Two Papers on Semi-Nonparametric Ill-posed Inverse Problems in Econometrics

In this talk, I shall discuss two applications of sieve minimum distance estimation of semi-nonparametric conditional moment restrictions containing unknown functions of endogenous variables. The first one belongs to the linear ill-posed inverse problem with unknown operators and i.i.d. observations; while the second one belongs to the nonlinear ill-posed inverse problem with unknown operators and financial time series observations.

Paper 1: Semi-Nonparametric Instrumental Variable Estimation of Shape-Invariant Engel Curves

(by *Richard Blundell, Xiaohong Chen and Dennis Kristensen*)

Abstract: This paper concerns the identification and estimation of a shape-invariant Engel curve system with endogenous total expenditure. The shape-invariant specification involves a common shift parameter for each demographic group in a pooled system of Engel curves. Our focus is on the identification and estimation of both the nonparametric shape of the Engel curve and the parametric specification of the demographic scaling parameters. We present a new identification condition, closely related to the concept of bounded completeness in statistics. The estimation procedure applies the sieve minimum distance estimation of conditional moment restrictions allowing for endogeneity, where the unknown engel curves are approximated by spline sieves. Nonparametric convergence rates, root-n asymptotic normality and semiparametric efficiency of the parametric components are established under a set of low-level sufficient conditions. The root mean squared convergence rate for the nonparametric case is new even in the literature on the ill-posed inverse problem with unbounded support. Monte Carlo simulations demonstrate that our estimators perform well. An application is made to the estimation of Engel curves using the UK Family Expenditure Survey and shows the importance of adjusting for endogeneity in terms of both the curvature and demographic parameters of systems of Engel curves.

Keywords: Nonparametric instrumental variables, bounded completeness, sieve minimum distance, measure of ill-posedness, nonparametric convergence rate, root-n semiparametric efficiency, splines.

Paper 2: Semi-Nonparametric Habit-Based Asset Pricing Models

(by *Xiaohong Chen and Sydney Ludvigson*)

Abstract: A leading explanation of aggregate stock market behavior suggests that assets are priced as if there were a representative investor whose utility is a power function of the difference between aggregate consumption and a "habit" level, where the habit is some function of lagged and (possibly) contemporaneous consumption. But theory does not provide precise guidelines about the parametric functional relationship between the habit and aggregate consumption. This makes formal estimation and testing challenging; at the same time, it raises an empirical question about the functional form of the habit that best explains asset pricing data.

This paper studies the ability of a general class of habit-based asset pricing models to match the conditional moment restrictions (Euler equations) implied by asset pricing theory. Our approach is to treat the habit as an unknown function of current and lagged consumption, and to estimate it along with the rest of the model's finite-dimensional unknown parameters that are part of the power utility function and time-preference. The facts that the habit enters the Euler equations nonlinearly and it is also an unknown function of current consumption make the problem becomes a nonlinear ill-posed inverse problem with unknown conditional expectations operator. The unknown habit function is approximated by a single-layer artificial neural network (ANN) sieve, and the unknown ANN sieve coefficients and the finite-dimensional model parameters are estimated jointly by applying the sieve minimum distance procedure. This semiparametric approach allows us to empirically evaluate a number of interesting hypotheses about the specification of habit-based asset pricing models, and to formally test the framework's ability to explain stock return data relative to other models that have proven empirically successful.

Keywords: nonlinear habit function, bounded completeness, sieve minimum distance, consistency, root-n semiparametric normality, artificial neural networks.