Accepted Manuscript

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PII: S0304-4076(14)00091-8
DOI: http://dx.doi.org/10.1016/j.jeconom.2014.04.022
Reference: ECONOM 3913

To appear in: *Journal of Econometrics*

Received date: 13 December 2012
Revised date: 12 January 2014
Accepted date: 23 April 2014

Please cite this article as: Hansen, C., Kozbur, D., Instrumental variables estimation with many weak instruments using regularized JIVE. *Journal of Econometrics* (2014), http://dx.doi.org/10.1016/j.jeconom.2014.04.022

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INSTRUMENTAL VARIABLES ESTIMATION WITH MANY WEAK INSTRUMENTS USING REGULARIZED JIVE

CHRISTIAN HANSEN AND DAMIAN KOZBUR

ABSTRACT. We consider instrumental variables regression in models where the number of available instruments may be larger than the sample size and consistent model selection in the first stage may not be possible. Such a situation may arise when there are many weak instruments. With many weak instruments, existing approaches to first-stage regularization can lead to a large bias relative to standard errors. We propose a jackknife instrumental variables estimator (JIVE) with regularization at each jackknife iteration that helps alleviate this bias. We derive the limiting behavior for a ridge-regularized JIV estimator (RJIVE), verifying that the RJIVE is consistent and asymptotically normal under conditions which allow for more instruments than observations and do not require consistent model selection. We provide simulation results that demonstrate the proposed RJIVE performs favorably in terms of size of tests and risk properties relative to other many-weak instrument estimation strategies in high-dimensional settings. We also apply the RJIVE to the Angrist and Krueger (1991) example where it performs favorably relative to other many-instrument robust procedures.

Key Words: ridge regression, high-dimensional models, endogeneity

1. Introduction

Instrumental variables (IV) regression is commonly used in economic research to calculate treatment effects for endogenous regressors. While the use of instrumental variables can aid in identification of structural effects, IV estimates of structural effects are often imprecise in practice as only variation in the endogenous variables induced by the instruments is used in estimating the treatment effect. One strategy to increasing the precision of IV estimates is to include many instruments in the hope that these will capture as much exogenous variation in the explanatory variable as possible. The use of many instruments can also be motivated by a desire to nonparametrically estimate the optimal instruments via series as in Newey (1990); see also Amemiya (1974) and Chamberlain (1987). In addition, the increasing availability of high-dimensional data makes it likely that applications where the number of potential instruments is similar to or larger than the number of observations will become more common in applied work; see, for example, the empirical application in Belloni, Chen, Chernozhukov, and Hansen (2010) (BCCH hereafter). While the improvement in efficiency available from using many instruments is appealing, it is well-known that the usual GMM-type approaches to estimating structural

Date: First version: August 2012, this version May 1, 2014.

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