

Risk Classification and Sex Discrimination in Pension Plans

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ABSTRACT

Two Supreme Court decisions concerning the legal definition of discrimination in the Civil Rights Act of 1964 prohibit as discriminatory the use of separate mortality tables for men and women in pension benefit calculations. We analyze discriminatory aspects of risk classification and find that the Civil Rights Act has increased discrimination in pension compensation. This article demonstrates both theoretically and by simulation that sex-based risk classification results in less sex discrimination and less individual discrimination than a unisex approach. This result holds for various sex-based classification policies, as well as for various definitions of discrimination and statistics used to quantify those definitions. Of six pension classification policies, the Supreme Court's policy of unisex classification is the most discriminatory.

Risk Classification and Statistical Discrimination

How do I know you will be a favorable juror, a long-term employee, a successful student, a profitable insurance or credit risk, or a responsible tenant? People are heterogeneous in their risk characteristics, and information about them is imperfect. One way to classify people in terms of risk is to use information about average risks for identifiable groups, a practice called statistical discrimination because the generalizations may be false for many individuals. While the U.S. federal government recognizes the validity of this practice for some individual characteristics—such as years of schooling completed—it prohibits statistical discrimination for other characteristics—such as race and religion—to protect demographic groups that have historically been discriminated against.

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Government efforts to prohibit statistical discrimination have extended also to regulation of risk classification by sex. In 1978 and again in 1983, the U.S. Supreme Court issued decisions based on the Civil Rights Act of 1964 that prohibit pension plans from using separate mortality tables for men and women to determine contributions and benefits (*Los Angeles Department of Water and Power v. Manhart*, 435 U.S. 702 [1978] and *Arizona Governing Committee v. Norris*, 51 U.S.L.W. 5243 [July 6, 1983]). Women, in general, outlive men so they receive pension benefits over a longer period of time. The Court argued that using separate mortality tables causes discrimination against women because they would receive lower annual benefits or pay more for equal benefits than men with identical work histories. In *Los Angeles Department of Water and Power v. Manhart*, the Supreme Court ruled that employers cannot require women to make larger contributions to a pension plan in order to receive the same monthly benefits as similarly situated men. In *Arizona Governing Committee v. Norris*, the Supreme Court ruled that women cannot receive lower monthly benefits than men who had made the same contributions.

The Supreme Court's rulings are now part of a larger body of regulation and law governing sex-based risk classification. In 1986, the Equal Employment Opportunity Commission broadened the Supreme Court's prohibition by forbidding sex-based differences in any employee benefit, even if justified by differences in cost. Actuarial risk classification by sex is prohibited in Montana and Massachusetts by laws requiring unisex insurance for automobile, life, disability, health and in six other states by laws requiring unisex rates for automobile insurance. The Congress and various state legislatures have considered bills expanding the requirement of unisex risk classification, and the issue continues to be litigated. A June 1990 ruling of the European Court of Justice prohibited sex-based differences in pension benefits throughout the twelve-nation European Community.

Economists have analyzed the effects of sex-based risk classification on efficiency and behavior (Crocker and Snow, 1986; Rea, 1987) but generally have not analyzed the discriminatory effects of such practice (see Goldberger, 1984; Cummins et al., 1983; and Aigner and Cain, 1977, for related analyses of sex discrimination in wages or governmental regulation of risk classification in insurance). This article examines the discriminatory effects of sex-based risk classification in the case of deferred pension compensation. Although we do not address the legal basis of the Supreme Court's 1978 and 1983 decisions, we analyze whether the application of the 1964 Civil Rights Act in those decisions alleviates economic discrimination against women (see Lautzenheiser, 1976; King, 1976; Benston, 1982; Burkhauser, 1984; and Connerton, 1983, for discussions relating to the unisex pension decisions).

Risk Assessment

Although sex-based mortality tables can no longer be used to calculate pension benefits, they are still commonly used by actuaries to value pension liabilities. Pension actuaries most frequently use the 1971 Group Annuity

Mortality (GAM) table (Turner and Beller, 1992, p. 518).¹ This mortality table, shown in Table 1, is based on the actual mortality experience of working men and women who are covered by pension plans. Life expectancies for this group are higher than for the general population. Based on the GAM table, the expected years of life remaining are 19.2 years for 65-year-old women and 15.1 years for 65-year-old men, a difference of 27.2 percent (Table 2). For comparison, life expectancy figures for the entire U.S. population of women and men at age 65 are 18.4 and 14.2 years, respectively (U.S. Department of Health and Human Services, 1985).

Table 1
Mortality Distribution for Men and Women

	<i>Expected Age at Death for Population Age 65</i>		<i>Standard Deviation</i>	<i>Skewness</i>
	<i>Mean</i>	<i>Median</i>		
Men	80	79	8.3	0.3
Women	84	84	8.6	0.1

Source: 1971 Group Annuity Mortality Table.

Although women as a whole have lower mortality risk than men, some men do outlive women. Such overlap between gender groups is one measure of error in classifying mortality risk by sex. For the population of pensioners, this error, measured as the probability that a man aged 65 drawn at random out of male mortality distribution will outlive a similarly chosen woman of the same age, is 36 percent (Table 2).² There is a 64 percent probability that a woman drawn at random will outlive a similarly chosen man.

The Supreme Court's Unisex Pension Decision

Before turning to the economic analysis, we briefly delineate the Supreme Court's rulings. In ruling against the use of sex-based mortality tables by pension plans, the Supreme Court applied Section 703(a)(1) of the Civil

¹ The 1971 GAM table is the one most frequently reported by pension actuaries when filing Form 5500 with the Internal Revenue Service. For large pension plans, however, pension actuaries generally adjust the table to more accurately reflect the mortality experience for the plan. The 1989 mortality table by Buck Consultants (1990) shows comparable life expectancies of 21 and 17 years for retirees of major corporations.

² To calculate this probability, we multiplied the probability that a man would die in a year age interval, given that he had survived to age 65, times the probability that a woman would have died previous to the midpoint of the age interval given that she had survived to age 65, and summed the probabilities from age 66 to 110. Indices so constructed always sum to one for men and women.

Table 2
Comparison of Male and Female Mortality Risk

Age	<i>Expected Years of Life Remaining</i>		<i>Female Advantage (Percent)</i>	<i>Probability of a male outliving a female</i>
	<i>Male</i>	<i>Female</i>		
60	18.8	23.5	25.3	35.7
65	15.1	19.2	27.3	36.3
70	11.9	15.3	28.1	37.6
75	9.2	11.7	27.1	39.2
80	7.0	8.9	26.7	40.2
85	5.3	6.6	23.0	41.9
90	4.1	4.7	15.1	44.6
95	3.1	3.2	5.3	47.9

Source: 1971 Group Annuity Mortality Table.

Rights Act of 1964, which prohibits sex discrimination in compensation.³ In a split decision, the Supreme Court ruled that a pension plan is guilty of discrimination in compensation if identically situated male and female retirees receive different annual pension benefits. The Court argued that sex-based mortality tables cause sex discrimination against women because it is not known with 100 percent certainty that an individual woman will outlive an individual man.

Pension Compensation

Because the Supreme Court's prohibition applies only to pensions received as compensation,⁴ the first step in the analysis is to define pension compensation.⁵

Compensation is employer remuneration to workers per unit of time worked. Pension compensation can be defined as the expected present value of lifetime pension benefits accruing due to an additional year of work. By measuring

³ Section 703(a)(1) of the Civil Rights Act of 1964 states: "It shall be an unlawful employment practice for an employer—(1) to fire, to refuse to hire, or to discharge any individual or otherwise to discriminate against any individual with respect to his compensation, terms, conditions, or privileges of employment, because of such individual's race, color, religion, sex, or national origin."

⁴ Insurers still use sex-based mortality tables to price individually-purchased annuities. The ruling has some other limitations as well: Insurers may differentiate among pension plans based on the sex composition of the plans. An insurer may provide lower benefits to an all female pension plan than to an all male plan (but it would be required to provide equal benefits if the two plans merged). Furthermore, the Internal Revenue Service permits pension plans to use sex-based mortality tables when determining the levels of legally required contributions by a firm to a defined benefit pension plan.

⁵ In its 1983 decision, the Supreme Court stated, "There is no question that the opportunity to participate in a deferred compensation plan is a 'condition or privilege of employment' and that retirement benefits are a form of 'compensation.'"

pension compensation per year of work rather than per year of retirement, this definition values pension compensation comparably to wage compensation. Annual benefits are rejected as a definition of pension compensation because they are not measured per unit of time worked.

The analysis is carried out for a defined contribution plan, which was the type of pension plan considered in the Supreme Court's 1983 *Norris* decision. In a defined contribution plan, an individual account is maintained for each participant, and the eventual benefits are based on the accumulated contributions and investment earnings. In 1988, there were 29.5 million workers participating in defined contribution plans (Turner and Beller, 1992). However, the 28.4 million participants in defined benefit plans who opt to receive benefits in a form other than single life annuity are also affected by the rulings, because conversions between benefit forms are now done on a unisex basis.

Defined contribution plans may offer several options for benefit distribution, but this article focuses on the form of benefit that was the subject of the 1983 *Norris* decision, the single life annuity beginning at retirement.⁶ As discussed elsewhere (Burkhauser, 1984), the unisex pension rulings have distorted the choice of the form in which benefits are received by distorting the calculations for converting between different forms. This article demonstrates the potential magnitude of the discrimination caused by such distortion.

For some purposes, the amount contributed to the worker's account may suffice as a measure of compensation provided through a defined contribution plan. Since this article focuses on the opportunity to convert the account balance to an annuity at group rates, a more complex and more general definition of pension compensation based on benefits must be developed.

Pension compensation P at age a is the increase in pension wealth that occurs at age a due to working at age a

$$P = \frac{\partial W}{\partial a} - (r+d)W, \quad (1)$$

where d represents the worker's subjective instantaneous mortality rate at age a , and r is the discount rate. The variable r can be interpreted as incorporating the percentage erosion of real benefits due to incomplete inflation indexation. (See the Appendix for a summary of the mortality concepts and notation used.) Pension wealth W is measured in constant dollars at age a and is the expected

⁶ One form of payment excluded from consideration is the lump sum. Payment of benefits from defined contributions plans as lump sums would eliminate the discrimination that concerned the Court but would also eliminate protection against longevity risk. Longevity risk is the risk that a retiree's savings will be exhausted due to greater than anticipated longevity. Surveys on form of benefit receipt have indicated that, since 1979, a higher percentage of married male beneficiaries aged 55 or older in defined benefit plans have taken benefits as lump sums (Turner and Beller, 1992, p. 269). Before 1979, three studies found percentages ranging from 3.9 to 6 percent. After 1979, three studies found percentages ranging from 6.2 to 14.9 percent. The causes of this difference have not been empirically investigated.

present value of pension benefits. For simplicity, the age subscripts are suppressed.

Pension wealth increases with the passage of time for two reasons unrelated to work: the decrease in the period of interest discounting and the reduced chance of dying before receiving benefits. The pension compensation expression is the overall rate of increase in pension wealth less the rates of increase attributable to these two sources (for studies of the relationship between pension benefits, pension wealth, and pension wealth accrual, see Kotlikoff and Wise, 1987, and Gustman and Steinmeier, 1989).

Substituting an equation for pension wealth into equation (1) yields an expression for pension compensation in terms of annual pension benefits B

$$P = \frac{\partial B}{\partial a} \int_R^{110} (1 - m(a, t)) e^{-r(t-a)} dt, \quad (2)$$

where R is retirement age, and m is the probability at age a of dying by age t . (The derivation of equation (2) is presented in an appendix available from the authors.)

What type of benefits policy minimizes discrimination in pension compensation P ? Equation (2), relating benefits and pension compensation, has two implications for the analysis of this question. First, pension benefits are not a measure of pension compensation, and, thus, male-female differences in pension benefits do not indicate whether discrimination in pension compensation has occurred. Second, the worker's actual age at death does not affect the worker's valuation of pension compensation, because age at death is unknown at the time of valuation. The fact that some men outlive some women is thus irrelevant in determining whether discrimination in pension compensation has occurred. Expected mortality, however, does affect the worker's valuation of pension compensation by affecting the length of the period over which the worker expects to receive benefits.

Pension Plans and Sex-Based Mortality Tables

Discrimination in pension compensation occurs when retired men and women who are identically situated in all relevant respects receive unequal pension compensation. Therefore, to analyze sex discrimination, we assume that major determinants of pension benefits, such as earnings, tenure, retirement age, and pension plan generosity, are equal for men and women. Although sex discrimination may cause differences in these variables, we disregard such differences to focus on the pension benefit calculation. Thus, expectations concerning mortality risk become the only determinant of differences in pension compensation. Mortality risk is the probability of dying within a fixed period of time.

Two perceptions of mortality risk affect pension compensation: the pension plan's perception, as reflected in its mortality table, and the individual's perception. For the remainder of the analysis, pension compensation at age a will be written as

$$P = P(M_g, m_g). \quad (3)$$

Both M_g^* and m_g are vectors of probabilities that worker g will die on or before each exact age a . The plan's perception is embodied in the mortality table M_g^* that it uses to calculate annuities; the worker uses his or her (subjective) perception, m_g , to value the annuity. The subscript g refers to workers of unspecified gender. For workers whose gender is specified, the subscript is either f for women or l for men.

The worker's subjective mortality risk, which is based on knowledge of his or her own health, family medical history, and other personal characteristics, differs from the plan's objective or actuarial mortality risk. The subjective mortality probabilities thus incorporate individual-specific information. If a bank were to value the worker's pension wealth, it would presumably take into account some individual characteristics. Generally, only institutions valuing or paying benefits to many retirees can take advantage of the law of large numbers by valuing pensions in the "objective" manner, based solely on age and sex.

All groups of identically situated workers are assumed to have average mortality expectations which equal the plan's expectations as reflected in its mortality table. In particular, this assumption implies actuarial fairness of the mortality table, meaning that the equality holds for each group of men and women. That is, $E(m_f) = M(f)$, and $E_k(m_l) = M(l)$, where E is the mathematical expectation taken over plan k , and m_f and m_l are, respectively, vectors of probabilities that a woman f and an identically situated man l will die on or before each age a .

A pension compensation function P is defined to be actuarially fair if it yields equal pension compensation for men and women when the plan, each woman, and each man base their valuations on an actuarially fair mortality table. That is,

$$P(M(f), M(f)) = P(M(l), M(l)). \quad (4)$$

Discrimination Against Individuals

Discrimination can be categorized as either individual discrimination or group discrimination (Aigner and Cain, 1977). Discrimination against individuals in pension compensation occurs if two or more identically situated workers receive different levels of pension compensation. The amount of dispersion in pension compensation within the group of identically situated workers is thus a measure of individual discrimination.

Previous studies have used a variety of wage dispersion measures, including the variance of the wage, the index of dispersion, the variance of the logarithm of wages, the coefficient of variation, the Gini coefficient, and Theil's entropy indices (Keefe, 1989). There is no consensus on a single best measure. Shorrocks (1980), however, has analyzed alternative measures by deriving the entire class of measures that are additively decomposable under relatively weak

restrictions on the form of the index. An additively decomposable inequality measure is one that can be expressed as a weighted sum of the inequality values calculated for population subgroups plus the contribution arising from differences between subgroup means. This class of inequality measures is a one-parameter family that includes the square of the coefficient of variation and two entropy indices proposed by Theil (1967).

Shorrocks concluded that only one member of this family—Theil's entropy index weighted for population share—yields decomposition coefficients that are independent of subgroup means. The interpretation of this property in the context of this article is that cost-neutral adjustments to the benefit levels of men and women, for example by uniformly raising women's benefits and lowering men's benefits, do not affect the contribution of either sex to total within-sex inequality. Men and women both contribute to total within-sex inequality in proportion to their population. This weighting gives equal consideration to each individual regardless of income, a desirable property for a measure of discrimination.

For the above reasons, this analysis emphasizes Theil's entropy index weighted for population share, I_0 , as a measure of individual discrimination and presents for comparison Theil's entropy index weighted for income share, I_1 , and the Gini coefficient, G .⁷ These measures are now defined for n age-sex groups of individuals using X_i to represent the population share of the i th group and Y_i to represent its share of pension compensation.⁸

<u>Formula</u>	<u>Lower Bound</u>	<u>Upper Bound</u>	
$I_0 = \sum_{i=1}^n X_i \log \left(\frac{X_i}{Y_i} \right)$	0	$+\infty$	(5)
$I_1 = \sum_{i=1}^n Y_i \log \left(\frac{Y_i}{X_i} \right)$	0	$\log(n)$	(6)
$G = \frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n X_i Y_j - X_j Y_i $	0	1	(7)

Regardless of how individual discrimination is measured, the underlying dispersion is due to workers' varying expectations about mortality risk. If workers base their expectations about mortality risk solely on the actuarial

⁷ Theil's entropy index weighted for income share is also a member of the class derived by Shorrocks. The Gini coefficient is a popular measure eliminated early in Shorrocks's derivation because of discontinuous first partial derivatives arising from its use of absolute values.

⁸ The simpler expressions sometimes seen for these measures assume that each group comprises one individual and can easily be derived by letting each $X_i = 1/n$. These more general expressions attributable to Theil (1967) are required for this analysis. Note that measures I_0 and I_1 are undefined if even one group has zero income.

mortality risks associated with their age and sex, actuarial sex-based annuity calculations would result in equal pension compensation for all workers and zero discrimination. In reality, characteristics such as family patterns of longevity provide individuals with mortality risk information beyond the actuarial information associated with their age and sex. Such information causes variation in workers' subjective mortality risk and in pension compensation, thus resulting in individual discrimination regardless of whether annuity calculations are based on sex. Although a zero level of individual discrimination is unattainable because of individual differences in mortality expectations, minimizing individual discrimination is a possible policy goal discussed below.

Sex Discrimination as Group Discrimination

Group discrimination in pension compensation can be defined as the disparity in levels of pension compensation between groups with the same age, expected earnings, service at retirement, and pension plan. Sex discrimination is a form of group discrimination.

Various statistical measures of disparity or inequality for two groups have been used. This analysis uses the traditional measure, the ratio of means, and two alternative measures: the Wilcoxon measure, and a measure proposed by Butler and McDonald (1987). The Wilcoxon measure for a woman is the probability that a randomly selected woman will receive greater lifetime pension compensation than a randomly selected man; the Wilcoxon measure for a man is the probability that a randomly selected man will receive greater lifetime pension compensation than a randomly selected woman. The difference between the Wilcoxon measures for a woman and a man is the second measure of sex discrimination. This difference ranges from -1 to +1 and equals zero with perfect equality between men and women.

The Butler and McDonald measure is the probability that a woman will receive more than the mean for men less the probability that a man will receive more than the mean for women. This measure also ranges from -1 to +1. This measure can produce a much different image of inequality than other measures. Butler and McDonald found a much larger secular decline in the income differential between the races than that reflected by the ratio of means.

The first measure D_{s1} of sex discrimination in pension compensation P is defined to be the female/male ratio of pension compensation less one:

$$D_{s1} = \frac{E_k(P(M^*(f), m_f))}{E_k(P(M^*(l), m_l))} - 1, \quad (8)$$

where m_l and m_f represent the vectors of annual subjective mortality probabilities for individual men and women, and $M^*(l)$ and $M^*(f)$ represent vectors of mortality probabilities for men and women from the plan k 's mortality table, whether it is sex-based or unisex.

A property of the pension compensation function P is that the expectations operator E can be moved inside P so that the expected value of pension compensation equals pension compensation valued at the expected value of mortality risk. This property follows because the P function is linear in m and because workers who are in the same pension plan and who have the same work history and discount rate are being compared (a demonstration of this property is presented in an appendix available from the authors).

$$D_{sl} = \frac{P(M^*(f), E_k(M_f))}{P(M^*(l), E_k(m_l))} - 1, \quad (9)$$

For an actuarially-fair sex-based mortality table, the mean amount of sex discrimination if measured as a ratio of means is

$$D_{sl} = \frac{P(M(f), E_k(m_f))}{P(M(l), E_k(m_l))} - 1 = \frac{P(M(f), M(f))}{P(M(l), M(l))} - 1 = 0, \quad (10)$$

where, as indicated earlier, the plan k subscript on the mortality tables M has been suppressed for notational simplicity. The equivalence follows from the assumption that M represents actuarial mortality risk, and the expression equals zero from the definition of an actuarially fair pension compensation function (equation (4)).

Thus, despite causing sex discrimination in pension benefits, sex-based mortality tables, by one measure, eliminate sex discrimination in pension compensation. (The impact of sex-based mortality tables on the other two measures of sex discrimination is discussed below.) Individual men and women with short life expectancies experience individual discrimination in pension compensation but not group discrimination.

The causal determinants of workers' subjective mortality risk do not affect the conclusion because of the assumption that the plans's mortality table measures expected mortality risk for workers in the plan regardless of its causal determinants. For example, actuarial sex-based mortality tables eliminate sex discrimination even if workers' mortality expectations are based in part on knowledge of the effect of their smoking behavior on mortality risk. Ignoring smoking behavior in constructing mortality tables causes discrimination against smokers, but it does not cause sex discrimination.⁹

⁹ Smoking is not used as a risk classification for pensions presumably because of the difficulty in obtaining reliable information on smoking habits. Because smokers would receive higher annual pension benefits than nonsmokers due to their greater mortality risk, nonsmokers would have an incentive to claim that they were smokers. Because blacks and whites have very similar life expectancy at retirement, there is no economic incentive for pension plans to classify risk by race.

Evaluation of Alternative Risk Classification Procedures

Risk classification procedures can be evaluated by calculating their effects on discrimination. The class of procedures considered are multiplicative adjustments to actuarially determined benefit levels for single life annuities. The adjustment factors are scalars a_m for men and a_f for women that are constrained to maintain constant total pension compensation paid by the plan. This class of policies includes sex-based benefits and unisex benefits as special cases. Because this analysis assumes that the firm and all workers have the same discount rate, this class of policies also holds constant the expected cost to the firm.

For each classification procedure we evaluate seven possible outcomes:

1. The difference between the annual benefits of men and women,
2. Sex discrimination in pension compensation measured using the ratio of means for men and women,
3. Sex discrimination in pension compensation measured using the Wilcoxon measure,
4. Sex discrimination in pension compensation measured using the Butler and McDonald measure,
5. Individual discrimination in pension compensation measured using Theil's entropy index weighted for population share (I_0),
6. Individual discrimination in pension compensation measured using Theil's entropy index weighted for income share (I_1), and
7. Individual discrimination in pension compensation measured using the Gini coefficient (G).

These outcomes are measured for six distinct risk classification policies:

1. Unisex benefits,
2. Sex-based benefits set so as to minimize the absolute value of sex discrimination using the difference between average (mean) lifetime pension compensation for men and women (equivalent to minimizing individual discrimination measured using I_0),
3. Sex-based benefits set so as to minimize the absolute value of sex discrimination using the difference between average (mean) lifetime pension compensation for men and women (equivalent to minimizing individual discrimination measured using the Wilcoxon measure),
4. Sex-based benefits set so as to minimize the absolute value of sex discrimination using the difference between average (mean) lifetime pension compensation for men and women (equivalent to minimizing individual discrimination measured using the Butler and McDonald measure),
5. Gender-based benefits set so as to minimize individual discrimination measured using Theil's entropy index weighted for income share (I_1), and
6. Gender-based benefits set so as to minimize individual discrimination measured using the Gini coefficient (G).

Although eliminating sex discrimination is a major policy goal, the Supreme Court's decision expresses concern about the effects of policy on individual discrimination. We have demonstrated elsewhere (in an appendix available from the authors) that the policy of eliminating sex discrimination and policy

of minimizing individual discrimination are equivalent, because individual discrimination measured using Theil's entropy index weighted for population share can be decomposed into additive within-sex and between-sex terms with the following properties:

1. The within-sex terms are unaffected by the class of adjustments under consideration, and

2. The between-sex term is minimized by the policy that eliminates sex discrimination.

The finding that the sex-based policy minimizes individual discrimination (by one measure) is a major result that favors the actuarial sex-based policy.

Thus, because of the equivalence of policies, there are only six distinct policies to be evaluated, and these correspond to the columns of Tables 3 and 4. The policy of equalizing annual benefits of men and women is included because it is the policy chosen by the Supreme Court, but it does not minimize any economic concept of discrimination in pension compensation, because annual pension benefits measure retirement income rather than pension compensation. The three policies involving minimization of individual discrimination are suggested by the reasoning of the Supreme Court in its unisex pension decision, which rejected the concept that the Civil Rights Act refers to the treatment of groups and instead chose the concept that discrimination against individuals is the legally prohibited activity.

As discussed above, individual discrimination is variation in pension compensation among identically situated workers. Variation in pension compensation within each plan is determined solely by sex, as it may determine benefit level, and mortality expectations, as they determine the worker's subjective valuation of those benefits. In the absence of data on workers's perceptions of mortality risk, we assume that each worker expects to die at his or her actual age of death and that deaths are distributed in exact accordance with the 1971 GAM table.

Agreement between average mortality expectations of workers and their plan's mortality table was a key assumption underlying the finding that actuarial sex-based tables eliminate sex discrimination. The mortality assumption for the simulation presented in Table 3 maintains this agreement.

The number of levels of pension compensation recognized (n) is 92, the product of two sexes 46 ages of death (ranging from 65 through 110, the oldest age on the 1971 GAM table). Persons dying at any time in year i are assumed to receive half of the annual payment for year i .

We assume equivalent work histories for men and women and compare lifetime pension compensation (pension wealth) valued at the point of retirement (assumed to be age 65). Annual pension benefits are set at \$100 for men in a sex-based pension. Pension benefits and pension wealth are calculated for other classification procedures so that the goal of the policy is achieved subject to the constraint that lifetime pension compensation aggregated across all workers in the plan is constant. For example, unisex benefits are calculated as those benefits such that the annual pension benefits of men and women are equal, and the total expense constraint is satisfied. A real interest rate of 2 percent is assumed for the firm and for each worker. The comparisons are

Table 3
Comparison of Cost-Neutral Classification Policies
for Setting Relative Benefit Levels of Men and Women

Outcome of Policy	Unisex Benefits	Sex-Based Policies				
		Minimize Absolute Value of Sex Discrimination Measured Using			Minimize Individual Discrimination Measured Using	
		Actuarial Present Value ^a	Wilcoxon ^b	Butler and McDonald ^c	Income-Weighted Entropy Index	Gini Coefficient
Annual Benefits ^d						
Men	\$89.5	\$100.0	\$100.1	\$101.0 ^e	\$97.6	\$96.9
Women	89.5	81.1	80.9	80.3	83.0	83.6
Lifetime Pension Compensation						
Men	\$1,125	\$1,256	\$1,258	\$1,269	\$1,226	\$1,217
Women	1,388	1,256	1,255	1,244	1,287	1,295
Total ^f	2,513	2,513	2,513	2,513	2,513	2,513
Benefit Difference ^g	0.0%	18.9%	19.2%	20.8%	15.0%	13.8%
Sex Discrimination						
Percent Difference in Means ^h	23.37	0.00	-0.30	1.98	4.92	6.40
Wilcoxon ^b	30.44	0.12	-0.01	-2.42	6.30	8.45
Butler and McDonald ^c	39.40	-1.61	-1.61	-1.61	10.97	15.29
Individual Discrimination						
Absolute Amount ⁱ						
Entropy Index Weighted for						
Population	0.16658	0.16108	0.16108	0.16113	0.16137	0.16156
Income	0.11397	0.11097	0.11100	0.11125	0.11069	0.11071
Gini Coefficient	0.25284	0.24946	0.24953	0.25000	0.24878	0.24874
Percent Excess ^j						
Entropy Index Weighted for						
Population	3.42%	0.00%	0.00%	0.03%	0.18%	0.30%
Income	2.97	0.25	0.29	0.51	0.00	0.02
Gini Coefficient	1.65	0.29	0.32	0.51	0.01	0.00

Note: This table assumes equal numbers of men and women in the plan, a 2 percent real discount rate, and payment of benefits as single life annuities beginning at age 65.

^a This policy is equivalent to minimizing individual discrimination measured using Theil's entropy index weighted for population share.

^b Probability that a woman will receive greater lifetime pension compensation than a man less probability that a man will receive greater lifetime pension compensation than a woman.

^c Probability that a woman will receive more than the mean lifetime pension compensation for men less the probability that a man will receive more than the mean lifetime pension compensation for women.

^d Annual benefit levels are relative to the arbitrarily set reference level of \$100 for men under the policy of equalizing actuarial present values.

^e Because the mortality table used only approximates a continuous mortality distribution, sex discrimination measured using the Butler and McDonald measure is minimized for any level of men's benefits from 100 to 102.

^f Total is for one man and one woman. This total is held constant by the cost-neutrality constraint. Detail may not add to total due to rounding.

^g Percent by which annual benefits of women fall short of those for men.

^h Percent by which lifetime pension compensation of women exceeds that for men.

ⁱ Unitless statistics.

^j Percent by which individual discrimination measure exceeds the minimum for its row.

Table 4
Benefit Levels Determined by Cost-Neutral Classification Policies
by Percentage of Men in the Pension Plan

Percentage of Plan Participants that Are Men		Sex-Based Policies				
		Minimize Absolute Value of Sex Discrimination Measured Using			Minimize Individual Discrimination Measured Using	
		Unisex Benefits	Actuarial Present Value ^a	Wilcoxon ^b	Butler and McDonald ^c	Income-Weighted Entropy Index
Men's Benefits						
20	\$84.2	\$100.0	100.4	101.5	\$96.3	\$95.2
50	89.5	100.0	100.1	101.0	97.6	96.9
80	95.5	100.0	100.0	100.4	99.0	98.8
100	100.0	100.0	100.0	100.0	100.0	100.0
Women's Benefits						
0	81.1	81.1	81.1	81.1	81.1	81.1
20	84.2	81.1	81.0	80.8	81.8	82.0
50	89.5	81.1	80.9	80.3	83.0	83.6
80	95.5	81.1	81.0	79.8	84.3	84.9

Note: This table assumes a 2 percent real discount rate, and payment of benefits as single life annuities beginning at age 65.

^a This policy is equivalent to minimizing individual discrimination measured using Theil's entropy index weighted for population share.

^b Probability that a woman will receive greater lifetime pension compensation than a man less probability that a man will receive greater lifetime pension compensation than a woman.

^c Probability that a woman will receive more than the mean lifetime pension compensation for men less the probability that a man will receive more than the mean lifetime pension compensation for women.

made assuming that pension benefits can only be received as a single life annuity (no survivors' benefits).¹⁰ A line search technique was used to determine the levels of benefits for men and women that minimize each measure of individual discrimination for various gender mixes within a pension plan.¹¹ Results of these and other calculations that evaluate the risk classification policies are presented in Tables 3 and 4.

Differences among the five sex-based policies are small compared with differences between these policies as a whole and the unisex benefit policy. When a plan switches from the sex-based policy of equalizing present values to a unisex benefit policy, benefits of the sex with the smaller number of

¹⁰ All workers who receive defined contribution pensions in the form of single life annuities are required by law to have had the option of a joint and survivor annuity. Most defined contribution plans offer lump sums as a form of benefit receipt. Thus, the percentage of single life annuitants who expect to die in their first few years of retirement is probably less than the 1971 GAM table indicates, because workers with short subjective life expectancies would generally not choose single life annuities. The assumption that expected ages of death are in accordance with the 1971 GAM table may nevertheless be appropriate, because assessment of the equity of the single life annuity option requires analysis for all those who could select such annuities, not merely those who do.

¹¹ A computer program was developed that measured the seven outcomes for ten policies regarding the relative benefit levels of men and women using any desired mix of sexes. To minimize any one of the outcomes, the program was run with policies equally spaced across the range under consideration. The process of examining outcomes, narrowing the range under consideration, and rerunning the program was repeated until convergence was achieved.

workers in the plan change by over 10 percent regardless of the mix of men and women. In contrast, a switch from a policy of equalizing present values to any of the other sex-based policies changes benefits by less than 5 percent for each sex regardless of the mix of women and men (Table 4).

The policy of equalizing actuarial present values eliminates sex discrimination. In the case where 50 percent of the workers in a pension plan are men and 50 percent are women (Table 3), the policy using the Wilcoxon measure and the policy using the Butler and McDonald measure result in sex discrimination equal to 0.3 percent and 2 percent, respectively, of men's lifetime pension compensation. The policies of minimizing individual discrimination yield sex discrimination equal to 4.9 percent of men's lifetime pension compensation for measure I_1 and 6.4 percent for measure G. The unisex policy, however, results in sex discrimination equal to 23.4 percent of pension compensation for men. Thus, of the six classification procedures considered, the most sex discrimination is found with the unisex policy.

The actuarial sex-based policy minimizes one measure of individual discrimination (I_0) and comes much closer than the unisex policy to minimizing individual discrimination for the other two measures (I_1 and G).¹² The unisex benefit policy produces excess (above minimum) individual discrimination of 3.4 percent for measure I_0 , 3 percent for measure I_1 , and 1.7 percent for measure G. Policies based on the Wilcoxon measure and the Butler and McDonald measure yield individual discrimination that ranges from 0 to 0.5 percent above the minimum level, depending on the measure of individual discrimination used.

We conducted sensitivity analysis of the results for the actuarial sex-based policy by analyzing the probability that a man will receive greater lifetime pension compensation than a woman. Varying the real interest rate between 2 and 3.5 percent and the retirement age between 62 and 65, the probability that a man would receive more than a woman from a sex-based annuity varied from 49 to 52 percent (Table 5).

Table 5
Probability that a Man Will Receive
Greater Lifetime Pension Benefits than a Woman

<i>Retirement Age</i>	<i>Real Interest Rate^a</i>	<i>Sex-Based Annuity</i>	<i>Unisex Annuity</i>
62	2.0	0.49	0.36
62	3.5	0.51	0.36
65	2.0	0.51	0.36
65	3.5	0.52	0.36

^a The real interest rate assumption can be interpreted as including the percent depreciation of real pension benefits due to incomplete inflation indexation.

¹² The traditional sex-based policy causes excess individual discrimination of 0.07 percent when individual discrimination is measured using the mean absolute departure from the median (McCarthy and Turner, 1989).

Keefe (1989) and Mookerkjee and Shorrocks (1982) also compared several measures of wage dispersion that included the measures used here. Although they used the measures for trend decomposition rather than optimization, they reached similar conclusions: differences among the measures, while not negligible, were not sufficient to affect the basic conclusion.

Unisex Pensions as a Transfer Program

Since a unisex pension policy transfers wealth among single life annuitants without reducing discrimination in pension compensation, it is properly evaluated as a transfer program. Transfers among participants in actual plans are more complicated than this analysis suggests because many pensioners do not select single life annuities (Turner, 1988). However, all pensioners who receive the option of an annuity receive the option of a single life annuity. Transfer effects among single life annuitants are important because a policy cannot be considered fair in general unless these transfers are fair.

Wealth is transferred from male to female single life annuitants within each defined contribution plan. This result holds for any unisex mortality table and does not depend on the mortality table reflecting the experience or expected experience of the plan. Within plans, the cost of the transfers is progressively allocated among men in proportion to their account balances at retirement. Allocation of benefits among women is also proportional to account balances, which undoubtedly have a strong negative correlation with financial need.

The primary determinant of cross-plan variation in the transfer program is the plan's mix of women and men, which has a substantial effect on the unisex benefit level. The benefit to women is positively related to the percent of men in the plan. The cost to men of the transfer is positively related to the percent of women in the plan. This result does not hold for individual small plans that are not experience-rated by a mix of sexes, but it does hold for experience-rated plans or experience-rated groups of plans.

The largest costs are borne by men in plans predominantly comprising women; the largest gains are received by women in plans predominantly comprising men. Measuring transfers as a proportion of pension compensation, men lose up to 19 percent, while women gain up to 23 percent. Measuring transfers as a proportion of total compensation, and assuming that pensions account for 10 percent of total compensation, men lose up to almost 2 percent, while women gain up to 2.3 percent. Both men and women fare better in plans made up mostly of men. It is doubtful whether a carefully considered program to transfer wealth from male to female retirees would have these characteristics.

Conclusion

The U.S. Supreme Court has ruled that the Civil Rights Act of 1964 requires the equitable treatment of individuals. A characteristic that is empirically identifiable with a sex or race but that is empirically false for many individuals cannot be used by employers to determine compensation. The Court argued that sex discrimination occurs against women when actuarially justified sex-based

mortality tables are used by pension plans, because it is not known with 100 percent certainty that an individual woman will outlive an individual man.

The Supreme Court argued correctly that sex-based mortality tables cause discrimination against women with high mortality risk. From an economic standpoint, the Supreme Court argued incorrectly that such discrimination is necessarily sex discrimination in compensation. Use of sex to determine pension benefits is not evidence of sex discrimination in compensation, because pension benefits do not measure pension compensation.

Measuring pension compensation as the accrual of pension wealth, the use of actuarially fair sex-based mortality tables is required to prevent sex discrimination in compensation. This result holds both under conditions of symmetric and asymmetric mortality information between firms and workers. This result is valid even if sex-based mortality tables overstate the true sex-based difference in mortality, due to a greater tendency for men than women to exhibit behavior (such as smoking) that increases mortality.

The Supreme Court's rulings indicated a concern about individual discrimination. This article demonstrates that benefit levels determined using actuarially-fair sex-based mortality tables minimize individual discrimination measured using what is arguably the best measure for this purpose, Theil's entropy index weighted for population share (I_0). Sex-based benefits are also close to the levels that minimize two alternative measures, Theil's entropy index weighted for income share and the Gini coefficient (I_1 and G).

The finding that the sex-based policy minimizes individual discrimination (by one measure) is a major result that favors the sex-based policy. Our comparison of six policies reveals that the unisex policy favored by the Supreme Court is the most discriminatory.

Reducing the economic disparity between retired men and women is a public policy goal that may lead some analysts to favor unisex pensions. For the situation considered by the Supreme Court of pensioners choosing single life annuities, a unisex pension policy clearly furthers this goal. The allocation of benefits and the incentives created by this *de facto* transfer program suggests that the goal probably could be pursued more equitably through other programs.

When all types of annuities are considered, it is unclear that unisex pension policy furthers the goal of reducing economic disparity. Connerton (1983) found that men received more net gain than women from unisex pensions. This unexpected result occurred because the benefits of retired men receiving joint and survivor benefits were increased since the benefit reduction for providing survivors' benefits to their wives was lessened.

The Supreme Court has required employers to ignore recognized differences in the mortality risk of men and women in computing pension benefits, but it cannot require workers to ignore these differences in their personal valuation of the promise of these benefits. The disparity between the Court's mandate of sex blindness and the worker's knowledge of sex differences in mortality risk exacerbates both sex discrimination and individual discrimination in pension compensation.

Appendix**Mortality Concepts and Notation Used in the Analysis**

<u>Concepts</u> ^a	<u>Notation</u>
Plan's mortality table based on	
Age and gender	$M(a,s) = M(f), M(l)$
Age and possibly gender, whatever the plan uses	$M^*(f), M^*(l)$
Worker's Perspective	
Probability of dying by age b	$m(a,b)$
Instantaneous mortality rate	d_a
Vector of annual mortality probabilities	m_g, m_f, m_l

Note: a = age, f = woman, g = individual, k = plan, l = man, s = gender.

^a All mortality concepts measure mortality risk given survival to age a.

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