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On the use of instrumental variables in accounting research ☆

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ABSTRACT

Instrumental variable (IV) methods are commonly used in accounting research (e.g., earnings management, corporate governance, executive compensation, and disclosure research) when the regressor variables are endogenous. While IV estimation is the standard textbook solution to mitigating endogeneity problems, the appropriateness of IV methods in typical accounting research settings is not obvious. Drawing on recent advances in statistics and econometrics, we identify conditions under which IV methods are preferred to OLS estimates and propose a series of tests for research studies employing IV methods. We illustrate these ideas by examining the relation between corporate disclosure and the cost of capital.

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1. Introduction

Instrumental variable (IV) methods are commonly used in accounting research to resolve econometric problems with observational data, such as when the outcome and explanatory variables are simultaneously determined (i.e., simultaneous-equation bias). Another problem occurs when a variable that affects both the outcome and explanatory variables is not included in the regression model (i.e., correlated omitted variable bias). Both of these problems frequently occur in accounting research. To resolve these problems, instrumental variable methods are used in both multiple equation models (to address simultaneity) and single-equation models (to address omitted variables).

In a typical IV application, the researcher first selects a set of variables that are assumed to be exogenous and then uses two-stage-least-squares (2SLS) or similar estimation methods to estimate the coefficients in the regression model. This standard textbook solution to endogeneity is appropriate if the researcher can find instrumental variables that are correlated with the endogenous regressor but uncorrelated with the error in the structural equation. However, as Maddala

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(1977, p. 154) points out "Where do you get such a variable?" Similarly, Reiss and Wolak (2001) discuss the "magic" of finding an instrumental variable and cynically suggest that the best instrumental variable is developed by simply adding random error to the endogenous variable (which will be correlated with the original variable by construction). Consequently, it is necessary for researchers to understand the consequences of using instrumental variables that do not precisely conform to the necessary assumptions about these variables.

The purpose of this paper is to evaluate IV applications in accounting research, synthesize the extensive literature in statistics and econometrics on IV estimators, and provide accounting researchers with a framework to guide the use of IV methods. Our analytical results and numerical simulations indicate that when the instrument is only weakly correlated with the regressor, IV methods can produce highly biased estimates when the instrumental variable is even slightly endogenous. In those cases, it is likely that IV estimates are more biased and more likely to provide the wrong statistical inference than simple OLS estimates that make no correction for endogeneity.[1]

It is important to highlight that our analysis should *not* be interpreted as indicating that it is impossible for accounting researchers to address endogeneity, and thus that there is no reason to even make an attempt at dealing with endogeneity.[2] Rather, our analysis illustrates that researchers need to carefully justify their instrumental variables using economic theory and report contemporary specification tests for weak instruments and over-identifying restrictions. We believe that it is also useful to assess the sensitivity of OLS results to unobserved correlated (moderator and suppressor) variables using the methods developed by researchers such as Frank (2000), Rosenbaum (2002), and DiPrete and Gangl (2004).

The remainder of the paper consists of six sections. In Section 2, we examine IV applications in 42 papers published in *Journal of Accounting Research*, *Journal of Accounting and Economics*, or *The Accounting Review* during the time period from 1995 to 2005. In general, the variables selected as instruments seem largely arbitrary and are not justified by any rigorous theoretical discussion. Moreover, few diagnostic statistics are reported in the published articles and this makes it virtually impossible for the reader to assess the quality of the IV application.

In Sections 3 and 4, we discuss the asymptotic and finite sample properties of OLS and IV estimators. In this discussion, we focus on situations where the selected instrumental variables are not completely exogenous (i.e., the instruments that are correlated with the error term in the structural model or "semi-endogenous"), and problems with "weak" instruments (i.e., instruments that explain only a small proportion of the variation in the endogenous variable). These results are then used in Section 5 to develop a framework for accounting researchers using IV methods.

Section 6 compares the results produced by OLS and IV estimators in a contemporary accounting research setting where there is substantial reason to suspect that the primary regressor variable is endogenous. In particular, we examine the association between corporate disclosure and the cost of capital and conclude that in the context of our example OLS (which finds no statistical association) is preferred to IV estimation (which finds a negative statistical association). Although endogeneity remains a problem for the OLS results, the IV estimation is even less reliable than OLS. In Section 7, we illustrate the use of a methodology developed by Frank (2000) that enables the researcher to assess the possible impact of endogeneity on OLS parameter estimates. Concluding remarks about IV estimation in accounting research are provided in Section 8.

2. Instrumental variable applications in contemporary accounting research

In order to provide some insight into the use of IV estimation by accounting researchers, we conducted an electronic search for the terms "2SLS," "3SLS," "instrumental variable," and "endogeneity" for papers published in *Journal of Accounting Research*, *Journal of Accounting and Economics*, or *The Accounting Review* during the time period from 1995 to 2005. This search produced 42 articles that applied IV methods (listed in Table 1) in the study of earnings management, external disclosure, other financial accounting topics, managerial accounting, auditing, and corporate governance.

Accounting researchers generally use instrumental variables in an attempt to mitigate the biases caused by endogeneity of the predictor variables or to identify a system of simultaneous equations.[3] Of the 42 papers in our sample, 15 papers use IVs in a single-equation 2SLS, 7 in a Heckman-type model (e.g., Heckman, 1978, 1979), and 20 in a simultaneous-equation model (see Table 2, Panel A). IV methods are used in approximately equal proportion for the primary empirical results or robustness analyses (Table 2, Panel B). One unusual aspect of the typical robustness analysis is that the researchers frequently comment that their results are "robust" to endogeneity if the IV and OLS results produce similar

[1] Accounting researchers differ in what they mean by endogeneity. We follow the definition in econometrics (Wooldridge, 2002, p. 50) and label a variable endogenous if it is correlated with the error term. Common econometric problems such as simultaneity bias and omitted variables fall under this definition.

[2] Another unfortunate aspect of issues discussed in this paper concerns the role of endogeneity in the review process. We very much agree with the editorial by Shugan (2004) which deplores how endogeneity has become the (perhaps primary) reason for rejecting papers. Obviously, endogeneity is a serious problem, but there costs and benefits to various solutions to this econometric problem.

[3] Instrumental variables are also used to mitigate measurement error in the independent variables. This has a long history in economic research and applications in the accounting literature date back to at least Beaver et al. (1970). We do not include these applications in our discussion because sophisticated latent variable models exist to address measurement error issues when there are multiple indicators for the same construct.

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