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A NEW MEASURE OF WAGE DISCRIMINATION

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There is evidence that the conventional method overstates wage discrimination. A new measure is proposed based on a comparison of male and female characteristics within the same wage brackets. The new measure shows a much lower wage discrimination. Although there is no evidence of a downward bias, more analysis is required of the statistical properties of the new measure.

1. Introduction

One phenomenon that is increasingly attracting attention is the presence of a wide differential between male and female wages. Many suspect that a large part of the differential is due to sex discrimination. This could result, for example, if employers undervalue the abilities of female employees and, as a result, are not willing to pay as much as female employee, as a male employee doing the same type of work. Similarly, this could result if employer attitudes, labour union practices, or other factors restrict entry of women into the better paying jobs. As a result, women would be forced to take jobs that are inferior to those of men with similar abilities.

From the empirical point of view, the main question is how much of the male/female wage differential can be attributed to differences in relevant characteristics – such as education and job experience – and how much to sex discrimination. The conventional approach is to standardize wages for differences in characteristics and attribute the remaining wage differential to sex discrimination.[1] A usual finding is that the

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[1] See for example Blinder (1973), Malkiel and Malkiel (1973), and Oaxaca (1973).

unexplained part of the wage differential is substantial.

A key difficulty in measuring wage discrimination is that information about individual characteristics is incomplete. Certain important characteristics – such as training aquired on the job or occupational preferences – are usually omitted. Other important characteristics – such as education or job experience – are often measured too broadly to allow adequate standardization of differences in characteristics. Education categories, for example, are defined too broadly and no distinction is made between different types of university degrees or different levels of academic achievement. As a result, the conventional method of measuring wage discrimination is 'crude since it basically defines labor-market discrimination as a residual, despite the fact that our earnings functions are far from perfectly specified'. [Masters (1974).]

This paper outlines briefly a new method of measuring wage discrimination. The proposed method has been developed independently by the author (1979, 1980), Roberts (1979, 1980) and Dempsters (1979). When applied to the findings of previous studies, the results of the new approach are quite dramatic: measured wage discrimination is reduced manyfold or disappears. Although the new measure opens a new way of looking into the problem of wage discrimination, it must be recognized that it is still at its developmental stage and requires further analysis.

2. The wage regression

The starting point of both the conventional and the new approach of measuring wage discrimination is the standard wage regression model, usually specified as follows:

$$Y_m = C_m + X_m b_m + u_m, \tag{1}$$

where subscript m refers to male employees; Y is the wage rate (usually specified in natural logarithmic form); X is an explanatory variable (usually in a dummy form); and u is the error term, assumed to satisfy the standard assumptions for a best, linear, unbiased estimator.

Typically, wage regressions leave unexplained a substantial part of the wage variance *among* male and *among* female employees. One may suspect that at least a good part of the unexplained variance is due to the fact that relevant variables have been omitted, or are represented by crude proxies. In a broad sense, this problem could be viewed as primarily a problem of omitted variables. In other words, if the necessary information were available, the unexplained variance could have been reduced by introducing additional variables, to either represent new characteristics or to refine characteristics that were already included (by, for example, replacing a single dummy variable representing university education by a set of dummy variables that distinguish between different types of university education).

3. The conventional measure

According to the conventional method, wage discrimination is measured by subtracting from the overall wage differential the contribution of differences in characteristics. The later is measured by the following expression:

$$\begin{array}{l}\textit{contribution of differences}\\ \textit{in characteristics}\end{array} = \sum\left(\bar{X}_m - \bar{X}_f\right)b_m, \tag{2}$$

where $\bar{X}_{\mathrm{m}}$ is an average male characteristic and $\bar{X}_f$ is the corresponding average female characteristic.[2] Thus, the conventional measure of wage discrimination is calculated as follows:

$$\begin{array}{l}\textit{conventional measure of}\\ \textit{wage discrimination}\end{array} = \left(\bar{Y}_m - \bar{Y}_f\right) - \sum\left(\bar{X}_m - \bar{X}_f\right)b_m. \tag{3}$$

Researchers employing the conventional method, although often reluctant to attribute the entire unexplained wage residual to wage discrimination, typically conclude that there is extensive wage discrimination against female employees. Implicit in this conclusion is the assumption that, even if a low R^2-coefficient is a reflection that relevant characteristics have been omitted, there is no *a priori* reason to believe that, with respect to characteristics omitted in empirical analysis, male employees are better endowed than female employees.

However, there is evidence, although no proof, that the conventional method overstates wage discrimination. Typically, adjustments for differences in characteristics lead to a lower male/female wage differential.

[2] The contribution of differences in characteristics can be measured also by employing the female wage regression coefficients (b_f), instead of the male ones (b_m). In general, the results would differ. This is an index number problem, common to any method of wage decomposition.

Moreover, cursory comparison of the results of various previous studies indicates that the stronger the explanatory power of the wage regression (i.e., the higher the R^2-coefficient), the lower the conventional measure of wage discrimination tends to be. To the author's knowledge, no one has yet systematically examined the existing evidence from this angle.

4. The new measure

While the conventional method measures wage discrimination by essentially comparing the wages of male and female employees with similar characteristics, the new method measures wage discrimination by comparing the characteristics of male and female employees with similar wages. In other words, wage discrimination exists if male and female employees earn the same wage rate, despite the fact that female employees are, for example, better educated.

The procedure of calculating the new measure is as follows. First, the sample of male and female employees is distributed by wage brackets. Then, the average male and female characteristics are compared within each wage bracket. If the average female characteristics are 'better' than the average male characteristics then, since the wage level is the same for both sexes, the evidence is consistent with the hypothesis of wage discrimination against women. According to the new approach, the extent of wage discrimination within any particular wage bracket is measured on the basis of the following expression:

$$\begin{array}{l}\textit{wage discrimination within}\\ \textit{a given wage bracket}\end{array} = \sum \left(\bar{X}_f - \bar{X}_m \right) b_m . \tag{4}$$

The extent of the overall wage discrimination is then simply the average of wage discrimination accross all wage brackets, weighted by the number of female employees in each wage bracket.

5. The relation between the two measures

It will be shown now that, except in the case when the R^2-coefficient of the wage regression equals one, the new measure would always be lower than the conventional one.

To prove the above statement, it is necessary first to describe a different way of approximately estimating the new measure. This alternative approach is based on the comparison of male and female characteristics not within all wage brackets, but only at the wage level that corresponds to the average female wage level.

Assuming that wages and characteristics are linearly related, the female characteristics that corresponds to the average female wage rate are equal to the average female characteristics in the entire female sample. The average male characteristics that correspond to the same wage level, however, need to be estimated. One way of achieving this is by regressing male characteristics as a function of wages, in the way described below. This technique can be referred to as the reverse regression technique. *The technique does not imply that education, job experience, and other characteristics are determined by wage levels. It is simply a way of predicting what these characteristics are likely to be at a given wage level, short of actually distributing the sample by wage brackets as suggested in the previous section.*

For the sake of simplification of the presentation, the case where only one independent variable is included in the wage regression – say years of education (X) – is discussed first. In this case, the conventional measure of wage discrimination can be expressed as follows:

$$\begin{array}{l}\textit{conventional measure of}\\ \textit{wage discrimination}\end{array} = \left(\bar{Y}_m - \bar{Y}_f\right) - \left(\bar{X}_m - \bar{X}_f\right)b_m. \tag{5}$$

The new measure of wage discrimination can be calculated by first estimating the male level of education that corresponds to a wage level equal to the average female wage rate. This can be accomplished by the following regression equation:

$$X_m = K_m + k_m Y_m + e_m, \tag{6}$$

where now what in eq. (1) was the independent variable has become the dependent variable, and vice versa. The new measure of wage discrimination is given now by the following expression:

$$\begin{aligned}\textit{new measure of} \quad & = \bar{X}_f b_m - \left(X_m \mid Y_m = \bar{Y}_f\right) b_m \\ \textit{wage discrimination} \; & = \bar{X}_f b_m - \left[\bar{X}_m - k_m\left(\bar{Y}_m - \bar{Y}_f\right)\right] b_m \\ & = k_m b_m\left(\bar{Y}_m - \bar{Y}_f\right) - \left(\bar{X}_m - \bar{X}_f\right) b_m.\end{aligned} \tag{7}$$

Coefficient b_m of the wage regression and coefficient k_m of the reverse regression and related by the well-known relation [Malinvaud (1970, p. 7)]

$$b_m k_m = R^2. \tag{8}$$

Therefore, eq. (7) becomes

$$\begin{array}{l}\textit{new measure of}\\ \textit{wage discrimination}\end{array} = R^2(\bar{Y}_m - \bar{Y}_f) - (\bar{X}_m - \bar{X}_f)b_m. \tag{9}$$

Eq. (9) can be proven to hold also in the case that more than one independent variables are included in the wage regression. The procedure is as follows. First, each male and each female employee is assigned a potential wage rate by introducing his/her characteristics in the male wage regression [eq. (1)]. The potential wage rate is treated then as a proxy for productivity and is entered as a single independent variable in eq. (6), in place of the education variable. The proof of eq. (9) then becomes identical to the one given above in the case that there is only one independent variable in the wage regression.

On the basis of eq. (9), it is clear that the new measure of wage discrimination will always be lower than the conventional one, except in the case that the R^2-coefficient is equal to one when the two measures converge. There is no reason to expect that the new measure is downward biased. As it was pointed out in section 3, there is evidence that the conventional measure of wage discrimination and the R^2-coefficient are inversely related. This means that the explained component – i.e., $(\bar{X}_m - \bar{X}_f)b_m$ – and the R^2-coefficient are positively related. But, since the explained component and the R^2-coefficient enter with opposite signs in eq. (9), there is no reason to expect that the new measure is biased. However, the results of future studies using the new approach would have to be examined to see whether the new measure and the R^2-coefficient of the wage regression are systematically related – as it appears to be the case with the conventional measure.

In conclusion, the measure proposed here provides an interesting and intuitively attractive way of looking into the problem of wage discrimination. The statistical properties of the new measure, however, require further analysis, which the author hopes that this paper will stimulate.

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