

1 Overview

This folder contains MATLAB files and data set for empirical illustration of the transformed likelihood approach proposed by Hsiao, Pesaran and Tahmiscioglu (2002, *Journal of Econometrics*) and Hayakawa and Pesaran (2012) “Robust Standard Errors in Transformed Likelihood Estimation of Dynamic Panel Data Models”.

2 Model and data

We estimate models of earning dynamics by using the same data set as Meghir and Pistaferri (2004 *Econometrica*). All data and details are given in "PSID.xls".

We consider the following two models:

$$\text{AR(1) model: } y_{it} = \alpha_i + \gamma y_{i,t-1} + u_{it} \quad (1)$$

$$\text{ARX(1) model: } y_{it} = \alpha_i + \gamma y_{i,t-1} + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + u_{it} \quad (2)$$

where $y_{it} = \log(\text{earning}_{it}/\text{price}_t)$, $x_{1it} = \text{age}_{it}$, $x_{2it} = \text{age}_{it}^2$, $x_{3it} = \text{fsize}_{it}$. (Note: *fsize* denotes family size)

The data is an unbalanced panel of 2069 individuals with $9 \leq T_i \leq 26$ for the period $t=1967-1992$ obtained from PSID. The sample is divided into three groups according to the education:

HSD: educ < 12: (high school dropouts)

HSG: $12 \leq \text{educ} \leq 15$ (high school graduates)

CLG: educ > 15 (college graduates)

We separately estimate the above AR(1) and ARX(1) models for these three groups as well as ALL(=HSD+HSG+CLG) data without grouping. Individuals which contain "not available data" are dropped to make the data balanced.

For the estimation period, we consider $t=1978-1982$ ($T=5$), $t=1978-1987$ ($T=10$) and $t=1978-1992$ ($T=15$). We estimate above two models by the transformed likelihood estimator and various GMM estimators. For the transformed likelihood estimator, we use robust standard errors proposed by Hayakawa and Pesaran (2012). For the GMM estimators, we use one-, two-step and continuous-updating GMM estimators, denoted as "1step", "2step" and "CUE", respectively, with the moment conditions: "DIF1", "DIF2", "SYS1" and "SYS2" where, for AR(1) model, "DIF1" denotes the moment conditions $E(y_{is}\Delta u_{it}) = 0$ for $s = 0, \dots, t-2; t = 2, \dots, T$ (Arellano and Bond 1991), "DIF2" denotes the moment conditions $E(y_{i,t-2-l}\Delta u_{it}) = 0$ with $l = 0$ for $t = 2$, $l = 0, 1$ for $t = 3, \dots, T$ (Arellano and Bond 1991) and "SYS1" and "SYS2" denote moment conditions $E[\Delta y_{i,t-1}(\alpha_i + u_{it})] = 0$ for $t = 2, \dots, T$ in addition to the ones used in "DIF1" and "DIF2", respectively (Blundell and Bond 1998). For ARX(1) model, "DIF1" denotes the moment conditions $E(y_{is}\Delta u_{it}) = 0$ for $s = 0, \dots, t-2; t = 2, \dots, T$ and $E(x_{kis}\Delta u_{it}) = 0$ for $s = 1, \dots, t; t = 2, \dots, T; k = 1, 2, 3$ (Arellano and Bond 1991). "DIF2" denotes the moment conditions $E(y_{i,t-2-l}\Delta u_{it}) = 0$ with $l = 0$ for $t = 2$, $l = 0, 1$ for $t = 3, \dots, T$ and $E(x_{ki,t-l}\Delta u_{it}) = 0$ with $l = 0, 1$ for $t = 2$, $l = 0, 1, 2$ for $t = 3, \dots, T$ and $k = 1, 2, 3$ (Arellano and Bond 1991). "SYS1" and "SYS2" denote the moment conditions $E[\Delta y_{i,t-1}(\alpha_i + u_{it})] = 0$ and $E[\Delta x_{kit}(\alpha_i + u_{it})] = 0$ for $t = 2, \dots, T$ and $k = 1, 2, 3$ in addition to the ones used in "DIF1" and "DIF2", respectively.

For two-step and continuous-updating GMM, we report Windmeijer's (2005) and Newey and Windmeijer's (2009) standard errors in addition to the conventional standard errors.

3 List of files

Two folders “AR1model” and “ARX1model” contain MATLAB files and data set which are used to estimate AR(1) and ARX(1) models, respectively.

Description of files in “AR1model”

example_ar1.m	: main file
results_AR1.doc	: estimation results in MS-Word format
results_AR1.pdf	: estimation results in PDF format
PSID1.csv	: all data in CSV format
PCED.csv	: price data in CSV format
ML_GMM_estimators_ar1.m	: m-file that computes transformed likelihood estimator and various GMM estimators
transformed_ml_ar1.m	: m-file that computes the transformed likelihood estimator
transformed_ml_opt_ar1.m	: m-file of log likelihood function
first_derivative_ar1.m	: first derivative of log likelihood
second_derivative_ar1.m	: second derivative of log likelihood
GMMestimator_ar1.m	: m-file that computes 1step, 2step and continuous-updating(CU) first-difference(Arellano-Bond) and system(Blundell-Bond) GMM estimators
Obj_CUE.m	: Objective function of CU-GMM estimator

Description of files in “ARX1model”

example_arx1.m	: main file
results_ARX1.doc	: estimation results in MS-Word format
results_ARX1.pdf	: estimation results in PDF format
PSID1.csv	: all data in CSV format
PCED.csv	: price data in CSV format
ML_GMM_estimators.m	: m-file that computes transformed likelihood estimator and various GMM estimators
transformed_ml.m	: m-file that computes the transformed likelihood estimator
transformed_ml_opt.m	: m-file of log likelihood function
first_derivative.m	: first derivative of log likelihood
second_derivative.m	: second derivative of log likelihood
minimum_distance_estimator.m	: m-file of the minimum distance estimator used in obtaining the starting values of nonlinear optimization of the transformed likelihood estimator
GMMestimator.m	: m-file that computes 1step, 2step and continuous-updating(CU) first-difference(Arellano-Bond) and system(Blundell-Bond) GMM estimators
Obj_CUE.m	: Objective function of CU-GMM estimator