

Issues and Opinions

Problems of Applying OLS / Path Analysis for Estimating Structural (Multi-Equation) Models

In their article, "The Effect of User Involvement on System Success: A Contingency Approach" (*MIS Quarterly*, March 1988, pp. 91-108), Tait and Vessey used *path analysis*, an *ordinary least squares* (OLS) procedure, to estimate the structural model they proposed in their study. Contrary to their contention, we would like to point out that this technique may *not* be "particularly suited to investigating sequential models" such as the one they propose.

OLS/path analysis is appropriate for estimating hierarchical multi-equation models that have independent error terms across equations (Hanushek and Jackson, 1977). If the error terms are correlated, OLS/path analysis leads to *biased* and *inconsistent* parameter estimates for the structural equations involved in the model. This may lead to erroneous conclusions.

With respect to the proposed model in the article — in fact, for most social science models based on observational data — it is not reasonable to assume the error terms in each equation are independent of each other. The difficulty in satisfying this assumption becomes clear if we consider why error terms are added to social science models. It is rarely possible to account for the total variance of an endogenous variable. Error terms are introduced to incorporate the effects of a large set of variables influencing the endogenous variables (Pedhazur, 1982). Even though individual influences may be small and randomly distributed with respect to the exogenous variables, it does not imply that they are uncorrelated across different equations. In

the extreme, if the same set of factors are omitted from each equation, the error terms across equations could be perfectly correlated.

Tait and Vessey present an appropriate theoretical justification for the causal model. However, Pedhazur offers some cautions even when the application of OLS/path analysis is consistent with a theoretical model. Violations of the assumptions of OLS/path analysis can threaten the validity of the study. Of particular importance are: omission of relevant variables, the use of unreliable measures, and correlation of the error terms.

As noted by the researchers, their model did not include all the factors affecting the endogenous variables (page 92). Hence, it is not reasonable to assume that the error terms are uncorrelated across equations in the proposed model. There are alternative procedures designed to deal with hierarchical models that have correlated error terms across equations. These procedures are generally more appropriate for those models typically found in social science research. Two such techniques are *indirect least squares* (ILS) and *two stage least squares* (TSLS). An excellent treatment of this topic may be found in the two books cited below.

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References

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- Pedhazur, E.J. *Multiple Regression in Behavioral Research: Explanation and Prediction*, 2nd edition, Holt, Rinehart, and Winston, New York, NY, 1982.