Adaptive Estimation and Uniform Confidence Bands for Nonparametric IV*

Xiaohong Chen† Timothy Christensen‡ Sid Kankanala§

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Abstract

We introduce computationally simple, data-driven procedures for estimation and inference on a structural function h_0 and its derivatives in nonparametric models using instrumental variables. Our first procedure is a bootstrap-based, data-driven choice of sieve dimension for sieve nonparametric instrumental variables (NPIV) estimators. When implemented with this data-driven choice, sieve NPIV estimators of h_0 and its derivatives are adaptive: they converge at the best possible (i.e., minimax) sup-norm rate, without having to know the smoothness of h_0, degree of endogeneity of the regressors, or instrument strength. Our second procedure is a data-driven approach for constructing honest and adaptive uniform confidence bands (UCBs) for h_0 and its derivatives. Our data-driven UCBs guarantee coverage for h_0 and its derivatives uniformly over a generic class of data-generating processes (honesty) and contract at, or within a logarithmic factor of, the minimax sup-norm rate (adaptivity). As such, our data-driven UCBs deliver asymptotic efficiency gains relative to UCBs constructed via the usual approach of undersmoothing. In addition, both our procedures apply to nonparametric regression as a special case. We use our procedures to estimate and perform inference on a nonparametric gravity equation for the intensive margin of firm exports and find evidence against common parameterizations of the distribution of unobserved firm productivity.

Keywords: Honest and adaptive uniform confidence bands, minimax sup-norm rate-adaptive estimation, nonparametric instrumental variables, bootstrap.

JEL codes: C13, C14, C36

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†Cowles Foundation for Research in Economics, Yale University. `xiaohong.chen@yale.edu`

‡Department of Economics, New York University. `timothy.christensen@nyu.edu`

§Department of Economics, Yale University. `sid.kankanala@yale.edu`