Bruce Levin, Debra Millenson and Mary Ellen Wynn. I retain responsibility for error.

ADDITIONAL REFERENCES

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ROBERTS, H. V. (1979). Harris Trust and Savings Bank: An analysis of employee compensation. Report 7946, CMSBE, Graduate School of Business, Univ. Chicago.

ROBERTS, H. V. (1980). Statistical biases in the measurement of employment bias. In *Comparable Worth: Issues and Alternatives* (E. R. Livernash, ed.). Equal Employment Advisory Council, Washington.

Comment

Arthur S. Goldberger

I am grateful to Arthur Dempster for pointing out an error in my article, but perturbed by his campaign against econometricians. On balance, my perturbation exceeds my gratitude.

A bit of background. The most popular approach to the assessment of gender discrimination has been to run the direct regression

$$\hat{y} = \mathbf{b}'\mathbf{x} + az,$$

where y = salary, $\mathbf{x}$ = vector of measured covariates and z = gender (coded 1 for men, 0 for women). In this approach, the coefficient "a" (typically positive) is taken to be the measure of discriminatory behavior on the part of the employer. An obvious objection is that relevant covariates have been omitted: $\mathbf{x}$ may not capture all the productivity-related characteristics available to the employer. When those covariates are correlated with gender, there is a presumption that their omission biases the direct regression estimate.

Some critics of direct regression had gone on to suggest that the bias would be eliminated by using reverse regression, in particular by running the composite covariate $q = \mathbf{b}'\mathbf{x}$ upon y and z,

$$\hat{q} = cy + dz,$$

and taking $-d/c$ as the measure of discriminatory behavior. The rationale for this was rather vague, some mention of errors in variables being made.

To an econometrician, it seemed inappropriate to discuss estimation bias until the parameter of interest had been defined and imbedded in a coherent model. I first sought a model that would support direct regression, and yet allow for omitted variables in the statisticians's regression. I found it in Model A:

$$\text{(A1)} \quad y = p + \alpha z, \quad p = \mathbf{x}'\boldsymbol{\beta} + w, \quad \mathbf{x} = \boldsymbol{\mu} z + \mathbf{u},$$

$$\text{(A2)} \quad E(w \mid \mathbf{x}, z) = 0, \quad E(\mathbf{u} \mid z) = \mathbf{0}.$$

The parameter of interest is α. I wrote that p is the "latent variable which is best interpreted as the employer's assessment of productivity" and that w is "a gender-free disturbance. That disturbance represents the additional information available to the employer but not to the statistician."

In this model, I deduced that

$$\text{(A3)} \quad E(y \mid \mathbf{x}, z) = \mathbf{x}'\boldsymbol{\beta} + \alpha z,$$

so that "direct regression gives an unbiased assessment of discrimination ($a = \alpha$) despite the fact that the measured variables do not exhaust the information used by the employer in assessing productivity." The key to the conclusion is the assumption that $E(w \mid \mathbf{x}, z) = 0$—the omitted variables are uncorrelated with gender after controlling for the measured variables. That is precisely why I introduced it.

Next I sought a model that would support reverse regression. Drawing on suggestions made by proponents of reverse regression, I found it in Model B:

$$\text{(B1)} \quad y = p + \alpha z, \quad \mathbf{x} = \boldsymbol{\gamma} p + \boldsymbol{\varepsilon}, \quad p = \mu z + u,$$

$$\text{(B2)} \quad E(\boldsymbol{\varepsilon} \mid p, z) = \mathbf{0}, \quad E(u \mid z) = 0.$$

I wrote that here "each observed qualification [element of $\mathbf{x}$] is merely an indicator of the employer's assessment [p] subject to a gender-free disturbance." The parameter of interest is again α.

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