Examining instrument relevance when there are multiple endogenous predictors: A new Index

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Abstract

The instrumental variable (IV) method has been increasingly believed to be one of the most powerful tools to make causal inference in observational studies. One major challenge is how to select a set of theoretically and statistically qualified instruments. The question remains largely open when there are multiple endogenous predictors. It has been widely believed that with multiple endogenous predictors, it is important to ensure that "Z (instrumental variables) have components important to X1 (the focal endogenous predictor) that are linearly independent of those important to X2 (the rest X variables)" (Shea, 1997, p.348). Shea's index (1997) and Cragg-Donald (Cragg & Donald, 1993) statistic have been proposed to assess the instrument relevance in this situation. We show from the perspective of the structural equation modeling approach to the IV causal inference that there exist scenarios that the IV method works satisfactorily whereas both existing statistics indicate the lack of instrument relevance and thus the failure of the IV method. We thus develop a new measure to better assess the quality of instruments in this situation: singular value ratio (SVR). We use two simulation studies to examine the performance of the proposed measure SVR and compare it with the two existing statistics. We conclude the study with a discussion on the limitations of the newly developed measure and practical guidance for applied researchers.

*Keywords:*instrumental variable, multiple endogenous predictors