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Proxy-quality thresholds: Theory and applications ☆

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Abstract

We consider alternative models of a regression containing a proxy for an unobserved regressor. For each model at most two pieces of prior information are necessary to determine the sign of any regressor coefficient: the sign of the partial correlation between the proxy and the unobserved regressor, and a lower bound on the partial or simple correlation between the proxy and the unobserved regressor. We apply our technique to investment and leverage regressions that contain a proxy for the incentive to invest. In both cases proxy quality must be high for the coefficient of interest to be non-zero.

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Instrumental variables, or other types of additional identifying information, are often unavailable for consistent estimation of regressions containing proxy variables, which are well known to render OLS estimation inconsistent. Frequently, however, only coefficient *signs* are of interest. In this case although additional prior information or assumptions are

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needed to draw inferences, they need not strong enough to identify coefficient *values*. We develop an econometric framework that inputs just enough prior information to identify coefficient signs.

We start with a linear regression with one unobserved regressor and an arbitrary number of perfectly observed regressors. A proxy is available for the unobserved regressor. We consider several assumption sets corresponding to whether the measurement error is correlated with some, any, or all of the other model variables. For each assumption set we show that an index of measurement quality for the unobserved regressor must surpass a threshold in order for a coefficient to retain the sign obtained via OLS. We express this index in terms of either the partial or simple correlation between the unobservable regressor and its proxy. For any coefficient and for either measure of proxy quality, we can compute multiple thresholds, corresponding to our different assumption sets. We suggest reporting all these thresholds, so that readers can use their own prior notions to decide whether the data set is informative about true coefficient signs. These threshold estimates will be particularly interesting if they are either near zero or one. In the first instance it will be hard to accept the hypothesis that the coefficient of interest is zero, and in the second it will be hard to reject this hypothesis. This situation is loosely analogous to that of a t-statistic, which is usually only interesting if it is either very low or very high. Finally, an additional contribution of the paper is the computation of the variances of these threshold bounds. To our knowledge, none of the previous research in errors-in-variables bounds has addressed the issue of threshold variances.

We provide two applications of our technique, both highlighting its computational simplicity and minimal assumption requirements. First, we examine the effects of external finance constraints on investment. Starting with Fazzari et al. (1988), most empirical studies of this issue have examined the sensitivity of investment to cash flow as an indicator of finance constraints. As summarized in Hubbard (1998), these efforts have shown that for groups of firms identified as financially constrained, investment responds strongly to cash flow, even after controlling for a proxy for the incentive to invest. Recently however, several papers have questioned these results, arguing that the usual control for the incentive to invest, Tobin's q, contains substantial measurement error. For example, Erickson and Whited (2000) use measurement-error consistent estimators on investment-q-cash flow regressions, finding that positive cash-flow coefficients produced by OLS are not robust to the use of measurement error remedies, even for financially constrained firms.

Our intent is to determine whether the message in Erickson and Whited (2000) is robust to relaxation of their assumptions. We find this to be the case. Under our less restrictive assumptions the proxy quality thresholds must often be quite high and even near one for the cash-flow coefficient to be positive. Further, the thresholds must also be high to infer a difference in cash-flow coefficients between groups of constrained and unconstrained firms.

Next, we examine the anomalous evidence in Rajan and Zingales (1995) that leverage is decreasing in lagged liquidity. This result counters the intuition from the static trade-off model that higher profits mean more dollars for debt service, more taxable income to shield, and therefore higher target leverage. Because Rajan and Zingales use a proxy for the incentive to invest, our technique is applicable. We find that our threshold must be implausibly high before one can infer a negative coefficient on lagged liquidity.