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Zellner A. An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. *J. Amer. Statist. Assn.* 57:348-68, 1962.
[University of Wisconsin, Madison, WI]

This paper describes a special multivariate statistical regression model that is useful in analyzing economic and other types of data. Statistical estimation and testing methods for the model are developed and applied. The relations of the new methods to older methods are set forth. [The *Science Citation Index*® (*SCI*®) and the *Social Sciences Citation Index*® (*SSCI*®) indicate that this paper has been cited in over 385 publications since 1962.]

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"In graduate work in economics and econometrics at the University of California, Berkeley, Ivan Lee and George Kuznets stimulated my interest in multivariate statistical models used in econometrics. The available models seemed very complicated and not appropriate for analyzing certain kinds of important types of micro-data. Thus, after completing my graduate work, I began to attempt to develop simpler models and methods while at the University of Washington, Seattle. In a 1958 paper, published in 1961,[1] I hit on the idea of algebraically representing a multi-equation model in single-equation form. This basic, simple idea that occurred to me late one rainy night in Seattle permits an easy interpretation of multi-equation models and an adaption of single-equation statistical inference procedures to apply to multi-equation problems. In my 1961 paper that considered traditional multivariate regression models, each dependent variable is a linear function of the same set of independent variables, a situation common in the physical sciences in which one sets the values of a set of independent variables and observes multiple responses. The model that I analyzed in my 1962 paper allowed dependent variables to depend on different sets of independent variables, a situation commonly encountered in analyses of micro-data in economics. It was surprising to me that this type of model had not been analyzed in the statistical literature and that the statistical estimation and testing techniques that I developed were very different from those for the traditional regression model. The model considered involved m regression equations, $y_\alpha = X_\alpha \beta_\alpha + u_\alpha$, $\alpha = 1,2,...,m$, that seem unrelated (and hence the term, 'seemingly unrelated regressions'). In fact, taking account of the correlation of the error terms across equations led to new estimates that are asymptotically more efficient than usual least squares estimates and appropriate test statistics for testing hypotheses.

"Much of the work on my paper was done while I was Fulbright visiting professor at The Netherlands School of Economics (now Erasmus University) in 1960-1961. P.J.M. van den Bogaard and H. Theil provided stimulating comments on my work, much of it done during evenings in our house on a Dutch polder ten miles south of Rotterdam.

"On my return to the US in 1961, friends inquired about the finite sample properties of my estimation technique which led to my 1963 paper[2] providing some exact finite sample properties. Subsequent developments are summarized in Srivastava and Dwivedi.[3] My paper and later work based on it were probably important in my election to fellowship in several professional organizations. The economics profession displayed an encouraging and receptive attitude toward my work for which I am very grateful.

"As regards why my paper is frequently cited, the following are possible factors. (1) My estimation and testing procedures were and are directly applicable to a number of important applied economic problems. (2) My model is a rich one that has served as a basis for a number of useful extensions. (3) My emphasis on simplicity with respect to exposition and analysis apparently appealed to many. (4) A.H. Stroud and I developed a computer program in 1962 that permitted ready use of my statistical estimation and testing techniques.[4] Over the years, the program has been improved and widely distributed. (5) I have consulted with many colleagues and students on applications of my techniques. They have been most appreciative."

1. **Zellner A.** Econometric estimation with temporally dependent disturbance terms. *Int. Econ. Rev.* 2:164-77, 1961.
2. **----------.** Estimators for seemingly unrelated regression equations: some exact finite sample results. *J. Amer. Statist. Assn.* 58:977-92, 1963.
3. **Srivastava V K & Dwivedi T D.** Estimation of seemingly unrelated regression equations: a brief survey. *J. Econometrics* 10:15-32, 1979.
4. **Stroud A H & Zellner A.** *Program for computing efficient regression estimates and associated statistics.* Unpublished manuscript. Madison, WI: Department of Economics, University of Wisconsin, 1962.