Available online at www.sciencedirect.com

SCIENCE DIRECT®

Economics Letters 86 (2005) 367–371

economics letters

www.elsevier.com/locate/econbase

A semiparametric panel data model for markets in disequilibrium

Walter J. Mayer*

Economics Dept., University of Mississippi, University, MS 38677-1848, Room 373 Holman Hall, P.O. Box 1848, United States

Received 6 March 2004; accepted 13 August 2004
Available online 8 December 2004

Abstract

Previously proposed semiparametric disequilibrium models do not allow endogenous prices and cannot accommodate panel data. Here, I demonstrate identification of a disequilibrium model under semiparametric assumptions that allow unknown sample separation, endogenous prices, and panel data with fixed or random effects.

Keywords: Semiparametric; Disequilibrium; Panel data

JEL classification: C14; C33

1. Introduction

Maximum likelihood methods for disequilibrium models were developed by Maddala and Nelson (1974) and many others (see Quandt, 1988). These methods, however, assume normally distributed errors. In recent years, alternative methods that possess good asymptotic properties under weaker distributional assumptions have been proposed. For example, Cosslett (1991) and Ahn and Powell (1993) propose two-step estimators for selectivity models of which disequilibrium models with "known sample separation" are a special case, while Mayer and Dorsey (1998) and Mayer (1999) extend Manski's (1985) maximum score to disequilibrium models with unknown sample separation. None of the proposed models, however, allow endogenous prices or can accommodate panel data.

* Tel.: +1 662 915 5980; fax: +1 662 915 6943.
E-mail address: wmayer@olemiss.edu.

0165-1765/$ - see front matter
doi:10.1016/j.econlet.2004.08.006

Here, I demonstrate identification of a disequilibrium model under semiparametric assumptions that allow unknown sample separation, endogenous prices, and panel data with fixed or random effects. We developed the model to analyze panel data on U.S. Navy enlistments. We assume that the number of recruits for region i at time t, y_{it}, is determined by the short-side rule:

$$\begin{aligned}
&y_{it} = \min(y_{1it}, y_{2it}) \\
&y_{1it} = \boldsymbol{x}_{1it}\boldsymbol{\beta}_1 + \alpha_{1i} + u_{1it}, \\
&y_{2it} = \boldsymbol{x}_{2it}\boldsymbol{\beta}_2 + \alpha_{2i} + u_{2it} \\
&i = 1,\ldots,n;\ t = 1,\ldots,T
\end{aligned} \tag{1}$$

where y_{1it} and y_{2it} are the quantities supplied and demanded, $\boldsymbol{x}_{1it}$ and $\boldsymbol{x}_{2it}$ are vectors of regressors that include price, $\boldsymbol{\beta}_1$ and $\boldsymbol{\beta}_2$ are coefficient vectors, α_{ji} is the individual effect, and u_{jit} is an error that changes across t as well as i. Sample data consists of observations on (y_{it}, $\boldsymbol{x}_{1it}$, $\boldsymbol{x}_{2it}$, $\boldsymbol{z}_{it}$), where $\boldsymbol{z}_{it}$ is a vector of instruments specified below.

We will focus on identification of $\boldsymbol{\beta}_1$ for the two period cases. $\boldsymbol{\beta}_2$ is analogous, and extensions to more than two periods is straightforward. We can write

$$y_{it} = \boldsymbol{x}_{1it}\boldsymbol{\beta}_1 + \alpha_{1i} + u_{1it} + y_{it} - y_{1it}$$

The regressors, $\boldsymbol{x}_{1it}$, are potentially correlated with each component of the error, $\alpha_{1i}+u_{1it}+y_{it}-y_{1it}$. The "fixed effects" component, α_{1i}, can be eliminated by time differencing:

$$\Delta y_{it} = \Delta\boldsymbol{x}_{1it}\boldsymbol{\beta}_1 + \Delta u_{1it} + \Delta(y_{it} - y_{1it}) \tag{2}$$

Under equilibrium, $\Delta(y_{it}-y_{1it})$=0 holds with probability one, and it thus suffices to specify a vector, $\boldsymbol{z}_{it}$, that satisfies:

$$E(\Delta u_{1it}|\boldsymbol{z}_{it}) = 0 \text{ for all } i \tag{3}$$

Without the equilibrium assumption, however, $\boldsymbol{z}_{it}$ will generally be correlated with $\Delta(y_{it}-y_{1it})$ even if Eq. (3) holds. This problem is resolved by Assumption 1 below, under which the indicator $I[E(\Delta(y_{it}-y_{1it})|\Delta\boldsymbol{z}_{it},\Delta\boldsymbol{z}_{it-1})=c_t]$ is observable asymptotically for an unknown c_t. With $I[E(\Delta(y_{it}-y_{1it})|\Delta\boldsymbol{z}_{it},\Delta\boldsymbol{z}_{it-1})=c_t]$ "identified," one can confine (asymptotically) the sampling process to observations such that $E(\Delta(y_{it}-y_{1it})|\Delta\boldsymbol{z}_{it},\Delta\boldsymbol{z}_{it-1})=c_t$ and use time dummies to control for the correlation between $\Delta(y_{it}-y_{1it})$ and $(\Delta\boldsymbol{z}_{it},\Delta\boldsymbol{z}_{it-1})$.

Assumption 1 (Fixed effects). There is an index $\Delta\boldsymbol{z}_{it}\pi$ and estimator π_n such that plim $\pi_n=\pi$ and $E(\Delta(y_{1it}-y_{2it})|\Lambda_{\Delta it}, \Lambda_{\Delta it-1})=0$, where $\Lambda_{\Delta it}=\{\Delta\boldsymbol{z}_{it}\pi=0\}$.

One basis for Assumption 1 is the linear price adjustment equation:

$$\Delta p_{it} = \theta(y_{1it} - y_{2it}) + \alpha_{3i} + u_{it}, \tag{4}$$

where $E(\Delta u_{it}|\Delta\boldsymbol{z}_{it}, \Delta\boldsymbol{z}_{it-1})=0$ and $E(\Delta(y_{1it}-y_{2it})|\ \Delta\boldsymbol{z}_{it}, \Delta\boldsymbol{z}_{it-1})=\Delta\boldsymbol{z}_{it}\pi$.

If Eq. (4) holds with $\theta\neq 0$, then π_n can be computed from the (reduced form) regression of $\Delta^2 p_{it}$ on $\Delta\boldsymbol{z}_{it}$.

Theorem 1 below formally establishes identification of $\boldsymbol{\beta}_1$ under Eq. (1), Assumption 1, and a set of rank and moment conditions (Assumption 2). Assumption 1 links $I[E(\Delta(y_{it}-y_{1it})|\Lambda_{\Delta it},\Lambda_{\Delta it-1})=c_t]$ to the index $\Delta\boldsymbol{z}_{it}\pi$; in particular, a key step in the proof of Theorem 1 (see Step 1) is that, under Assumption 1, $(\Delta\boldsymbol{z}_{it}\pi,\Delta\boldsymbol{z}_{it-1}\pi)=(0,\ 0)$ implies $E(\Delta(y_{it}-y_{1it})|\Lambda_{\Delta it},\Lambda_{\Delta it-1})=c_t$ for an unknown c_t. We also present an alternative "random effects" specification (Assumptions 1′ and 2′) that permits identification of the coefficients of time-invariant regressors.