Diagnostics for Exclusion Restrictions in Instrumental Variables Estimation

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Abstract

This paper considers diagnostics of the exclusion restriction based on the internal consistency of the instrument variables model. In most cases, empirical studies involve a number of control variables. Usually, there is a theory or mechanism that explains the instrument, and why it can be excluded from the outcome equation. The exclusion restriction is typically formulated and expected to hold conditional on a number of individual characteristics. That is, the argument is usually not that the exclusion restriction holds on average, but that it holds for all individuals in the population of interest. In other words, the typical reasoning in favor of the exclusion restriction should hold not only for the population but also for its different subpopulations. We use this observation to construct a testable implication. Consider a subpopulation that has zero or low correlation between the instrument and the endogenous variable. If the exclusion restriction holds, we should also find that the correlation between the instrument and the outcome variable is low. This provides a basis for the diagnostics of the exclusion restriction. Note that the existence of subpopulations for which the instrumental variable is (almost) irrelevant is rather typical for applied studies.

It turns out that the above implication leads to a nonstandard econometric testing problem. The problem contains elements that are similar to the literatures on partially identified models and on weak instrument models, but none of these literatures provides a satisfactory solution to our problem. For example, the analysis of weak instrument models is typically greatly simplified by observing that conditional on a certain sufficient statistic the distribution of the Quasi-Likelihood Ratio test statistics does not depend on the true concentration parameter. This argument does not apply in our problem thus requiring a more complicated analysis.

We provide a number of testing strategies and discuss their theoretical properties, optimality, as well as the practical aspects of their use in applications. We consider the analyses of subpopulations determined by the discrete and continuous covariates. The latter case involves additional theoretical and practical considerations. The finite sample properties of our procedures are studied in a number of Monte Carlo simulations. We illustrate the use of the methods in an empirical application estimating returns to schooling.

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