Communications

Estimating the demographic mix of the available labor force

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Statistical arguments have played an important role in establishing prima facie cases of discrimination based on race or sex. The courts have generally established that a disproportionate racial impact in hiring can be demonstrated with one of two statistical methods:[1] comparing the proportion of minority applicants who are hired to the corresponding proportion of majority applicants (applicant flow method); or comparing the percentage of minorities currently employed or hired over a period of time to the proportion of minorities in the labor force (or population) in the relevant geographic area (demographic method). The two statistical methods may yield conflicting results.

Although the first approach is the standard two-sample test of equality of proportions (binomial probabilities), Mark Rosenblum[2] emphasized that the logic underlying its applicability rests on two assumptions: ability and qualifications for the job are distributed similarly in all race (sex) groups in the population; and the people who actually apply for the job can be considered a random sample from the total population (or the relevant subpopulations). Kenneth T. Lopatka[3] noted that if the minority group contains a disproportionately large share of incompetent potential candidates or if some eligible candidates are eliminated by the imposition of an invalid requirement (so some might not even apply), the actual applicants may not even be a close approximation to a random sample.

The demographic method does not rely on applicant data. It was originally used because courts noticed that minority members might not apply to firms with a reputation for employment discrimination. So that even though a statistically acceptable proportion of minority applicants get jobs, the minority proportion of all hires may be far less than the minority population share.[4] Thus, the two statistical methods are consistent only when the recruiting process draws a representative sample of all eligible applicants and the pool of eligible applicants can be determined from available data. Indeed, two 1977 Supreme Court decisions emphasize the importance of properly specifying the labor pool for new hires,[5] and recent articles in the legal literature have been concerned with this topic.[6]

This study will show that the appropriate labor force in minority hiring and promotion cases may have race-sex proportions substantially different from those derived from the 1970 census or from the Current Population Survey, the two most commonly used statistical sources. The reasons for this include the following:

1. New hires come from persons not in the labor force, (for example, students and persons returning to the labor market) in addition to the current labor force. The race-sex proportions of these sources of new hires are quite di fferent from those among the currently employed;
2. The census data for 1970 and, to a lesser extent, more current data include many employed persons who were hired prior to the 1964 Civil Rights Act, possibly reflecting pre-act societal discrimination.[7] Thus, the minority fraction of post-act entrants to the labor force, especially a "qualified labor force," is usually higher than the corresponding fraction of persons employed in that occupation as of 1970 (or even 1980);
3. Because persons already employed in an occupation for some time typically earn more than the beginning wage o ffered by an alternative employer and may be employed in higher level positions in the occupations, they are unlikely to be interested or available for entry level positions in that occupation and should be excluded from the potential labor pool for new hires.[8]

Because the race-sex mix of potential new hires differs from that of the entire labor force, refinements to the statistical procedure which adjust for some of the problems noted are discussed. For example, occupational wage data on employed persons enable us to account for the fact that persons who change jobs usually seek another job paying at least as much as the previous one.[9] This approach also tends to correct the census data for pre-act hires, as wages typically increase with seniority. Although there are severe data limitations with the use of gross flow data to refine the "entrant" portion of the labor force,[10] the wage adjustment alone

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more accurately defines the available labor pool than do the census data. This approach is illustrated on data used in a case on new hires and in one on promotions, showing how it narrows the differences in the results obtained from the applicant flow and demographic approaches.[11]

Because labor force data are also being used in promotion cases,[12] the applications of this refinement of the occupational wage data also are discussed in that context. In particular, it is shown that by failing to make an adjustment for pre-act employees in the 1970 census data, a Federal appeals court may have reached a statistically incorrect inference, as it excluded pre-act promotions from the firm's data which it then compared to the raw census data.

In a final section, the need for better labor market data is discussed, as well as the implications for the use of statistical hypothesis testing when the minority proportion against which the data are tested is itself inaccurate.

Refining availability data

Courts have noted that the 1970 census data on persons employed in a specific occupation may be outdated or may reflect discrimination that occurred prior to the 1964 Civil Rights Act,[13] and, therefore, underestimate the availability of minorities for new positions. The Supreme Court's *Hazelwood* decision[14] focused attention on post-act hiring data and the need to develop statistical methods to exclude employees hired prior to the law's e ffective date from census or other data[15] to properly analyze an employer's post-act hiring decisions.

It can be demonstrated that the use of all employed persons or persons in the civilian labor force as a referent group for new hires can lead to serious errors. Recall that the labor force is composed of employed persons and persons available for work who are unemployed. Furthermore, the unemployed are classified into three subcategories: persons laid off from their most recent jobs; persons who quit their previous jobs; and persons who have just entered or reentered the labor force.

The available pool for new hires can be similarly separated into persons who have been unemployed, those employed elsewhere, or those who are not in the labor force but intend to enter or reenter the labor force. The Bureau of Labor Statistics reports monthly data on the flow of workers from both unemployment and not in the labor force into employment.[16] The data for 1978 are presented in table 1.

Although data specifically for job changers (persons employed in consecutive months but who changed employers) are unavailable, they are counted in the employed category. It is evident from the percentages in table 1 that using the currently employed civilian labor force as a referent to determine an affirmative action goal or standard of comparison in a legal case yields an underestimate of the proportion of minorities and women in the available labor pool for new hires. The degree of this statistical bias may depend on the particular position, as the fraction of new hires who come from the currently employed undoubtedly varies among the occupations and by experience level within an occupation.

As an estimate of the magnitude of the bias, a recent survey showed that 4.1 percent of persons currently employed were looking for work.[17] Of course, not all seekers of jobs find them within a month, so the actual job changers form a smaller percentage than 4.1 percent of the employed. However, the turnover in manufacturing jobs ranges from 1.1 to 3.4 percent with a typical value of about 2.2 percent.[18] For illustrative purposes, assume that 2.5 percent of the employed change jobs. Then the composition of new hires can be derived from table 1 by adding 2.5 percent of the previous month's employed to the new hires. The results are presented in the following tabulation:

	Number	*Percent*
Total	7,393	
Male	3,659	49.50
Female	3,734	50.50
White	6,414	86.76
Nonwhite	979	13.24

Comparing these race-sex percentages of the available labor force with those of the currently employed in table 1, we note that the difference between 13.24 and 11.66 percent for minorities is more important than it may first appear because minorities are not spread uniformly over the country. In an area where the labor force goal is about 35 percent, our estimate of availabil-

Table 1. Civilian labor force employment and new hires, by race and sex, annual averages, 1978

[Numbers in thousands]

Characteristic	Civilian labor force		Currently employed		New hires from unemployment		From not in labor force	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	100,312	100.00	94,433	100.00	1,678	100.00	2,882	100.00
Male	58,589	58.41	55,659	58.94	921	54.89	1,068	37.06
Female	41,723	41.59	38,774	41.06	757	45.11	1,814	62.94
White	88,618	88.34	84,145	89.11	1,396	83.19	2,494	86.54
Nonwhite	11,694	11.66	10,288	10.89	282	16.81	388	13.46

ity would be 40 percent. Moreover, lower paid workers are more likely to search for a new job while employed,[19] so that our adjustment, especially for minorities, may still be on the low side. As detailed data on new hires by occupation or geographic region are not available, we now turn to the development of methods of refining the census labor force data to obtain a more realistic estimate of the labor pool available for new hires.

One method for eliminating pre-act hires from census data is based on the fact that senior employees tend to earn more than the entry level wage and normally seek jobs paying at least as much as they currently earn.[20]

This idea only applies to the potential new hires among currently employed persons. And because the other two sources of new hires have higher minority percentages, it often yields reasonable numbers for the whole problem. Moreover, courts have often relied on experienced labor force data as the demographic referent, and indeed prior experience may be required for some jobs.

In addition to the use of wage data, in some applications data on school and university enrollment may be used to develop availability data for specific occupations such as lawyers, teachers, and technicians. Potential new hires may then be separated into persons hired directly from school and those hired from the external labor market.

Illustrations

In this section, two cases are examined to show how apparent conflicts between applicant flow data and the demographic method are diminished considerably when high wage earners are eliminated from the labor force to obtain the new hire pool. *Hill v. Western Electric* presents the issue clearly.[21] Entry level assembler positions requiring no previous background or experience were at issue. Applicant flow statistics showed that both black and female applicants had significantly lower hire rates than their white and male counterparts. The data for 1970–74 are shown in table 2.

To rebut the applicant flow statistics, the employer introduced data for the standard metroplitan statistical area (SMSA) showing that blacks formed 24 percent and women 40.4 percent of the civilian labor force. Because 25 percent of the hires were black, the firm claimed it had not discriminated in hiring blacks. A more accurate new hire pool might exclude persons earning more than $10,000 (in 1969 dollars) from the labor force and operative data.[22] The basic labor force data as well as data on earnings of the experienced labor force are given in table 3.

Blacks form about 40 percent of the experienced labor force and an even higher proportion of operative workers earning less than $10,000. As blacks formed 38.1 percent of the unemployed in the relevant SMSA, their proportion of the applicants (44 percent) probably reflects the lack of commuting problems.[23] Similarly, the female proportion of all applicants (41.1 percent) is between their percentages of the overall and operative labor force without high wage earners. Recalling the high proportions of women hired from the unemployed and out of the labor force categories in table 1, we realize the female share (30 percent) of actual hires is lower than their estimated availability from each source. Thus, Judge Bryan's original finding of discrimination in hiring of both blacks and females on the basis of applicant data is not in conflict with a proper demographic analysis. Indeed, the applicants (table 2) appear to be a representative sample from the labor pool available for the jobs at issue.

Both the District Court and appellate opinions in *EEOC v. UVB*[24] illustrate the problem and our approach quite clearly. Both courts stated that the proper comparison for determining whether the bank had engaged in racial discrimination in hiring for office/clerical and management positions is between the black fraction of the employees in these jobs and the black percentage of the local force with the requisite qualifications, *not* the black fraction of the total labor force or population. The District Court allowed the EEOC to establish a prima facie case (later rebutted by the defendant), in part on the basis of a significant disparity between the black fraction of employees in each job category and the SMSA data. The Fourth Circuit asserted that the EEOC failed to establish a prima facie case because it made no effort to exclude employees hired prior to the effective date of the Civil Rights Act. Moreover, the appeals court disregarded applicant flow data showing that 12.4 percent of whites were hired but only 4.4 percent of blacks because applicants for all positions were aggregated, and no evidence was presented by the EEOC as to qualified applicants.

The data used by the District Court, based on a Virginia Employment Commissions report for 1975:

Job category	*Black percentage in SMSA (1975)*	*Black percentage of employees (1970)*	*Black percentage of employees (1974)*
Managers	4.8	0.0	1.8
Office/Clerical . .	14.0	6.5	9.5
Operative	45.4	20.0	33.3
Service	49.6	55.0	78.6

The Fourth Circuit rejected the EEOC's assertion that the black percentage (27 percent) of the total labor force in the Norfolk-Portsmouth SMSA should be used as the availability figure for clerical workers and agreed with the District Court choice of referent data. However, it disagreed with the judge's use of "1975" referent data to evaluate the 1970 employment pattern[25] and proceeded to perform the usual "standard deviation"

Table 2. 1970–74 applicant-hire data for Western Electric Co.

Worker characteristics	Applicants		Hires		Percent hired
	Number	Percent	Number	Percent	
Race:					
Black	1,489	44.03	189	25.06	12.7
White	1,893	55.97	565	74.94	29.8
Sex:					
Female	1,443	41.10	244	30.54	16.9
Male	2,068	58.90	555	69.46	26.8

analysis on the bank's employment data and on employees hired in the post-act era. The Fourth Circuit did not eliminate high wage earners from the Census data, even though the District Court had found that a specific plaintiff did not suffer discrimination when she was not hired in 1972 for a clerical job paying $300 a month because she had been paid $375 a month in her previous job and expressed interest in jobs of the same level she previously held. Because the census earnings data report 1969 earnings, eliminating clerical workers receiving more than $3,600 would be conservative and allow for some persons who are willing to take a small pay cut.

Repeating the same type of calculations made in our discussion of *Hill v. Western Electric,* we found that blacks formed 14 percent of all clericals, 14.9 percent of clericals earning less than $4,000 in 1969, and 17.2 percent of all clerical workers earning less than $3,000 in 1969. For the specific positions of bank tellers and cashiers, the corresponding percentages are 14.6, 16.1, and 17.2. Therefore, it seems reasonable and conservative to use 15.5 percent instead of 14 percent as the black availability for entry level clerical jobs. As there were 301 clerical employees at UVB hired after July 1, 1965, we would expect 46.66 black clericals in contrast with the actual number of employees (30) which leads to a difference of 2.65 standard deviations instead of the 2.02 calculated by the Fourth Circuit.

Although our approach did not increase the number of standard deviations between the observed and expected number of black clerical employees to three or more, the data are significant at the .01 level rather than at the .05 level. Thus, our approach supports Judge Clarke's original finding that a prima facie case had been established as well as Judge Butzner's concurrent opinion. Moreover, excluding higher paid workers in the other occupations would also have reinforced the statistics showing black underrepresentation in managerial positions.

Both overall labor force data and specific occupational data have been used by a number of courts to aid in the determination of liability and in fashioning an appropriate remedy in cases involving possible discrimination in promotions. In particular, the Fourth Circuit held in two promotion cases[26] "that the ratio of blacks and females in supervisory positions should be judged on the basis of their ratio in the qualified work force and that a standard might be found in the SMSA data."

Because 1970 census data on managers include persons employed in higher paid supervisory positions, many of whom presumably became first level managers prior to July 1965, the concepts developed above imply that the basic labor force data need some refinement before being used in a promotion case.

In contrast with the demographic comparisons in hiring cases, where persons represented by census data could actually apply or be recruited for jobs, promotion cases focus on the advancement of current employees. Although most statisticians would prefer to base their analysis of promotion data on a test of the significance of the difference in the promotion rates,[27] comparisons with an external group are needed in cases where minorities are underrepresented in the feeder position, either because of hiring discrimination[28] or because of discriminatory placement or advancement at an earlier level.[29] Judges have also used demographic comparisons to find a firm innocent of discrimination when minorities were "overrepresented" in the feeder position but received a share of promotions corresponding to their proportion of the total labor force.[30] Our approach should aid in defining an appropriate comparison group from census data.

In *Patterson v. American Tobacco Company,*[31] the Fourth Circuit upheld the district court's finding that blacks and women had been discriminated against in

Table 3. Basic labor force data for the Washington SMSA, 1970 Census

Characteristic	Civilian labor force		Experienced labor force		Experienced labor force earning less than $10,000		Operatives in experienced labor force		Operatives earning less than $10,000	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	1,292,347	100.00	1,174,888	100.00	737,059	100.00	41,182	100.00	37,259	100.00
Male	769,718	59.56	680,522	57.93	387,106	52.52	27,175	65.72	23,407	62.82
Female	522,629	40.44	494,366	42.07	349,953	47.48	14,117	34.28	13,852	37.18
Black	310,505	24.03	294,130	25.03	267,976	39.91	15,919	38.65	15,248	40.92

SOURCE: Data from the SMSA labor force are from tables 164–65 and those for the experienced labor force are from tables 175–76 of the Detailed Characteristics Volume of the 1970 Census for the District of Columbia.

promotions, but overturned the district court's remedy that vacancies for foremen and assistant foremen be filled with qualified blacks and women, except when none could be found, until their proportion equalled that in the Richmond, Va., SMSA work force.

The appeals court focused on the firm's post-act employment decisions in its two Richmond branches. During the post-act period, 1965–73, at the "Virginia Branch," the company appointed 18 assistant foremen, of whom 5 (27.5 percent) were black and 3 (16.6 percent) were women. At the "Richmond Branch," 3 (33.3 percent) of the 9 post-act supervisory appointments were black and 2 (22.2 percent) were women. Of the six entry level supervisory positions at the Richmond Branch at the time of the trial, 5 were white men with one vacancy, although there was some evidence indicating that the defendent subsequently promoted one black and one woman.

The appeals court found that 6.8 percent of the blacks and 1.5 percent[32] of the women in the Richmond SMSA could be classified as supervisory personnel. However, in a post-*Hazelwood* appeal,[33] the defendants asserted that blacks formed 12 percent of those eligible for supervisory work and women, 5 percent. These data were used by appeals court Judge Widener in dissent, claiming that these percentages were lower than the percentages of new promotions that actually went to blacks and women.

Ideally, the company's promotion data should be compared with all promotions to supervisory positions made from July 1965 through March 1970 in the labor market area. As these data are unavailable, a reasonable substitute is to eliminate senior (higher paid) supervisory positions. This should yield a closer approximation to the desired data on persons holding comparable lower level supervisory positions. For purposes of illustration, a 1969 income of $7,000 was used as the salary for entry level supervisors.[34] Table 4 reports the number and minority percentages of the experienced civilian labor force, managers and administrators, and foremen. The data for all workers and for persons who earned less than $7,000 in 1969 are presented.

Table 4. The experienced civilian labor force eligible for supervisory occupations, by salary, in the Richmond SMSA, 1970 Census

Labor force group	Men		Women		Black	
	Number	Percent	Number	Percent	Number	Percent
Total labor force	128,962	59.00	89,602	41.00	50,246	22.99
Experienced labor force	59,591	42.82	79,583	57.18	43,319	31.13
Managers	16,887	85.11	2,955	14.89	1,211	7.17
Eligible managers	3,334	61.59	2,079	38.41	706	13.04
Foremen	4,104	92.83	317	7.17	359	8.12
Eligible foremen	729	76.82	220	23.18	154	27.57

NOTE: For each of the three occupations, the minority percentages of the entire population and of the eligible portion of the occupation (workers earning less than $7,000) were used.

Regardless of whether one considers the general managerial category or the specific occupation of foremen as the appropriate comparison group, it is clear that the minority share of lower level jobholders (thus eligible for promotion) is substantially larger than their percentage of all persons employed in the occupation. Using the "eligible foremen" as a comparison group, we might conclude that the firm promoted enough blacks but women had not received their fair share. Of course, the *dates* of the minority promotions played a major role in the original finding of discrimination which was sustained by the Fourth Circuit.

Although this statistical approach might not have led the Fourth Circuit to reach a different decision in its reversal of the quota remedy, it does give a more realistic measure of the available labor pool for entry level supervisory positions.

Implications

We have seen that the female and minority proportion (p_1) of persons employed in an occupation usually is an underestimate of their proportion (p_2) of the labor pool available for hire into lower level positions within that occupation and that this difference is often substantial enough to change the statistical inference reached by the judiciary. In this section we present formulas for the difference, in standard deviation units, between the actual and expected number of hires when a low availability proportion (p_1) is used instead of p_2 and the number of hires that female and minority plaintiffs consequently lose in legal proceedings because of an underestimate of availability. If minority availability is overestimated, similar formulas yield the number of "excess" minority members firms would need to hire to "pass" the usual standard deviation analysis.[35] Numerical results obtained from these formulas illustrate the important role the assumed availability proportion plays in the statistical analysis once a moderate number of hires is examined. Therefore, we suggest the need for additional labor market data which should aid in improving the accuracy of availability estimates.

Letting S denote the number of standard deviations from the expected number of hires when M minorities are observed among n hires calculated under the assumption that the minority function of the available labor pool is p_1, and letting T denote the corresponding number of standard deviations from expected assuming that minority availability is p_2, we have

$$(1.1)\quad S = \frac{(M - np_1)}{[np_1(1-p_1)]^{1/2}},\quad T = \frac{(M - np_2)}{[np_2(1-p_2)]^{1/2}}$$

and

$$(1.2)\ T = -n^{1/2}\frac{(p_2-p_1)}{[p_2(1-p_2)]^{1/2}} + S\left[\frac{p_1(1-p_1)}{p_2(1-p_2)}\right]^{1/2}$$

When p_1 is less than p_2 and n is of reasonable size, the value of T is less than S; for example the plaintiff is required to show a disparity of more than 2 or 3 standard deviations from the expected number of hires in order to establish a prima facie case under the *Hazelwood* criteria. Conversely, a defendant employer is similarly disadvantaged when minority availability is overestimated.

Another measure of the potential minority loss in employment from using p_1 instead of p_2 as the minority availability fraction is the difference between the minimum number of minority hires a firm needs to "pass" the 2 standard deviation criterion. For any value of p, this minimum number is given by

$$(1.3)\ np - 2\,[np(1-p)]^{1/2}$$

so using p_1 instead of p_2 (when $p_1 < p_2$) leads to an expected loss of

$$(1.4)\ n(p_2-p_1) - 2n^{1/2}[(p_2(1-p_2))^{1/2} - (p_1(1-p_1))^{1/2}]$$

jobs in a legal action. This loss in jobs is usually slightly less than the difference, np_2-np_1, between the expected number of minority hires calculated using the different availability fractions, as the statistical allowance for chance effects has been taken into account.

In table 5, we present the true number (T) of standard deviations from the expected number of hires when the number of standard deviations (S) is calculated assuming an availability fraction p_1, while the true availability is p_2 (larger than p_1). The results are given for sample size (n=100, 300, 1000) and for several choices of p_1 and p_2 and values of S=0 and −1. The number of legally missed hires (equation 1.4) is also reported. To avoid the problem of rejecting the null hypothesis for insubstantial differences we have selected values of p_1 and p_2 which obey $p_1/p_2 \leq 0.8$[36] and sample sizes which are reasonably, but not overly, large. The results show that when S=−1 (for example, minority hires are one standard deviation below expectation) a difference of 5 percentage points between p_1 and p_2 would yield significance according to the 2 standard deviation criterion for samples of size 100 and a difference of 3 percentage points yields significance using the 3 STD criterion for samples of 300. Thus, comparatively small errors in the determination of the minority fraction (p) of the available labor pool can have a large effect on the ultimate statistical inference. It should be noted that the effect of the "statistical allowance" (the second term in (1.4) or the difference between $n(p_2-p_1)$ and the lost hires in table 4) depends on the actual values of p_1 and p_2. Indeed, for pairs (p_1, p_2) with the same difference p_2-p_1, it is larger for the smaller values; that is, the allowance is larger for (p_1, p_2) = (.1, .15) than for (.2, .25). Hence, the statistical allowance for chance effects increases the importance of properly determining the minority availability (p) when p is small. The results also indicate the influence of sample size upon the degree of statistical significance.

To develop more accurate estimates of minority availability (p), statisticians and labor economists will require more data of a longitudinal nature. Even our refinement of the data on currently employed persons (to a yield a more realistic estimate of the race-sex mix of job changers) is just one step in the process because new hires come from other components of the labor force (table 1). Moreover, about 10 percent of all workers change jobs during a year and the occupational mobility rate varies by occupation, age, education, and to a lesser extent by race.[37] Because it is virtually impossible to obtain precise estimates of mobility for very specific jobs (for example, waiters), one can use data showing that 30 to 40 percent of job changers move to other jobs within the same broad occupational category to aid in the development of a weighting model or transition matrix. Some types of information which will enable us to develop more precise availability estimates include:

1. The proportion of new hires in an occupation coming from each of the three components of the labor force.
2. The previous jobs and the salary in both old and new jobs for job changers.
3. For the new and re-entrant portions of the labor force, data on the nature of the job sought and qualifications required (for example, training, previous employment).

Much of the data could be obtained by additional tabulations of the gross flow data by broad occupational categories and by making the CPS supplements on occu-

Table 5. True number of standard deviations from expected value and lost hires when the number of standard deviations was calculated assuming a low value of P_1

Low P P_1	True P P_2	P_2-P_1	Population = 100			Population = 300			Population = 1000		
			S = 0	S = −1	Lost hires	S = 0	S = −1	Lost hires	S = 0	S = −1	Lost hires
.10	.15	.05	−1.40	−2.24	3.86	−2.43	−3.27	13.02	−4.43	−5.27	46.39
.20	.25	.05	−1.15	−2.08	4.34	−2.00	−2.92	13.85	−3.65	−4.58	47.91
.10	.20	.10	−2.50	−3.25	8.00	−4.33	−5.08	26.54	−7.91	−8.66	93.68
.20	.30	.10	−2.18	−3.06	8.83	−3.78	−4.65	27.98	−6.90	−7.77	96.32
.30	.40	.10	−2.04	−2.98	9.37	−3.45	−4.47	28.90	−6.45	−7.39	98.00

pational mobility and job search regular yearly surveys.

As all the above-mentioned labor market information may not be readily available, other possible approaches that could yield more accurate availability estimates than the raw census data on employed persons are:

1. For entry-level jobs an age-weighted labor force model can be developed using the age distribution of new hires in a weighted average of the minority proportions in the same age brackets in the relevant labor force. This approach tends to place relatively little weight on senior workers and more on younger workers, most of whom were hired in the post-Civil Rights Act era and who do more job changing. Because of Age Discrimination in Employment Act, one might wish to use this method to supplement another approach.
2. For some occupations (for example, lawyers and pharmacists), data on new degree recipients[38] or on persons employed in various types of jobs within an occupation[39] may be useful.
3. Memberships rosters of professional societies[40] and National Research Council data on scientists and engineers may also be helpful. However, using the demographic mix of all persons on these registers as a referent for new hires will typically underestimate minority availability as does raw census data. Hence, an adjustment based on current position and salary may be needed.

In situations where several reasonable methodologies yield slightly differing availability estimates, the actual hiring data can be tested against all values of p. Frequently, the ultimate statistical conclusions, at the usual .05 and .01 levels of significance, will agree. □

FOOTNOTES

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[1] Distilled from three methods established in *Green v. Missouri Pac. R.R. Co.*, 523 F.2d 1290 (8th Cir. 1975).

[2] Mark Rosenblum, "The Use of Labor Statistics and Analysis in Title VII Cases: Rios, Chicago and Beyond," *Industrial Relations Labor Journal, Vol. 1*, 1977, pp. 685–710.

[3] Kenneth T. Lopatka, "A 1977 Primer on the Federal Regulation of Employment Discrimination," *University of Illinois Law Forum*, 1977, pp. 60–168.

[4] For example, in *Jones v. Tri-County Electric Cooperative*, 512 F.2d 1 (5th Cir. 1975) the court noted that although 8 of 23 black applicants were hired in contrast with 35 of 159 white applicants so that blacks had a larger hire rate (34 percent vs. 22 percent), the black fraction of hires was only 18.6 percent, less than half of their fraction (40 percent) of the population. Moreover, during the first seven years the Civil Rights Act was in effect the defendant had employed only one black person. Thus, the fifth circuit reversed the district court decision, which apparently relied on the applicant-hire percentages, when it found the firm innocent of violating Title VII.

[5] *Hazelwood School District v. United States*, 97 S. Ct. 2736 (1977), and *International Brotherhood of Teamsters v. United States*, 431 U.S. 324 (1977).

[6] Marcy Hallock, "The Numbers Game—The Use of and Misuse of Statistics in Civil Rights Litigation," *Villanova Law Review*, Vol. 23, 1977, pp. 5–34; and Mark Rosenblum, "The External Measures of Labor Supply: Recent Issues and Trends," *Connecticut Law Review*, Vol. 10, 1978, pp. 892–919.

[7] Several courts have noted this explicitly; for example *Greenspan v. Automobile Club of Michigan*, 22 FEP Cases 184 (1980), at 192; *Smith v. Union Oil Co. of California*, FEP 960 Cases (1978), at 967. The fact that the defendant city had hired a black as a fireman or in an administrative capacity prior to 1974 played a role in Judge Keady's decision to rely on applicant flow data rather than the demographic method in *NAACP v. City of Corinth*, 20 FEP Cases 1044 (1979), at 1056.

[8] In *Hoard v. Teletype*, 20 FEP Cases 1070 (1978), Judge Heany noted that the "Managerial" census category included higher level managers, for example, vice presidents, while no black had ever held supervisory positions higher than section chief. The reverse situation may occur when senior positions are being filled; see *Agarwal v. McKee*, 19 FEP Cases 501 (N.D. Ca., 1977).

[9] See Carl Rosenfeld, "The extent of job search by employed workers," *Monthly Labor Review*, March 1977, p. 57, who reports that the most common reason given by employed workers seeking a new job is the desire for higher pay. Moreover, low pay is the most frequent reason given by unemployed persons for declining a job. See Carl Rosenfeld, "Job search of the unemployed, May 1976," *Monthly Labor Review*, November 1977, p. 39.

[10] For more information concerning the potential usefulness of and problems inherent in the gross flow data, see T. F. Bradshaw, "Employment in perspective: a cyclical analysis of gross flows in the labor force," Report 508 (Washington, U.S. Department of Labor, 1977); Harvey J. Hilaski, "The status of research on gross changes in the labor force," *Employment and Earnings*, October 1968; and R. E. Smith and J. E. Vanski, "Gross change data: the neglected data base" (Washington, National Commission on Employment and Unemployment Statistics, 1975). Also see Barbara Bailar, "The Effects of Rotation Group Bias on Estimates for Panel Surveys," *Journal of the American Statistical Association*, March 1975, pp. 23–30.

[11] Courts have taken different views on the issue of which of the two approaches is the more relevant, in part, because they do not wish to penalize an employer for taking affirmative action in recruitment. Some relevant cases are: *Hill v. Western Electric Co.*, 12 FEP Cases 1175 (E.D. Va., 1976), at 1179, 19 FEP Cases 596 F.2d 99; *Hester v. Southern Railway Co.*, 497 F.2d 1374 (5th Cir, 1974); *Robinson v. Union Carbide*, 538 F.2d 652 (5th Cir., 1976); and *Pate v. Transit District*, 21 FEP Cases 1228 (N.D. Cal., 1979) at 1231.

[12] See *Patterson v. American Tobacco Co.*, 8 FEP Cases 778; 12 FEP Cases 314, 535 F.2d 257; 18 FEP Cases 378. *Smith v. Union Oil Co. of California*, 17 FEP Cases 960 (1978) and cases using employment data from comparable employers, for example, *Garcia v. Victoria Independent School District*, 17 EPD 8544.

[13] See *U.S. v. County of Fairfax*, 23 FEP 485 (4th Cir. 1980); *Greenspan v. Automobile Club of Michigan*, 22 FEP Cases 184 (1980); *EEOC v. Radiator Speciality Co.*, 21 FEP Cases 351 (1979) at 357.

[14] 433 U.S. 299 (1977).

[15] Two post-*Hazelwood* decisions which illustrate the effect of emphasizing postact hiring data rather than employment statistics are *El Concilio v. Modesto School District*, 17 FEP Cases 819 (1978) and *Drayton v. City of Petersburgh*, 20 FEP Cases 1495 (M.D. Fla., 1979).

[16] These data are not published regularly due to technical difficulties noted in the article cited in footnote 10; however, it is available on request.

[17] See Carl Rosenfeld's articles cited in footnote 9.

[18] See "Measurement and Significance of Labor Turnover" (Washington, National Commission on Employment and Unemployment Statistics, 1979), Background paper 27.

[19] See Carl Rosenfeld's first article cited in footnote 9.

[20] Because some persons are willing to take small pay cuts to move to jobs offering better opportunities for advancement or having a con-

venient location, we will usually include persons making 10 to 15 percent more than the beginning wage in the available labor pool. The author has not seen any data showing that a sizable fraction of job changers is willing to move to jobs involving a large percentage pay decrease.

[21] 12 FEP Cases 1175 (E.D. Va., 1976). Although this part of the district court's decision was reversed on grounds of standing.

[22] Unfortunately, the entry level salary was not reported so we are using a relatively high salary (in 1969 dollars) for such jobs. For a more recent case in which the applicant flow approach was preferred, in part, because most new hires were given low paying production jobs, see *Vaughn v. Westinghouse,* 19 FEP Cases 1475 (1979).

[23] For further discussion of modifications of census labor force data to account for commuting patterns, see Joseph Gastwirth and Sheldon Haber, "Defining the labor market for equal employment standards," *Monthly Labor Review,* March 1976, pp. 32–36; and discussions in *Markey v. Tenneco Oil Co.,* 439 F. Supp. 219, 234–235 (E.D. La., 1977); *Gay v. Waiter's Union Local 30,* 22 FEP Cases 281 (N.D. Cal., 1980), at 296–7; and *EEOC v. North Hills Passavant Hospital,* 19 FEP Cases 212 (W.D. Pa., 1979).

[24] 21 FEP Cases 1392 (E.D. Va., 1977), 21 FEP Cases 1405 (4th Cir. 1980).

[25] See the original opinion at 1400. The Court relied on a Virginia Employment Commission report for 1975. The author reproduced these numbers from tables 86 and 93 from the General Social Economic Statistics Volume of the 1970 Census for Virginia. Thus, the Court was incorrect in criticizing the original opinion. Indeed, the State agency report may have misled the Court about the currentness of the data.

[26] *Patterson v. American Tobacco Co.,* 18 FEP Cases 378 (1979); *Hill v. Western Electric,* 19 FEP Cases 490 (1979).

[27] David C. Baldus and Joseph W. L. Cole, *Statistical Proof of Discrimination* (New York, McGraw-Hill, 1980).

[28] *Garcia v. Victoria Independent School District,* 17 EPD Cases 8544.

[29] *Kyriazi v. Western Electric Co.,* 18 FEP Cases 924; *St. Marie v. E.R.R. Ass'n,* 458 F. Supp. 1147 (S.D. N.Y., 1978).

[30] *Smith v. Union Oil Co.,* cited in footnote 12.

[31] 8 FEP Cases 778 (1974).

[32] The source of the data quoted was not reported. The author could not reproduce the percentages from published census data.

[33] 18 FEP Cases 378 (1979), at 383.

[34] The entry level salary used (1969) for the position appears reasonable, perhaps conservative. In legal proceedings, the actual salary should be used.

[35] Since *Hazelwood,* this technique has become a standard method of statistical proof. For more discussion and additional cases, see Chapter 9 of Baldus and Cole cited in footnote 27; and Michael O. Finkelstein, "The Application of Statistical Decision Theory to the Jury Discrimination Cases," *Harvard Law Review,* Vol. 80, 1966, pp. 338–76. And, Judge Higgenbotham's opinion, in *Vuyanich v. Republic National Bank,* 24 FEP Cases 128 (1980), interprets the meaning of statistical significance at 223–24, and illustrates the importance of properly determining the availability fraction, p, at 243–44.

[36] For further discussion of the "four-fifths rule" and the EEOC testing guidelines, see Jacob Van Bowen and C. Riggins, "A Technical Look at the Eighty Percent Rule as Applied to Employee Selection Procedures," *University of Richmond Law Review,* Vol. 12, 1978, pp. 647–56.

[37] See Carl Rosenfeld, "Occupational mobility during 1977," *Monthly Labor Review,* December 1979, pp. 44–48; Patrick Wash, "Occupational mobility of health workers," *Monthly Labor Review,* May 1977, pp. 25–29; and Dixie Sommers and Alan Eck, "Occupational mobility in the American labor force," *Monthly Labor Review,* January 1977, pp. 3–19.

[38] These are published by the National Center of Educational Statistics; the 1975 survey of recent doctorates was used to determine availability of *Cooper v. University of Texas at Dallas,* 22 FEP Cases 1064.

[39] For example, the Bureau of Health Manpower in the Department of Health and Human Services issued data on type of position held by Pharmacists in the report, *Pharmacy Manpower Resources* (for 1974) and in separate reports for each State.

[40] Membership data in the AAUP were used in *Cooper v. University of Texas at Dallas,* 22 FEP Cases 1064 to compare the percentage of tenured female professors with the national average.