)$ is well defined. Since $\phi(t) \equiv 1/\sqrt{2\pi}\exp[-\frac{1}{2}t^2]$, it may be readily shown that

[9] Marianne Bertrand and Sendhil Mullainathan (2004) present evidence that, in practice, employers use signals about a candidate's minority status, such as name or address, to illegally prescreen candidates. We study the case where employers are law abiding, i.e., our model is one of undirected search.

$$s_\gamma(q) = \frac{1}{2} - \sigma_\gamma^2 \ln\left(\frac{1-q}{q}\frac{p}{1-p}\right).$$

Prior to the realization of the signal, but after having observed a candidate's kind, the success probability $Q_\gamma = q_\gamma(S_\gamma)$ is a random variable. Now, let $G_\gamma(\cdot)$ denote the cumulative distribution function (cdf) of Q_γ. Formally,

$$G_\gamma(q) = p\,\Phi\left(\frac{s_\gamma(q)-1}{\sigma_\gamma}\right) + (1-p)\,\Phi\left(\frac{s_\gamma(q)}{\sigma_\gamma}\right),$$

where $\Phi(\cdot)$ denotes the cdf of a Standard Normal random variable. The associated density of $G_\gamma(q)$ is

$$g_\gamma(q) = \left(p\phi\left(\frac{s_\gamma(q)-1}{\sigma_\gamma}\right) + (1-p)\,\phi\left(\frac{s_\gamma(q)}{\sigma_\gamma}\right)\right)\frac{\sigma_\gamma}{q(1-q)}.$$

Similarly, let $G(\cdot)$ denote the cdf of the success probability prior to observing the candidate's kind or signal, and $g(\cdot)$ its associated density. Formally, $G(q) = (1-m_B)G_A(q) + m_B G_B(q)$.

Finally, it is useful to establish the following stochastic dominance relations for $G(\cdot)$ and $G_\gamma(\cdot)$. (The proofs of these lemmas, as well as the proofs of all other results in this paper, may be found in the online Appendix, available at http://www.aeaweb.org/articles.php?doi=10.1257/aer.99.1.472.)

LEMMA 1: *For all* $p > p'$, $G(\cdot; p)$ *first-order stochastically dominates* $G(\cdot; p')$.

LEMMA 2: $G_A(\cdot)$ *is a mean-preserving spread of* $G_B(\cdot)$. *And, for all* $m_B < m_B'$, $G(\cdot; m_B)$ *is a mean preserving spread of* $G(\cdot; m_B')$.

II. Optimal Search and Hiring

In this section, we show that the optimal hiring strategy is to set an identical i.e., "color blind," success probability threshold, $\underline{q}^*$, for all candidates, irrespective of their kind. To see this, let V^* denote the employer's expected payoff if he follows an optimal search, hiring, and firing strategy. In any optimal strategy, the employer hires a candidate if and only if his belief q that the candidate can do the job is such that the expected payoff from hiring, which we denote by $H(q, V^*)$, exceeds the expected payoff from not hiring and moving to the next period. Since the employer's problem is a standard one in dynamic programming, it is well known that V^* attains a unique optimal value.

We may write the value function as

$$V^* = \delta \int_0^1 \max\{H(q, V^*), V^*\}\, dG(q) - k, \tag{1}$$

where $H(q, V^*) = qv + (1-q)(V^* - c)$. Note that, according to our timing convention, cost k is incurred immediately, while the payoff from hiring, $H(q, V^*)$, is received in the next period. Furthermore, since the employer's problem is stationary, any strategy attaining V^* must be a threshold strategy (see, for example, McCall 1970). And the threshold must be the same for both kinds of candidates since, conditional on q, a candidate's kind γ is completely irrelevant.

Under a generic threshold strategy, which we denote by $\underline{q}$, the value function given in equation (1) reduces to

$$V(\underline{q}) = \delta\left[G(\underline{q})V(\underline{q}) + \int_{\underline{q}}^{1} H(q, V(\underline{q}))\, dG(q)\right] - k.$$

Substituting for H and solving for $V(\underline{q})$, we obtain

$$V(\underline{q}) = \frac{\delta\int_{\underline{q}}^{1}(qv + (1-q)(-c))\, dG(q) - k}{1 - \delta(1 - \int_{\underline{q}}^{1} q\, dG(q))}.$$

Thus, the employer's problem reduces to choosing $\underline{q}$ to maximize $V(\underline{q})$. Proposition 1 characterizes the unique optimum.

PROPOSITION 1: *The optimal hiring strategy, $\underline{q}^*$, is the unique interior solution to*

$$\underline{q}^* = \frac{\left(1 - \delta\left(1 - \int_{\underline{q}^*}^{1} q\, dG(q)\right)\right)c}{(1 - \delta G(\underline{q}^*))c + (1-\delta)v + k}. \tag{2}$$

Finally, Proposition 2 establishes that every interior threshold success probability can be an optimum.

PROPOSITION 2: *For all $\underline{q} \in (0,1)$, there exist parameter values such that $\underline{q}^* = \underline{q}$.*

III. Performance Metrics

In this section, we study the implications of a "color blind" success probability threshold, $\underline{q}$, for observable performance metrics of diversity.

A. *Permanent Workforce Composition*

Perhaps the most important performance metric of diversity is the fraction of minorities in the permanent workforce, relative to their share in the underlying population. In terms of our model, this corresponds to the probability that a permanently hired candidate is a minority.

Formally, let r_γ denote the probability that the vacancy is permanently filled by a candidate of kind γ, when the employer uses the threshold strategy $\underline{q}$. Then, r_γ can be expressed recursively as follows:.

$$r_\gamma = m_\gamma(p((1 - G_\gamma(\underline{q}|\theta = 1)) + G_\gamma(\underline{q}|\theta = 1)r_\gamma) + (1-p)r_\gamma)$$
$$+ (1 - m_\gamma)((1 - p(1 - G_{-\gamma}(\underline{q}|\theta_{-\gamma} = 1)))r_\gamma).$$

We can write this expression much more compactly if we define $G_{\gamma\theta}$ to be the probability that a candidate of kind γ and type θ induces a posterior success probability less than or equal to $\underline{q}$. Formally, $G_{\gamma\theta} \equiv G_\gamma(\underline{q}|\theta)$. Solving for r_γ, we obtain in our more economical notation:

$$r_\gamma = \frac{m_\gamma(1 - G_{\gamma 1})}{1 - m_\gamma G_{\gamma 1} - (1 - m_\gamma)G_{-\gamma 1}}.$$

Minorities are proportionally represented in the workplace when $r_\gamma / m_\gamma = 1$. It is easily verified that this is equivalent to the condition that $G_{A1} = G_{B1}$. In other words, minorities are proportionally represented if and only if the probability of type I error (rejection of competent candidates) is the same for both kinds of candidates.

When does equality of type I error hold?

LEMMA 3: *There exists a unique threshold,* $\underline{q}^I \equiv 1/[1 + ((1-p)/p)e^{1/(2\sigma_A\sigma_B)}] < p$, *where the probability of type I error is the same for both kinds of candidates.*

The optimal threshold $\underline{q}^*$ given in Proposition 1 is generically not equal to $\underline{q}^I$. The next proposition shows that, depending on the relationship between $\underline{q}^*$ and $\underline{q}^I$, minorities may be over- or underrepresented in the workplace.

PROPOSITION 3:

(i) *Minorities are overrepresented in the workplace if and only if the employer's optimal search strategy leads to lower type I error for minorities than for majorities, i.e.,* $0 < \underline{q}^* < \underline{q}^I$.

(ii) *Minorities are underrepresented if and only if the employer's optimal search strategy leads to higher type I error for minorities than for majorities, i.e.,* $\underline{q}^I \leq \underline{q}^* < 1$.

Figure 1 illustrates how the difference in type I error for majority and minority candidates varies with the choosiness (threshold strategy) of the employer. The ratio $(1 - G_{A1})/(1 - G_{B1})$ of hiring probabilities for competent majority versus competent minority candidates is plotted as a function of $\underline{q}$, when the parameter values are $p = 0.3$, $\sigma_A = 1$, and $\sigma_B = \sqrt{2}$.

At low thresholds ($\underline{q} < \underline{q}^I$), minority candidates are overrepresented in the workplace. In the figure, the degree of minority overrepresentation is greatest at $\underline{q} = 0.18$ and declines thereafter. At higher thresholds ($\underline{q} > \underline{q}^I$), minorities are underrepresented in the workplace. By the time the threshold reaches 0.7, a competent majority candidate is 140 times more likely to be hired than a competent minority candidate, and this situation only worsens as the employer becomes choosier. Indeed, as the figure illustrates, a competent majority candidate becomes infinitely more likely to be hired than a competent minority candidate as the threshold approaches one. As we show in the next proposition, the positive relationship between the choosiness of an employer and the homogeneity of the workplace is a general property of the model.

PROPOSITION 4: *Suppose that the employer is "selective," i.e.,* $\underline{q}^* > p$; *then:*

(i) *As the employer becomes more selective, minority representation in the workplace decreases. Formally,* r_B *is decreasing in* $\underline{q}^*$.

(ii) *As the employer becomes arbitrarily selective, minorities vanish from the workplace. Formally,* $\lim_{\underline{q}^* \to 1} r_B = 0$.

What conditions on primitives guarantee that an employer will be selective in the sense described in Proposition 4? A sufficient condition is that $p < c/(c + v)$. To see this, consider the

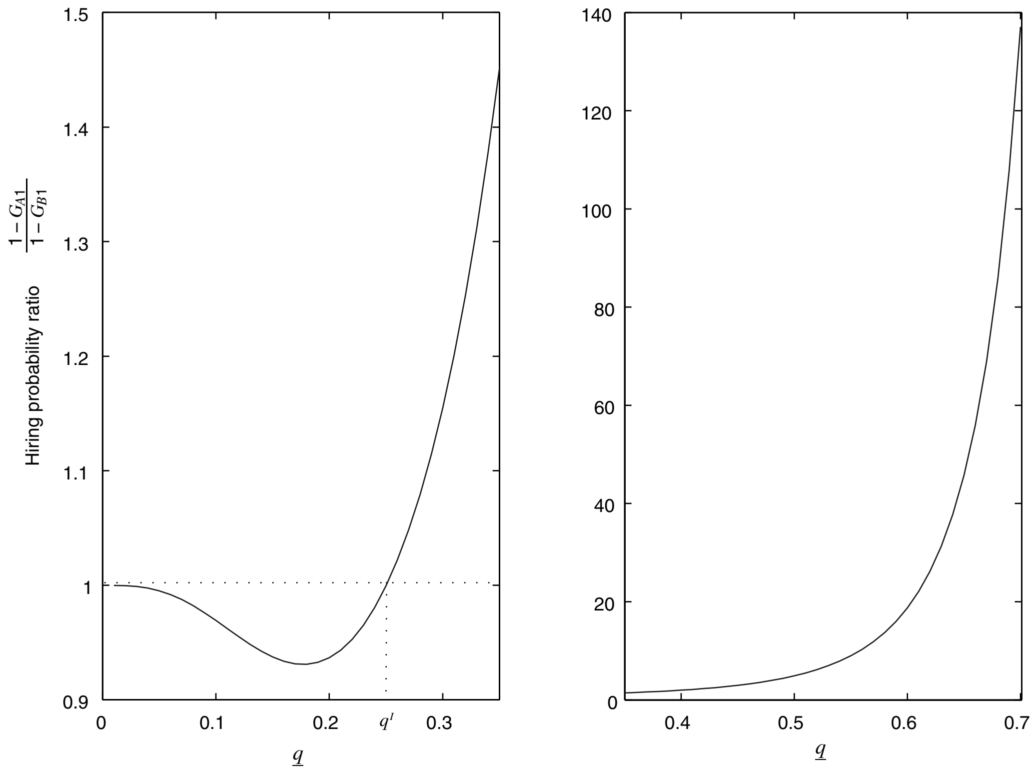

FIGURE 1

optimal threshold of a "myopic" employer who derives benefit one period into the future. Such an employer would choose a "break-even" threshold where $v\underline{q} - (1 - c)\underline{q} = 0$ or, equivalently, $\underline{q} = c/(c + v)$. Employers who value payoffs in periods beyond the next will optimally raise the threshold above the break-even level to capture some of the option value of waiting. Hence, $\underline{q}^* > c/(c + v) > p$.

B. *Initial Hiring Rates*

Given the "color blind" threshold strategy of the employer, one might speculate that the fraction of minorities among initial hires *would* reflect the underlying population. As we shall see, this is not typically the case.

The fraction of initial hires of kind γ, h_γ, is

$$h_\gamma = \frac{m_\gamma(1 - G_\gamma)}{m_\gamma(1 - G_\gamma) + m_{-\gamma}(1 - G_\gamma)}.$$

The probability that a candidate of kind γ will be hired, $1 - G_\gamma$, consists of the probability of two separate events: (i) the joint event that the candidate is competent and passes the interview; and (ii) the joint event that the candidate is incompetent and passes the interview. Event (ii) is equivalent to the probability of type II error.

Having previously established a threshold, $\underline{q}^I$, where type I error is equalized across the two kinds of candidates, it is useful to determine the analogous threshold for type II error. Define $\underline{q}^{II}$ to be the threshold such that $G_{A0} = G_{B0}$, which has as its solution

$$\underline{q}^{II} = \frac{1}{1 + ((1-p)/p)e^{-1/(2\sigma_A \sigma_B)}} > p.$$

When $\underline{q}^* < \underline{q}^{II}$, incompetent minority candidates have a greater chance of being hired than incompetent majority candidates, while for $\underline{q}^* > \underline{q}^{II}$ the opposite holds. Furthermore, the threshold at which type II error is equalized always lies above that where type I error is equalized; that is, $\underline{q}^I < \underline{q}^{II}$. Finally, we turn our attention to the threshold, $\underline{q}^{\emptyset}$, where the initial hiring proportions are equal to the underlying population proportions. That is, $\underline{q}^{\emptyset}$ solves $G_A = G_B$. There is no closed-form solution for $\underline{q}^{\emptyset}$. However, from the fact that G_A is a mean-preserving spread of G_B (Lemma 2), it follows that $\underline{q}^{\emptyset}$ exists and is unique. Moreover, since $\underline{q}^{\emptyset}$ represents a trade-off between type I and type II error, $\underline{q}^I < \underline{q}^{\emptyset} < \underline{q}^{II}$.

As was the case for the composition of the permanent workforce, depending on the optimal threshold $\underline{q}^*$, minorities may be under- or overrepresented among initial hires. Since $\underline{q}^I < \underline{q}^{\emptyset}$, an employer's optimal policy may lead to minority overrepresentation in initial hiring, but minority underrepresentation in the permanent workforce owing to differences in firing rates.

C. *Firing Rates*

Whether minorities are underrepresented among initial hires and in the permanent workforce depends on the choosiness of the employer. However, as we will show, the model predicts that minorities are always fired at greater rates than majorities.

The firing rate for hires of kind γ, which we denote by f_γ, is equal to the probability that a candidate of kind γ is incompetent conditional on actually having been hired. Formally,

$$\begin{aligned} f_\gamma &= \Pr(\theta = 0 \mid Q_\gamma \geq \underline{q}) \\ &= \frac{(1 - G_{\gamma 0})(1-p)}{1 - G_\gamma}. \end{aligned}$$

One might speculate that differences in firing rates across populations simply reflect differences in type II error. This is not true, however, because the firing rate is the probability of being incompetent conditional on having a signal above the threshold, while type II error is the probability of having a signal above the threshold conditional on being incompetent. The former is affected by the base rate of having a signal above the threshold (i.e., by both types of error), while the latter is not. To see this formally, it is helpful to write f_γ as follows:

$$f_\gamma = \frac{(1-p)\Pr(\text{Type II})}{(1-p)\Pr(\text{Type II}) + p(1 - \Pr(\text{Type I}))}.$$

When $\underline{q}^I \leq \underline{q}^* \leq \underline{q}^{II}$, minorities suffer greater type I and type II error than do majorities. As a consequence, they are fired at higher rates. When $\underline{q}^* < \underline{q}^I$, minorities continue to experience greater type II error; however, type I error is now higher for majorities. Hence, the ordering of majority and minority firing rates depends on the relative magnitude of the two types of errors. Similarly, when $\underline{q}^* > \underline{q}^{II}$, type II error is smaller for minorities but type I error is greater. Again, the ordering of firing rates could go either way. As the next proposition shows, however, the

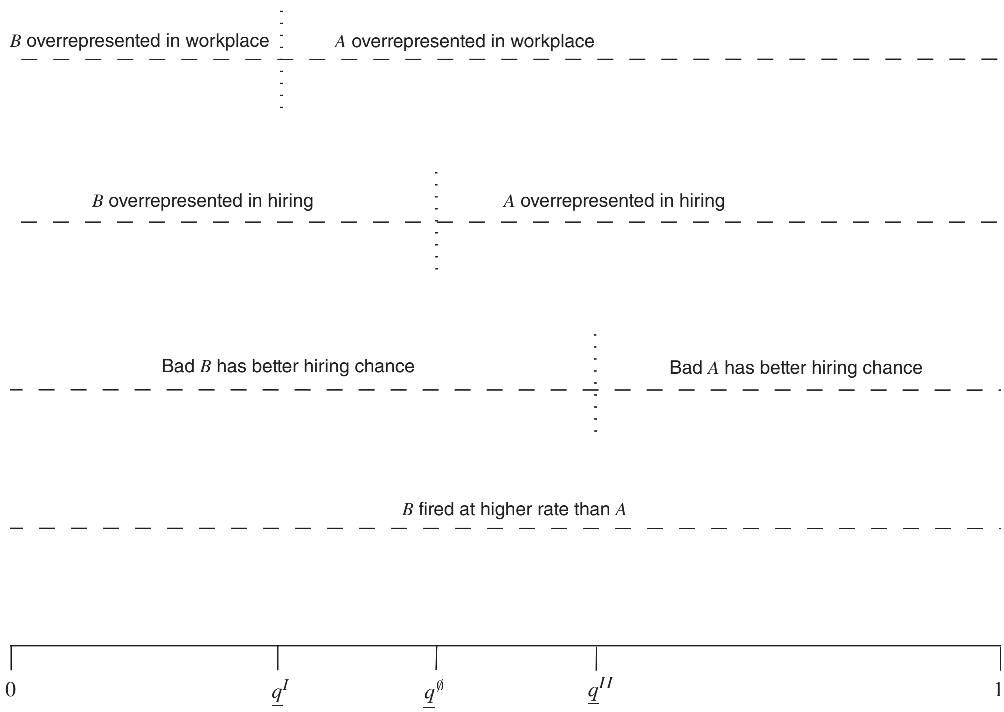

FIGURE 2

trade-off between type I and type II error is always resolved in the direction of higher firing rates for minorities.

PROPOSITION 5: *Minorities are always fired at higher rates than majorities.*

D. *Summary*

Figure 2 summarizes the various performance metrics of diversity as a function of the success probability threshold $\underline{q}^*$.

IV. Policy Implications

In this section, we examine how the optimal threshold—and, by implication, the diversity metrics—vary with the parameters of the model. Policymakers may be able to affect some of these parameters and hence influence workplace diversity.[10] Here, we assume that the employer is "selective" in its hiring policy, i.e., $\underline{q}^* > p$; hence, the problem is underrepresentation of minorities. In this case, an increase in $\underline{q}^*$ decreases diversity, and vice versa.

Diversity and Worker Protections.—There has been considerable debate, especially in Europe, over the appropriate level of worker protections against dismissal. The mass street protests in

[10] We shall use the term workplace diversity as being synonymous with the minority representation ratio r_B/m_B. The closer this ratio is to one, the more diverse is the workplace.

France during the spring of 2006 against the *contrat première embauche* are a salient example. This law would have allowed for summary dismissal of employees under age 26 during the first two years of their contract. By reducing the risk of hiring, it was hoped that this policy change would lead to a reduction in youth unemployment.

What would the *contrat première embauche*, which was in fact retracted in response to the protests, have meant for workplace diversity? In terms of our model, it may be thought of as reducing the cost of firing, c.

IMPLICATION 1: *Reducing the cost of firing increases workplace diversity.*

Intuitively, reducing the cost of firing decreases the cost of type II error for the employer. As a result, he is more willing to take chances and, consequently, lowers the threshold for hiring. This increases diversity.

Diversity and the Cost of Recruiting.—Breakthroughs in videoconferencing technology have the potential to dramatically reduce firms' costs of interviewing, k (see, e.g., Matt Bolch 2007). This will allow recruiters to "cast their nets more widely" in seeking job candidates. A common intuition suggests that such a widening would increase diversity in the workplace. The model, however, shows how this intuition can go wrong.

IMPLICATION 2: *Reducing the cost of interviewing decreases workplace diversity.*

By reducing the cost of interviewing, it becomes less expensive for the employer to be choosy. As a result, the employer optimally raises his threshold for hiring, which harms diversity. Hence, reducing frictions in the labor market does not guarantee improvements in minority representation: while reducing firing costs improves diversity, reducing interview costs hurts it.

Diversity and the Business Cycle[11].—At a peak in the business cycle, job candidates become scarcer and, hence, the cost of recruiting increases. In addition, the value-added of a competent employee is also likely to be higher. In terms of our model, this corresponds to increases in k and v, respectively. In either case, employers optimally respond by lowering the hiring threshold. Hence:

IMPLICATION 3: *Diversity is procyclical.*

This prediction is consistent with the Dutch experience over the last decade.

Diversity and Business Risk.—The model also predicts that variation in the riskiness of firms leads to differences in workplace diversity. If the discount rate δ reflects the probability of bankruptcy, then:

IMPLICATION 4: *Riskier firms are more diverse.*

[11] This analysis relies on comparative static implications of our stationary model. This is appropriate if firms view changes in the business climate to be permanent rather than transitory. Otherwise, one needs to account for the nonstationarity of the future value of not hiring conditional on the present state of the economy—a considerably more involved dynamic programming problem, which is beyond the scope of this paper.

Intuitively, the option value of waiting is worth less for risky firms than for safe firms. Hence, risky firms are less choosy and, consequently, more diverse.

Diversity and the Size of the Minority Population.—Europe's minority population has grown rapidly owing to immigration and higher fertility rates. Will these developments improve diversity in the workplace? In terms of the model, will an increase in m_B, the minority fraction of the population, help or hurt?

IMPLICATION 5: *The larger is the minority, the smaller its degree of underrepresentation.*

Intuitively, an increase in the minority fraction of the population makes the employer less selective, since it raises the expected time to fill a vacancy under any given threshold. As a consequence, the fraction of minorities among initial hires and in the permanent workforce increases. A similar result can be found in Lundberg and Startz (2007).

Diversity and the Scarcity of Competence.—When competence is scarce (i.e., p is small), candidates must overcome the negative prior beliefs of the employer in order to be hired. For minority candidates, who have noisier signals, this is much harder than for majority candidates. Hence, the model predicts underrepresentation of minorities, both at the hiring stage and in the permanent workforce.

In contrast, when competence is plentiful (i.e., p is large), an imprecise signal in the interview stage can be an advantage. Suppose that p is so high that the employer is no longer selective; that is, he is predisposed to give candidates a chance unless they greatly disappoint in the interview. In that case, minority candidates have a high chance of being hired. Majority candidates, who convey more precise signals, have a greater chance of making a bad impression and not being offered the job—even when they are competent. Therefore, overrepresentation of minority candidates, both in hiring and in the permanent workforce, is the more likely outcome. The next implication formalizes this intuition.

IMPLICATION 6: *In jobs that require rare skills, minorities will be underrepresented. In jobs that require common skills, minorities will be overrepresented. Formally, there exist* $0 < p_0 < p_1 < 1$ *such that for all* $p \in (0, p_0)$, $r_B / m_B < 1$, *while for all* $p \in (p_1, 1)$, $r_B / m_B > 1$.

V. Conclusion

We have studied diversity in the workplace when employers engage in optimal sequential search and minority workers have noisier ability signals. In these circumstances, there exists a tension between job security and diversity. When job security is high—that is, firing non-performing staff is expensive—minorities are likely to be severely underrepresented in the workplace, particularly in demanding positions. When job security is low, minorities are overrepresented in undemanding positions. These distortions occur even though in our model majority and minority populations have identical skill levels.

While the occurrence of reverse discrimination may be interesting from a theoretical perspective, from a policy perspective, the underrepresentation of minorities in demanding positions seems the more relevant case. In our model, it is the communication mismatch between the majority employer/interviewer and minority job candidates that harms workplace diversity. Obviously, matching the background of the interviewer with that of the candidate would solve this problem. However, this may not be feasible. A more realistic option is to lower firing costs. This induces employers to be less choosy and creates opportunities for competent minority candidates to prove themselves on the job. More liberal bankruptcy laws that spur the creation of riskier ventures may also improve workplace diversity. However, seemingly intuitive policies can sometimes be counterproductive. For instance, reducing recruiting costs may harm diversity.

Our model is limited in several respects. One limitation is the one-sided search, or partial equilibrium nature, of the analysis. It would be useful to extend the model to a general equilibrium framework. Also, the binary nature of competence—candidates either can or cannot do the job—is clearly restrictive. Other, less technical limitations include assumptions of equal average skill levels, identical firing costs, and the absence of naked racism or directed search on the part of employers. Also, we have assumed that employers care only about technical competence and not about how a candidate fits into the culture of the organization. Some or all of these assumptions do not hold in practice, while most realistic deviations all point in the same direction: toward more rather than less discrimination. As such, the model puts a lower bound on the problem and shows that, even under the best of circumstances, competent minority candidates are likely to have a much harder time securing a coveted job than equally competent majority candidates.

REFERENCES

Aigner, Dennis J., and Glen G. Cain. 1977. "Statistical Theories of Discrimination in Labor Markets." *Industrial and Labor Relations Review*, 30(2): 175–87.

Arrow, Kenneth J. 1972. "Models of Job Discrimination," and "Some Models of Race in the Labor Market." In *Racial Discrimination in Economic Life,* ed. A. H. Pascal, 83–102. Lexington, MA: D. C. Heath.

Arrow, Kenneth J. 1973. "The Theory of Discrimination." In *Discrimination in Labor Markets*, ed. Orley Ashenfelter and Albert Rees, 3–33. Princeton, NJ: Princeton University Press.

Arrow, Kenneth J. 1998. "What Has Economics to Say About Racial Discrimination?" *Journal of Economic Perspectives*, 12(2): 91–100.

Athey, Susan, Christopher Avery, and Peter Zemsky. 2000. "Mentoring and Diversity." *American Economic Review*, 90(4): 765–86.

Becker, Gary S. 1957. *The Economics of Discrimination*. Chicago: Chicago University Press.

Bertrand, Marianne, and Sendhil Mullainathan. 2004. "Are Emily and Greg More Employable Than Lakisha and Jamal? A Field Experiment on Labor Market Discrimination." *American Economic Review*, 94(4): 991–1013.

Black, Dan A. 1995. "Discrimination in an Equilibrium Search Model." *Journal of Labor Economics*, 13(2): 309–33.

Bolch, Matt. 2007. "Lights, Camera . . . Interview!" *HR Magazine*, 52(3): 100–102.

Coate, Stephen, and Glenn C. Loury. 1993. "Will Affirmative-Action Policies Eliminate Negative Stereotypes?" *American Economic Review*, 83(5): 1220–40.

Cornell, Bradford, and Ivo Welch. 1996. "Culture, Information, and Screening Discrimination." *Journal of Political Economy*, 104(3): 542–71.

Dagevos, Jaco. 2006. *Hoge (jeugd)werkloosheid onder etnische minderheden. Nieuwe bevindingen uit het LAS-onderzoek*. Den Haag: Sociaal en Cultureel Planbureau.

Heckman, James J., and Bo E. Honoré. 1990. "The Empirical Content of the Roy Model." *Econometrica*, 58(5): 1121–49.

International Centre for Migration Policy Development. 2003. *Migrants, Minorities and Unemployment: Exclusion, Discrimination and Anti-Discrimination in the 15 Member States of the European Union*. Vienna: European Monitoring Centre on Racism and Xenophobia.

Lang, Kevin. 1986. "A Language Theory of Discrimination." *Quarterly Journal of Economics*, 101(2): 363–82.

Lundberg, Shelly J., and Richard Startz. 1983. "Private Discrimination and Social Intervention in Competitive Labor Markets." *American Economic Review*, 73(3): 340–47.

Lundberg, Shelly J., and Richard Startz. 1998. "On the Persistence of Racial Inequality." *Journal of Labor Economics*, 16(2): 292–323.

Lundberg, Shelly J., and Richard Startz. 2007. "Information and Racial Exclusion." *Journal of Population Economics*, 20(3): 621–42.

McCall, John J. 1970. "Economics of Information and Job Search." *Quarterly Journal of Economics*, 84(1): 113–26.

Phelps, Edmund S. 1972. "The Statistical Theory of Racism and Sexism." *American Economic Review*, 62(4): 659–61.

Rosen, Asa. 1997. "An Equilibrium Search-Matching Model of Discrimination." *European Economic Review*, 41(8): 1589–1613.

Scollon, Ronald, and Suzanne Scollon. 2001. *Intercultural Communication: A Discourse Approach*. Boston: Blackwell Publishers.

Stigler, George. 1961. "The Economics of Information," *Journal of Political Economy*, 69(3): 213–25.

Tesser, Paul, Ans Merens, and Carlo van Praag. 1999. *Rapportage minderheden 1999: Positie in het onderwijs en op de arbeidsmarkt*. Den Haag: Sociaal en Cultureel Planbureau.

Welch, Finis. 1967. "Labor Market Discrimination: An Interpretation of Income Differences in the Rural South." *Journal of Political Economy*, 75(3): 225–240.