Tests For Compliance With Phased Plans To Equalize Discriminate Wages

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Abstract

Organizational policies and programs to correct for historical inequities in wages between employee groups are becoming increasingly evident, especially those which address gender-based wage discrimination. However, no systematic means for monitoring the progress of such a program appears to exist. This paper presents fair and objective tests for compliance with such a phased plan. Procedures are suggested for testing compliance not only at the aggregate level, but for individuals as well.

Introduction

The argument over equal pay for equal work and comparable pay for comparable work has been raging for decades. With the passage of the Equal Pay Act (1963) and the Civil Rights Act (1964) the legal foundation was in place for individuals to seek relief if they believed that they were being discriminated against in compensation due to personal characteristics such as gender.

In 1955, women earned about 64% that of males; in 1993, that figure ranges from 65-70%, depending on the source, even though the above two laws had been in effect some 30 years. A great deal of research has been done to examine the pay differential between males and females. Many studies have used national wage survey data (Current Population Survey, Quality of Employment Survey) or state wage data to isolate that part of the wage differential that is due to gender and that which is due to other factors (Filer 1985; Grune and Reder 1984; Montgomery and Wascher 1987; Robinson and Wunnava 1989; Sorenson 1986).

The above studies, which focus primarily on national data, use mathematical procedures (e.g., stochastic earning frontier, regression techniques) in an attempt to determine the percentage of the wage differential that is gender-based and that which is due to other variables (Barrett, Alexander and Anesgart 1986; Robinson and Wunnava 1989). The most commonly identified non-gender variables that have been included in these studies are age, job tenure, education, occupational prestige, supervision, hours worked per week, region and occupational category. The results of the statistical analyses

have shown that the wage gap is still significant, even after the above non-gender variables have been removed from the analysis. It is estimated that after adjusting for factors other than gender, women are still only earning 80-85% of males (Gerhart and Milkovich 1992).

National, state and local agencies have, at times, mandated pay equalization based on identified wage gaps between males and females. The studies conducted at the state level provide additional useful information on the relationship between wages currently being paid job incumbents and job evaluation points assigned to specific jobs (Madigan and Hoover 1986; Sorenson 1986). This process would determine, for an individual firm, rather than for the nation in general, whether there is gender-based wage discrimination. There are two pieces of information required in reaching pay equity. First, the firm must determine what is the relative worth of different jobs. Second, the firm must also determine what is the appropriate wage that corresponds to each relative point value.

Job evaluation is a process whereby the organization systematically determines the relative value of a job. This enables the organization to identify the internal equity between jobs that are not identical, but comparable. Each job is compared to a common set of compensable factors (e.g., knowledge, accountability, working conditions) to determine how much each job possesses of each factor. Once the amount of each factor that a job possesses (in points) is identified, the points can be summed across the factor to yield a composite point value for each job. Jobs that have equal or similar point

values should be receiving equal or similar pay.

Obtaining valid measures of job worth is a difficult task. In an excellent study done by Madigan and Hoover (1986) multiple methods of job evaluation were tested to determine if the method influences the relative worth of a job and the corresponding pay decision. The results reveal some differences in the outcomes of different job evaluation plans and large differences on how the different methods would evaluate the jobs for classification decisions. The method used to evaluate jobs significantly influences the job grade assigned to the job and the corresponding pay range for the job. In addition, the study found via regression analysis that the method used to evaluate jobs influences the size of the gender effect on wages.

It must be noted that some question the use of job evaluation in pay equity situations. One of the major concerns is that job evaluation results are often relative to market rates, which may be discriminatory. Thus, job evaluation may actually perpetrate discrimination within the firm. Even though there is a degree of controversy around job evaluation, it is a widely used technique to determining the relative value of job in pay equity research (Gerhart and Milkovich 1992). The caution here is that the organization must take extra effort to increase the probability that the job evaluation plan is measuring true differences in job worth, and not differences which are an artifact of the job evaluation method used. Since compliance plans are often mandated, the organization is still required to move forward, but must be aware of the potential problem.

This paper will not focus on either job evaluation or wage level setting, but will describe a technique that can be used once the relative worth of jobs and their corresponding wage values have been determined to monitor whether the firm's policy of equalizing wages is occurring. It is assumed that the firm does an objective job evaluation and identifies wage (via wage surveys) differentials between comparable jobs (same or similar point values) that cannot be explained due to such factors as experience, performance, etc.; a systematic adjustment in wages must be made to equate the wages of the two groups being reviewed. For example, if job A earned 450 out of 1000 points through job evaluation and job B earned 454 points, they should be paid similarly. But if in practice the monthly pay of occupants of job A is \$1200 (90% male dominated), whereas job B is paid on average \$900 per month (90% female dominated), the firm must implement a program to equate the wages of these two jobs or, increasingly face possible legal action.

In 1984 the state of Minnesota mandated that comparable worth be implemented in all governmental units within the state (Madigan and Hoover 1986). The state

of Wisconsin, using a consultant to determine relative values of jobs (job evaluation), adjusted wages to correspond to the relative values of those jobs as determined through the job evaluation. Ideally, the organization should immediately adjust the lower-paid jobs to the higher level, but financially that is almost never possible.

The policy issue of comparable worth in setting wages remains a controversial issue. We argue neither for nor against its adoption in this paper, only to provide fair and objective tests in support of a wage adjustment mandate. Whether the need for pay adjustments is determined by the firm itself or mandated by some governing agency, it is not unusual for organizations to phase in the higher wage level over some predesignated number of years, taking into account adjustments due to inflation (general wage increase) during that period. With any such long-term plan, frequent monitoring is called for to assure that the plan is accomplishing its goal. Such monitoring is desired by the firm itself, by agencies mandating change, and by individuals affected by the change. The following compliance models provide a means of determining how successfully such plans are operating.

Compliance Tests

We define men's and women's salaries at time t by the random variables $X_M(t)$ and $X_F(t)$, respectively. $X_M(t)$ and $X_F(t)$ are independently normally distributed with means $\mu_M(t)$ and $\mu_F(t)$ and variances $\sigma_M^2(t)$ and $\sigma_F^2(t)$, respectively. The time index t is suitably selected such that salary increments occur only at integer values of t . Initially, $\mu_F(0) < \mu_M(0)$ and it is desired to increase $\mu_F(t)$ linearly to achieve equality of mean salaries at the end of T salary cycles (typically years). One approach would be to execute a change of variable of the form

$$X_F(t) = X_F(0) + \{X_M(T) - X_F(0)\} [t]/T, 0 \leq t \leq T,$$

where $[t]$ indicates the greatest integer function, i.e., $[t]$ is the largest integer equal to or less than t . The change of variable insures the continued normal distribution of $X_F(t)$ and $\mu_F(T) = \mu_M(T)$. It fails to insure against inequities, however, any time the variances of the two distributions differ substantially at $t=0$. If, for example, $\sigma_M^2(0)$ is much greater than $\sigma_F^2(0)$, a not unlikely event, then at time T women's salaries will be more tightly clustered about the mean. Superior women performers will not have attained an equitable position in the combined distribution and only moderately below-average men might be paid less than all women.

To prevent occurrence of such a secondary inequitable effect, we propose instead to perform independent transformations on the parameters $\mu_F(t)$ and $\sigma_F^2(t)$, such that $\mu_F(T) = \mu_M(T)$ and $\sigma_F^2(T) = \sigma_M^2(T)$. Denote α_i , $i = 1, 2, \dots, T$, as the average fractional salary increments awarded to the men at the end of each period. Then,

$$\mu_M(t) = \mu_M(0) \prod_{i=0}^{[t]} (1 + \alpha_i), \quad 0 \leq t \leq T, \quad (1)$$

where $\alpha_0 = 0$. To achieve $\mu_F(T) = \mu_M(T)$ via the linear plan,

$$\mu_F(t) = \mu_F(0) + \{\mu_M(T) - \mu_F(0)\} [t]/T, \quad 0 \leq t \leq T. \quad (2)$$

Substituting (1) into (2) for $\mu_M(T)$ and simplifying, we get

$$\mu_F(t) = \mu_F(0)(1 - [t]/T) + \mu_M(0) \prod_{i=0}^{[t]} (1 + \alpha_i), \quad 0 \leq t \leq T. \quad (3)$$

The above assumes, of course, that the parameters $\mu_M(0)$, $\mu_F(0)$, and the α_i are known. Similarly assuming knowledge of $\sigma_F^2(0)$ and $\sigma_M^2(0)$, a well-known result of mathematical expectation yields

$$\sigma_M^2(t) = \sigma_M^2(0) \prod_{i=0}^{[t]} (1 + \alpha_i)^2, \quad 0 \leq t \leq T. \quad (4)$$

Equating $\sigma_F^2(T)$ and $\sigma_M^2(T)$ by analogy to (2) results in

$$\sigma_F^2(t) = \sigma_F^2(0) + \{\sigma_M^2(T) - \sigma_F^2(0)\} [t]/T, \quad 0 \leq t \leq T, \quad (5)$$

or

$$\sigma_F^2(t) = \sigma_F^2(0)(1 - [t]/T) + \sigma_M^2(0) \prod_{i=0}^{[t]} (1 + \alpha_i)^2, \quad 0 \leq t \leq T. \quad (6)$$

Large-Sample Compliance Testing

When the phased plan is implemented at the organizational level, complete data will generally be available. Compliance "testing" will therefore amount to simple comparisons to $\mu_F(t)$ and $\sigma_F^2(t)$ as given in (3)

and (6), respectively, the precise expressions which guide the implementation of the plan. On the other hand, when pay equalization has been mandated at the macro level, e.g., by a state, provincial, or national governing agency, neither implementation nor compliance testing will be so straightforward. In this section we suggest classical hypothesis testing for both primary ($\mu_F(t)$) and secondary ($\sigma_F^2(t)$) compliance.

Primary Compliance Test

The traditional assumption requires that we draw a sufficiently large random sample ($n \geq 30$) from the women's salary population at some time t to legitimately invoke the central limit theorem with respect to the normality of the sampling distribution of the mean $\bar{x}_F(t)$. Note that the assumption of normally distributed salaries is not required for this test. Assuming for the moment that the secondary (variance) component of the pay equalization plan is in compliance, the following statistic is computed:

$$\begin{aligned} z(t) &= (\mu_F(t) - \bar{x}_F(t)) / (\sigma_F^2(t)/n)^{1/2} \\ &= n^{1/2} \{ \mu_F(0)(1 - [t]/T) + \mu_M(0) \prod_{i=0}^{[t]} (1 + \alpha_i) - \bar{x}_F(t) \} / \\ &\quad \{ \sigma_F^2(0)(1 - [t]/T) + \sigma_M^2(0) \prod_{i=0}^{[t]} (1 + \alpha_i)^2 \}^{1/2} \end{aligned} \quad (7)$$

If $z(t) > z_\alpha$, where z_α is the one-tailed critical value of the standard normal distribution at the α level of significance, noncompliance is concluded (Neter and Wasserman 1974).

Secondary Compliance Test

This test requires the normal salary distribution assumption and computation of the sum of squared deviations from the sample mean (numerator of the sample variance)

$$(n-1)s_F^2(t) = \sum_{i=1}^n (x_i - \bar{x}_F(t))^2,$$

where the x_i , $i=1, \dots, n$, represent the $n \geq 30$ sampled salaries from the women's population. We compute the statistic

A key assumption must be made with respect to what constitutes "fairness." We propose to achieve that goal by maintaining the individual at the same standardized salary level throughout the adjustment period as that at which she began. That is, $z(t) = z(0)$, $0 < t \leq T$, where $z(t)$ is simply the standardized "z score" for the normal distribution, defined by

$$z(t) = (X(t) - \mu_F(t)) / \sigma_F(t). \quad (9)$$

By maintaining an individual at the same z-score, her relative standing among the women during $[0, T]$ and among all men and women at time T is preserved. At the same time, however, we would not wish to impose such rigidity on individual salaries during the adjustment period as to invalidate the merit pay system. Accordingly, it will be appropriate to establish a confidence interval about the individual's expected z-score, to allow for performance variations during the adjustment period. Conceptually, this is equivalent to the dynamic control chart utilized in industrial statistical quality control, modified to the step-functional form of the problem. Figure 2 provides a graphical representation.

Setting $z(t) = z(0)$, then from (9),

$$X'(t) = \mu_F(t) + [X(0) - \mu_F(0)] \sigma_F(t) / \sigma_F(0), \quad 0 < t \leq T, \quad (10)$$

identifies the individual's expected fair salary level at time t . Upper and lower control limits are, respectively,

$$UCL = X'(t) + z_{\alpha/2} \sigma_F(t) \quad (11)$$

$$LCL = X'(t) - z_{\alpha/2} \sigma_F(t) \quad (12)$$

where, typically, only the LCL will be of concern. That is, if the individual's salary $X(t) < X'(t) - z_{\alpha/2} \sigma_F(t)$, then the organization should expect to answer discrimination

$$X^2(t) = (n-1)s_F^2(t) / \sigma_F^2(t)$$

$$= (n-1)s_F^2(t) / \{\sigma_F^2(0)(1 - [t]/T)\}$$

$$+ \sigma_M^2(0) \left(\frac{[t]/T}{\pi} (1 + \alpha_i)^2 \right) \quad (8)$$

If $X^2(t) < \chi_{\alpha/2}^2(n-1)$ or $X^2(t) > \chi_{1-\alpha/2}^2(n-1)$, where $\chi_{\alpha}^2(n-1)$ is

the critical value of the chi-square distribution with $n-1$ degrees of freedom at the α significance level, noncompliance is concluded (Neter and Wasserman 1974).

Test for Discrimination Against An Individual

An individual is most likely to challenge her progress in a phased pay equalization plan when she enters the adjustment period at a salary level below that of the women's average. This may be due to junior status, placement in a lower-paying specialty, a history of below-average merit raises, etc., or some combination of those factors. Despite an upward trend in her salary, she observes an ever-widening gap between what she earns and the mean. In this section a test is developed to determine whether the individual whose salary does not happen to correspond with the mean is indeed receiving fair adjustments under the plan.

charges.

Extensions

The linear phasing scheme (salary adjustment) represents but one means of equalizing $\mu_F(T)$ and $\mu_M(T)$, but may not necessarily be the most desirable plan. Since the women are receiving equal dollar adjustments annually, on average, during $[0, T]$, that implies larger percentage salary increases in the earlier years. While the larger percentage salary adjustment will certainly tend to satisfy the women, the employer, desiring to defer payments as late as possible, will be less enamored with such a scheme from a present value point of view. In this section three alternative equalization schemes will be examined: constant percentage salary increment, proportional percentage salary increment, and constant dollar supplement. In each case, the linear phasing of $\sigma_F^2(t)$ is retained, since there should be neither any harm in doing so nor any particular meaningfulness associated with tracking the same nonlinear pattern as $\mu_F(t)$.

Constant Percentage Increment

A natural solution to the present value concern of an employer, as noted above, would be to determine the average fractional salary adjustment β which will achieve $\mu_F(T) = \mu_M(T)$, where

$$\mu_F(t) = \mu_F(0)(1 + \beta)^t, 0 \leq t \leq T.$$

By equating this expression with (1) at $t=T$ and solving for β , we get

$$\beta = \left\{ \left[\mu_M(0) / \mu_F(0) \right] \prod_{i=0}^T (1 + \alpha_i) \right\}^{1/T} - 1,$$

such that

$$\mu_F(t) = \left\{ \mu_F(0) \right\}^{1-t/T} \left\{ \mu_M(0) \prod_{i=0}^T (1 + \alpha_i) \right\}^{t/T}, 0 \leq t \leq T. (3)$$

The appropriate substitution is then made into (7) for the primary compliance test statistic.

Proportional Percentage Increment

Neither the linear nor the constant β plans will be particularly logical (nor particularly affordable) whenever the α_i change appreciably from year to year as fluctuating general economic conditions of recent years have necessitated in many industries. An employer may be able to avoid additional controversy by selecting average fractional salary increments β_i , $i=1, \dots, T$, such that $\beta_i/\alpha_i = k$, a constant (greater than one). Analogous

to (1), women's mean salary at time t will be

$$\mu_F(t) = \mu_F(0) \prod_{i=0}^{[t]} (1 + \beta_i), 0 \leq t \leq T, \beta_0 = 0. \quad (3'')$$

The β_i are determined by again equating $\mu_M(T)$ and

$\mu_F(T)$ and substituting $\beta_i = k\alpha_i$, which yields

$$\prod_{i=0}^T (1 + k\alpha_i) = [\mu_M(0) / \mu_F(0)] \prod_{i=0}^T (1 + \alpha_i).$$

This T th degree polynomial in k is solved for its smallest real root greater than one, from which $\beta_i = k\alpha_i$, $i=1, \dots, T$. The test statistic $z(t)$ is again modified appropriately.

Constant Dollar Supplement

None of the three alternatives suggested thus far insures that *every* individual benefits from the pay equalization program. Weak performers who might receive low, or even 0% annual raises during normal times are unlikely to fare any better during the adjustment program. A means of insuring that some salary adjustment does take place, without sending unintended signals concerning rewards for poor performance, would be to supplement each woman's annual percentage raise with a constant dollar amount.

It can be shown that this scheme results in

$$\mu_F(t) = \mu_F(0) \prod_{i=1}^T (1 + \alpha_i) + c \left[\sum_{m=2}^T \prod_{i=m}^T (1 + \alpha_i) + 1 \right],$$

where c is the annual dollar supplement. Equating this expression with $\mu_M(T)$ and solving for c , we get

$$c = \frac{\prod_{i=1}^T (1 + \alpha_i) [\mu_M(0) - \mu_F(0)]}{\left[\sum_{m=2}^T \prod_{i=m}^T (1 + \alpha_i) + 1 \right]}.$$

Women's mean salary is then expressed in the recursive form

$$\mu_F(t) = \mu_F([t] - 1)(1 + \alpha_{[t]}) + c, 0 \leq t \leq T. \quad (3''')$$

$z(t)$ similarly will assume a recursive form.

Examples

Consider an occupational class for which a government agency has found non-supportable wage differentials and has mandated a five-year wage equalization program. Men's and women's salaries are assumed each to be normally distributed with parameters $\mu_M(0) = \$36,000$, $\sigma_M^2(0) = \$4,000^2$, $\mu_F(0) = \$27,000$, and $\sigma_F^2(0) = \$3,000^2$. Forecast α_i , $i=1, \dots, 5$, are 0.07, 0.02, 0.02, 0.04, and 0.04, respectively. Random samples of size 100 are to be taken each year to test compliance with the program; 95% confidence in these tests is desired. Table 1 lists output parameters for the linear salary adjustment alternative, including the minimum sample mean women's salaries to constitute primary compliance in each year and the lower and upper bound requirements on the sample variance for secondary compliance. Note, for example, that a sample mean of \$35,000 observed in the fourth year qualifies as compliant with the program, but that a sample variance of 10,000,000 (units are dollars²) indicates inadequate dispersion.

Table 2 lists $\mu_F(t)$ and the minimum $\bar{X}(t)$ required for primary compliance for each of the other three

Table 1
Example output parameters for linear phasing scheme

[t]	$\mu_M(t)$	$\sigma(t)$	$\mu_F(t)$	Min $F(t)$	$\sigma(t)$	Bounds on $s(t)$	
						Lower	Upper
0	36000	16000000	27000	---	9000000	---	---
1	38520	18318384	30269	28479	11839250	8378936	15493991
2	39290	19058384	33538	31535	14678501	10388346	19209710
3	40076	19828320	36808	34631	17517744	12397750	22925418
4	41679	21446272	40077	37730	20356992	14407157	26641134
5	43346	23196256	43346	40841	23196256	16416576	30356870

Table 2
Example output parameters for alternative phasing schemes

[t]	Constant % Increment		Proportional % Increment		Constant \$ Supp.	
	$\mu_F(t)$	Min $F(t)$	$\mu_F(t)$	Min $F(t)$	$\mu_F(t)$	Min $F(t)$
1	29681	27891	31991	30201	30915	29125
2	32629	30636	33681	31688	33559	31566
3	35869	33692	35459	33282	36256	34079
4	39431	37084	39205	36858	39732	37385
5	43346	40841	43346	40841	43346	40841

program alternatives described in the previous section. Since the data are dependent upon the specified α_i , meaningful generalizations are not possible. However, taking into account the pattern of the α_i over the planning horizon, the expected differences among alternatives are readily apparent. If the program were being constructed at the organizational level (rather than mandated by government), such data as that provided by Tables 1 and 2 would be highly meaningful to corporate decision makers for selecting a plan alternative.

To illustrate individual discrimination testing, suppose that one woman's salary prior to implementation of the linear equalization plan described was \$18,000. Midway through the fourth year ($t = 3.5$) she files a wage discrimination claim, since her salary at that time of \$19,000 represents a cumulative raise over three years of less than 6%, considerably less than the 11+% average raise received by the men. However, even though her expected fair salary (from (10)) would be \$24,251, her current salary is still in excess of the lower control limit of \$16,048. That is, in this case, the increase in $\sigma_F^2(t)$ to insure against secondary inequities in the aggregate implies that this particular poor performer (assuming an accurate and defensible performance appraisal) need not have been awarded any raise during the first three years of the program. Her discrimination claim is unfounded.

Discussion

The preceding illustration reveals an apparent flaw in the test, at first blush. How can a salary equalization program be worthy of its name when a lower-paid member of the discriminated class fails to merit adjustment over an extended period of time? The answer is in two parts. On the one hand, the equalization program is not

intended to override the merit system in any way. Excellent performers in the discriminated class must be allowed to earn their way to the top of the combined male-female pay scale; dismal performers must not be rewarded any more than their male counterparts. It is essential that employees of equal performance be paid the same at the end of the adjustment period.

On the other hand, the program is one of aggregate management. As pointed out, true equity amounts to more than simply adjusting class means; every effort must be made to match the salary distributions as best possible. If the normal distribution assumption is valid, that requires attention to variance matching (secondary compliance) as well. A reality is that testing for secondary compliance will be much easier than achieving it! The scope of this paper has been limited to testing phased plans for compliance. Further work is needed to develop managerial guidelines for making salary decisions subject to such a program. This need is particularly felt when it is realized that plans implemented within an organization and those mandated across organizations (as in the illustration) present very different problems.

The compliance model permits the organization to examine whether its pay equalization program is operating as proposed. Many times a program of an organization is well-meaning but is not effective in correcting the problem for which it was designed. This model permits the systematic monitoring of the equal pay policies to determine if expected results are being achieved. If change is not occurring as desired, additional action must be taken to ensure organizational compliance.

Application of standard hypothesis tests for equality of means and variances is strongly recommended in the

future to ensure that discriminatory practices do not creep in after the wage adjustments have been completed. Since organizations typically will be experiencing continuing organizational changes (mergers, acquisitions, downsizing, growth) it is essential that a formal program be established that can be applied to all current and future units. A steady-state counterpart to the individual test is especially important to an organization in that sometimes individuals can slip through the cracks. A program can be working quite well in general, but through some quirk, an individual may be inadvertently wronged. Such a test could both rectify the situation for a wronged employee or provide evidence and support for an organization wrongly accused.

This issue of pay equity does highlight the need to be able to objectively evaluate the relative value of jobs within the organizations. It is essential that professional, objective, reliable and valid job analyses and evaluations be done by all organizations in order to fairly treat employees (for retention and attraction reasons), and to protect the organization from legal liability (Filer 1985). In addition, the need for unbiased and valid performance appraisal to maintain just wage adjustments based on factors other than gender becomes evident. Assuming that prior analysis of jobs and wages and continuing appraisal of individuals is accurate, the model herein can permit the monitoring of pay levels and increases during the difficult equalization period to assure a fair and equitable future.

Suggestions for Future Research

The pay differential between males and females is well documented, but controversy remains over what proportion is caused by gender discrimination versus other factors. Organizations have developed elaborate programs in an attempt to reduce and eventually eliminate the pay differential that cannot be explained by non-gender based factors. Future research is needed that focuses on how to determine more accurately what part of the pay differential can be attributed to non-gender factors. It would also be interesting to measure the psychological and productivity impacts on non-minority employees as female employees receive wage increases significantly higher than their current performances would justify. It is equally important to determine the most effective way to communicate and explain the wage equalization program to direct beneficiaries (females), as well as to other groups (males). Lastly, it would be beneficial to study an organization perhaps five years after total equalization has occurred to determine if total equality has been maintained or if past problems have begun to reappear.

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