Program “dfelrtnb.tsp” for conducting the root-N consistent estimations of the dynamic fixed effects logit models with time dummies and no explanatory variable

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1 Introduction

The program “dfelrtnb.tsp” is one part of the set “DFEL-RTN (version 0.0.0)” that conducts root-N consistent estimations of dynamic fixed effects logit models. The program “dfelrtnb.tsp” deals with a model with time dummies and no explanatory variable. This document illustrates the usage of “dfelrtnb.tsp”. See the document “dfelrtn000.pdf” for how to install “DFEL-RTN (version 0.0.0)”.

2 Model and estimation

This section considers the model that the program deals with and root-N consistent estimators that the program implements. The dynamic fixed effects logit model is of the simple ‘AR(1)’ form with time dummies and no explanatory variable. Throughout this document, i ($i = 1, \ldots, N$) and t ($t = 1, \ldots, T$) denote the individual and time period, where it is assumed that the number of individual $N \to \infty$, while the number of time periods T is fixed.

2.1 Model

The simple ‘AR(1)’ fixed effects logit model with time dummies and no explanatory variable is written as follows:

$$y_{it} = \frac{\exp\left(\eta_i + TD_t + \gamma\, y_{i,t-1}\right)}{1 + \exp\left(\eta_i + TD_t + \gamma\, y_{i,t-1}\right)} + v_{it}, \qquad \text{for } t = 2, \ldots, T,$$

where y_{it} is the binary dependent variable for i at t, η_i is the fixed effect for i, TD_t is the time dummy at t, γ is the parameter of interest, and the disturbance v_{it} for i at t satisfy

$$\mathrm{E}[v_{it} \mid \eta_i, y_{i1}, v_i^{t-1}] = 0$$

with v_{i1} being empty and $v_i^{t-1} = (v_{i1}, \ldots, v_{i,t-1})$. The binary dependent variable y_{it} takes one with the probability given by the first term on the right-hand side in the equation above.

The specification above is called the implicit form for the dynamic fixed effects logit model in this document.

2.2 Conditional moment conditions

Kitazawa (2016) proposes conditional moment conditions for the 'AR(1)' fixed effects logit model in previous subsection, which mimic those proposed by Kitazawa (2013) for the model including strictly exogenous continuous explanatory variables. These imply that root-N consistent estimations for the dynamic fixed effects logit model with time dummies and no explanatory variable are feasible. Kitazawa (2016) proposes two types of moment conditions: those based on g-form and those based on h-form.

Conditional moment conditions based on g-form

$$\mathrm{E}[\hbar U_{it}^{-}(\gamma, \Delta TD_t, \Delta TD_{t+1}) \mid \eta_i, y_{i1}, v_i^{t-2}] = 0, \quad \text{for } t = 3, \ldots, T-1,$$

where

$$\begin{aligned}\hbar U_{it}^{-}(\gamma, \Delta TD_t, \Delta TD_{t+1}) &= U_{it}^{-} - y_{i,t-1} \\ &- \tanh\left(\frac{-\gamma y_{i,t-2} + \Delta TD_t + \Delta TD_{t+1}}{2}\right)(U_{it}^{-} + y_{i,t-1} - 2U_{it}^{-} y_{i,t-1})\end{aligned}$$

with

$$\begin{aligned}U_{it}^{-} &= y_{it} + (1-y_{it})y_{i,t+1} - (1-y_{it})y_{i,t+1}\exp\left(-\Delta TD_{t+1}\right) \\ &- (\exp(\gamma)-1)y_{i,t-1}(1-y_{it})y_{i,t+1}\exp\left(-\Delta TD_{t+1}\right)\end{aligned}.$$

Conditional moment conditions based on h-form

$$\mathrm{E}[\hbar \Upsilon_{it}^{-}(\gamma, \Delta TD_t, \Delta TD_{t+1}) \mid \eta_i, y_{i1}, v_i^{t-2}] = 0, \quad \text{for } t = 3, \ldots, T-1,$$

where

$$\hbar\Upsilon_{it}^{-}(\gamma,\Delta TD_t,\Delta TD_{t+1}) = \Upsilon_{it}^{-} - y_{i,t-1}$$
$$-\tanh\left(\frac{\gamma(1-y_{i,t-2})+\Delta TD_t+\Delta TD_{t+1}}{2}\right)(\Upsilon_{it}^{-}+y_{i,t-1}-2\Upsilon_{it}^{-}y_{i,t-1})$$

with

$$\Upsilon_{it}^{-} = y_{it}y_{i,t+1} + y_{it}(1-y_{i,t+1})\exp\left(\Delta TD_{t+1}\right)$$
$$+(\exp(\gamma)-1)(1-y_{i,t-1})y_{it}(1-y_{i,t+1})\exp\left(\Delta TD_{t+1}\right).$$

The operator Δ is the first-difference operator: for example, $\Delta TD_t = TD_t - TD_{t-1}$ and $\Delta x_{it} = x_{it} - x_{i,t-1}$. The parameters to be estimated root-N consistently by utilizing the conditional moment conditions are $\gamma, \Delta TD_3, \ldots, \Delta TD_T$.

2.3 Unconditional moment conditions

Root-N consistent estimations are conducted by employing the GMM estimators using the unconditional moment conditions constructed from the conditional moment conditions based on g-form and h-form in the previous subsection. Typical constructions (selections) of the unconditional moment conditions based on g-form and h-form are as follows:

Typical unconditional moment conditions based on g-form

$\mathrm{E}[\hbar U_{it}^{-}(\gamma,\Delta TD_t,\Delta TD_{t+1})]=0$, for $t=3,\ldots,T-1$,

$\mathrm{E}[y_{is}\,\hbar U_{it}^{-}(\gamma,\Delta TD_t,\Delta TD_{t+1})]=0$, for $s=1,\ldots,t-2$; $t=3,\ldots,T-1$.

Typical unconditional moment conditions based on h-form

$\mathrm{E}[\hbar\Upsilon_{it}^{-}(\gamma,\Delta TD_t,\Delta TD_{t+1})]=0$, for $t=3,\ldots,T-1$

$\mathrm{E}[y_{is}\,\hbar\Upsilon_{it}^{-}(\gamma,\Delta TD_t,\Delta TD_{t+1})]=0$, for $s=1,\ldots,t-2$; $t=3,\ldots,T-1$.

2.4 GMM estimation

The GMM estimators are illustrated using the unconditional moment conditions $\mathrm{E}[\varphi_i(\theta)]$. With

$$\hbar U_i^{-}(\gamma,\Delta TD_3,\ldots,\Delta TD_T)$$
$$=[\hbar U_{i3}^{-}(\gamma,\Delta TD_3,\Delta TD_4)\ \ldots\ \hbar U_{i,T-1}^{-}(\gamma,\Delta TD_{T-1},\Delta TD_T)]'$$

and

$$\hbar\Upsilon_i^-(\gamma, \Delta TD_3, \ldots, \Delta TD_T)$$
$$= [\hbar\Upsilon_{i3}^-(\gamma, \Delta TD_3, \Delta TD_4) \;\ldots\; \hbar\Upsilon_{i,T-1}^-(\gamma, \Delta TD_{T-1}, \Delta TD_T)]',$$

the vector forms of the typical g-form and h-form unconditional moment conditions are

$$\mathrm{E}[\varphi_i(\theta)] = \mathrm{E}[\varphi_i^g(\theta)] = \mathrm{E}[Z_i' \;\hbar U_i^-(\gamma, \Delta TD_3, \ldots, \Delta TD_{T-1})]$$

and

$$\mathrm{E}[\varphi_i(\theta)] = \mathrm{E}[\varphi_i^h(\theta)] = \mathrm{E}[Z_i' \;\hbar\Upsilon_i^-(\gamma, \Delta TD_3, \ldots, \Delta TD_{T-1})],$$

respectively. The vector form using the moment conditions based on both forms is

$$\mathrm{E}[\varphi_i(\theta)] = \mathrm{E}[\varphi_i^{gh}(\theta)] = \mathrm{E}[\mathbf{vec}(\varphi_i^g(\theta) \;\; \varphi_i^h(\theta))],$$

where

$$Z_i = [Y_i \;\; I_{T-3}]$$

with

$$Y_i = \begin{bmatrix} y_{i1} & & & \\ & y_{i1} \; y_{i2} & & \\ & & \ddots & \\ & & & y_{i1} \cdots y_{i,T-3} \end{bmatrix}$$

and I_{T-3} being the identity matrix of order $T-3$.

The two-step GMM estimator for $\theta = (\gamma, \Delta TD_3, \ldots, \Delta TD_T)'$ is defined as

$$\hat{\theta}_2 = \arg\min_{\theta} \; \bar{\varphi}(\theta)' \left(\bar{\Theta}(\hat{\theta}_1)\right)^{-1} \bar{\varphi}(\theta)$$

where $\bar{\varphi}(\theta) = (1/N)\sum_{i=1}^{N} \varphi_i(\theta)$ (the sample analogue of the vector form of the unconditional moment conditions $\mathrm{E}[\varphi_i(\theta)]$ where $\mathrm{E}[\varphi_i(\theta)]$ is selected from $\mathrm{E}[\varphi_i(\theta)] = \mathrm{E}[\varphi_i^g(\theta)]$, $\mathrm{E}[\varphi_i(\theta)] = \mathrm{E}[\varphi_i^h(\theta)]$, and $\mathrm{E}[\varphi_i(\theta)] = \mathrm{E}[\varphi_i^{gh}(\theta)]$) and $\bar{\Theta}(\hat{\theta}_1) = (1/N)\sum_{i=1}^{N} \varphi_i(\hat{\theta}_1)\varphi_i(\hat{\theta}_1)'$ (the inverse of weighting matrix for the two-step GMM estimator) with $\hat{\theta}_1$ being the one-step GMM estimator for θ. The estimator of variance of $\hat{\theta}_2$ is defined as

$$\hat{\mathrm{V}}(\hat{\theta}_2) = \frac{1}{N}\left(D(\hat{\theta}_2)' \left(\bar{\Theta}(\hat{\theta}_1)\right)^{-1} D(\hat{\theta}_2) \right)^{-1},$$

where $D(\hat{\theta}_2) = \frac{1}{N}\sum_{i=1}^{N} \left.\frac{\partial \varphi_i(\theta)}{\partial \theta'}\right|_{\theta=\hat{\theta}_2}$.

Two types of the Sargan test statistic are defined for the two-step GMM estimator: that with the weighting matrix being estimated by the one-step GMM estimator and that with the weighting matrix being estimated by the two-step GMM estimator. The former is

$$N\ \bar{\varphi}(\hat{\theta}_2)'\left(\bar{\Theta}(\hat{\theta}_1)\right)^{-1}\ \bar{\varphi}(\hat{\theta}_2),$$

while the latter is

$$N\ \bar{\varphi}(\hat{\theta}_2)'\left(\bar{\Theta}(\hat{\theta}_2)\right)^{-1}\ \bar{\varphi}(\hat{\theta}_2),$$

both of which are asymptotically distributed as chi-square with degree of freedom being the number of moment restrictions minus the number of parameters to be estimated.

On the other hand, the one-step GMM estimator for θ is defined as

$$\hat{\theta}_1 = \arg\min_{\theta}\ \bar{\varphi}(\theta)'\left(\bar{\Theta}_Z\right)^{-1}\ \bar{\varphi}(\theta)$$

where $\bar{\Theta}_Z = (1/N)\sum_{i=1}^{N} Z_i' Z_i$ (the inverse of weighting matrix for the one-step GMM estimator). The estimator of variance of $\hat{\theta}_1$ is defined as

$$\hat{\mathrm{V}}(\hat{\theta}_1) = \hat{\mathrm{V}}_A(\hat{\theta}_1)\left(\hat{\mathrm{V}}_B(\hat{\theta}_1)\right)^{-1}\ \hat{\mathrm{V}}_A(\hat{\theta}_1)$$

with $\hat{\mathrm{V}}_A(\hat{\theta}_1) = \dfrac{1}{N}\left(D(\hat{\theta}_1)'\left(\bar{\Theta}_Z\right)^{-1} D(\hat{\theta}_1)\right)^{-1}$

and

$$\hat{\mathrm{V}}_B(\hat{\theta}_1) = \frac{1}{N}\left(D(\hat{\theta}_1)'\left(\bar{\Theta}_Z\right)^{-1}\ \bar{\Theta}(\hat{\theta}_1)\left(\bar{\Theta}_Z\right)^{-1} D(\hat{\theta}_1)\right)^{-1}.$$

The Wald tests for the null hypothesis that the time dummies to be estimated are jointly zero are defined for the one-step and two-step estimators. For the Wald test, see Hall and Cummins (2009).

3 Illustrative processing

This section explains the executing procedure of the program "dfelrtnb.tsp" using a practical example. The dataset supplied is artificially designed. For the model with no explanatory variable, the following dependent variables are supplied:

Dependent variable y_{it} : fls (female labor supply, binary variable: 1=supply; 0=no supply)

The program deals with the nonlinear GMM estimations as seen from the previous section. In this case, the local minimum problem can arise presumably due to inappropriate starting values of the parameters of interest in the process of minimizing the GMM objective function. To circumvent this problem as far as possible, the program generates multiple sets of random starting values to carry out multiple minimization trials. Then, the "best" one-step and two-step GMM estimates, that is, those whose Sargan test statistic (with weighting matrix estimated using the two-step estimates) is minimal, are selected.[1] It will take a considerable amount of time to run the program to completion if a large number of trials are carried out.

3.1 Data arrangement

The Microsoft EXCEL 97-2003 worksheet files for a dependent variables must be prepared. The name of the file is composed of the variable name and postfix "_dt" with the extension ".xls". For example, if the name of a dependent variables is "fls", the corresponding file name must be "fls_dt.xls".

In the EXCEL file, the variable "icode", which represents the individual code, must be in the first column. From the next column, the data variables for respective time periods are given, whose names are the amalgamations of [variable name] and [time period]. The [time period]s must be in ascending order from left to right, without omission.[2] The dataset used must be a balanced panel dataset.

For the illustrative example, the file is as follows:

File: fls_dt.xls

icode	fls1986	fls1987	fls1988	fls1989	fls1990	fls1991	fls1992	fls1993
1	1	0	1	1	1	1	1	1
2	1	1	0	0	0	1	1	0
3	1	1	1	0	1	0	1	1
4	1	1	0	1	1	0	1	1
:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:

3.5 Commands setup

The setup of the commands (parameters) needed for running the program are conducted in the file "prmb.tsp", which is edited by the user. The TSP command "list" gives a single name to a list of TSP variables, while "set" stores a new scalar value. The start of a

[1] In this case, non-convergent results in either one-step or two-step estimation are ruled out. In addition, we rule out the results where the rank deficiency occurs in calculating the Sargan test statistic (with weighting matrix estimated using the two-step estimates).

[2] In this data arrangement, the program cannot deal with the EXCEL file with more than 65536 rows of data. For the information for loading the file with more rows, see the manual "docum_ex2.pdf" in the folder "estim_ex2". In this folder, the estimation example is completed using the file with more rows. See also section 4 in this document.

comment line must be a question mark "?". The semicolon ";" is the separator between commands. An illustration of the setup in the file "prmb.tsp" (with highlighted explanations that are not part of the file) is as follows:

? Parameter Setting File for dfelrtnb.tsp

list dpv fls ;

The dependent variable used in the estimations (which is "fls" in this case) is defined as the dependent variable list "dpv".

set cnob = 15000 ;

The cross-sectional sample size (number of individuals) is set to the variable "cnob", which is 15000 in this case.

set drm = 1 ;

The variable "drm" specifies the method of reading the dataset. If "drm = 1", the dataset is loaded directly from the EXCEL worksheet file exhibited in previous subsection. However, this specification allows us to load up to 65536 rows of data. When loading more rows, "drm" should be set to 0 such that "drm = 0", the appropriate statements should be written in the file "detrb.tsp", and the EXCEL worksheet files should be converted into the CSV files after eliminating the headers (see the manual "docum_ex2.pdf" in the folder "estim_ex2" for more information).

set spy = 1986 ; set epy = 1991 ;

These parameters set the time span for the dependent variable used in the estimation equations. The parameter "spy" is the start year (in this case 1986), while "epy" is the end year (in this case 1991). The number of equations plus two must equal to epy – spy.

set spu_fls = 1986 ; set epu_fls = 1991 ;

These parameters set the start and end years for the variable "fls" used in the estimation equations and/or the instruments. The parameter "spu_fls" is the start year (in this case 1986) for the variable "fls", while "epu_fls" is the end year (in this case 1991).

set fls_sg = -2 ; set fls_eg = -99 ;

These parameters set the lead/lag range for the variable "fls" used as instruments for the g-form and h-form. Positive, zero, and negative values represent leads, contemporary values, and lags, respectively, for the g-form and h-form at time t. The value of "fls_sg" must be greater than or equal to that of "fls_eg". In this case, the variables "fls" dated t – 2 and before (until t – 99) are used as instruments for the g-form and h-form at time t.

set cinst = 1 ;

The variable "cinst" specifies whether the constant (i.e. one) is used as the instrument for the g-form and h-form at time t or not. If the constant is used, "cinst = 1"; if not, "cinst = 0"..

set g_fls_lag1_min = -2 ; set g_fls_lag1_max = 2 ;

The range of the randomly generated starting values of the coefficient ("g_fls_lag1") on the 1 lagged value of the dependent variable "fls" is set in order to carry out the nonlinear optimization in the GMM estimations. In this case, the minimal value ("g_fls_lag1_min") is set to -2, while the maximal value ("g_fls_lag1_max") is set to 2. The initial letter "g" stands for "gamma".

set dtd1988_min = -2 ; set dtd1988_max = 2 ;
set dtd1989_min = -2 ; set dtd1989_max = 2 ;
set dtd1990_min = -2 ; set dtd1990_max = 2 ;
set dtd1991_min = -2 ; set dtd1991_max = 2 ;

The minima and maxima of the randomly generated starting values of the first-differenced time dummy coefficients for 1988 to 1991 are set for use in the nonlinear optimization in the GMM estimations.

set ufm = 3 ;

The variable "ufm" specifies the transformations used in the estimation. If ufm = 1, only the g-form is used; if ufm = 2, only the h-form is used; and if ufm = 3, both forms are jointly used for the estimation.

set ig2 = 1 ;

The variable "ig2" specifies whether to use the one-step GMM estimates or randomly generated starting values as the starting values of the parameters of interest in the optimization for obtaining the two-step GMM estimates. If "ig2 = 0", randomly generated starting values are used; if "ig2 = 1", the one-step GMM estimates are used.

set ntrial = 100 ;

The variable “ntrial” specifies the number of the optimization trials for obtaining the GMM estimates that minimizes the two-step GMM criterion function where the weighting matrix is estimated by the two-step estimates. If “ig2 = 0”, the number of sets of the starting values randomly generated in the optimization equals to “ntrial” times two, since the generation of the starting values occurs in both the one-step and two-step estimations.

set sdgp = 256 ;

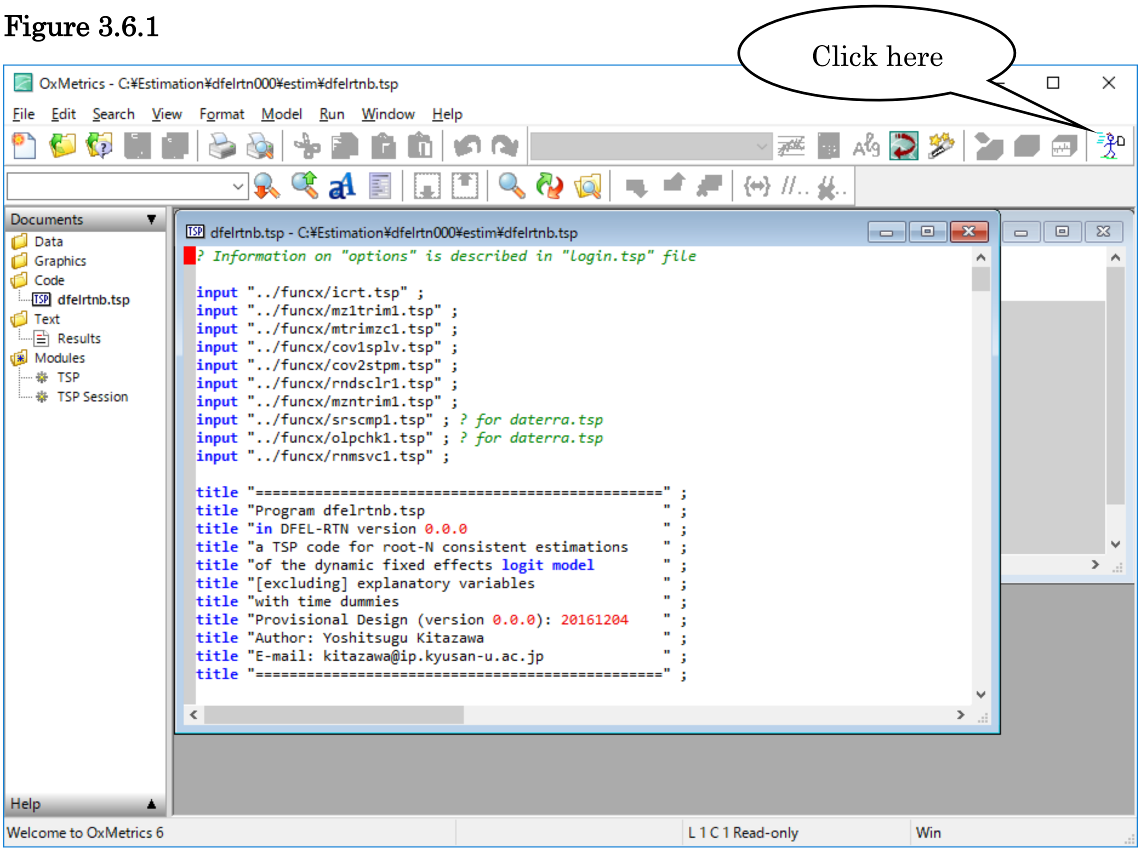
The variable “sdgp” sets the seed for generating random starting values for the parameters of interest in the optimization trials. If “sdgp = -99999”, the seed is automatically created in TSP. To obtain reproducible results, any seed value except “-99999” can be assigned to sdgp. In this case, the seed is 256.

3.6 Running the code

After completing the data arrangement and command setup, double-click the file "dfelrtnb.tsp" to launch OxMetrics. Then, click the "Run" button to run the program (see Figure 3.6.1).

It might take a considerable time (e.g., several days, as the case may be) to obtain conclusive estimation results, if the number of optimization trials "ntrial" is large.

Figure 3.6.1



3.7 Run termination

If the run terminates successfully, the output is displayed in the OxMetrix screen (see Figure 3.7.1). At the end of the output, the termination sentence “END OF OUTPUT” is printed. When the optimizations do not work out in some trials, a numbers of “ERROR MESSAGES”, “NUMERIC WARNINGS”, “WARNING MESSAGES”, and so on are printed.

At this stage, the output file is not saved. To do this, first click the frame of the inner window “dfelrtnb.out” and then click the “File” button in the OxMetrix screen (see Figure 3.7.1). Next, select the menu “Save As…” in the emerging menu bar (see Figure 3.7.2). Third, click the “Save (S)” button in the “Save as” dialog to save the output file “dfelrtnb.out” in the subfolder “estim” (see Figure 3.7.3).

Figure 3.7.1

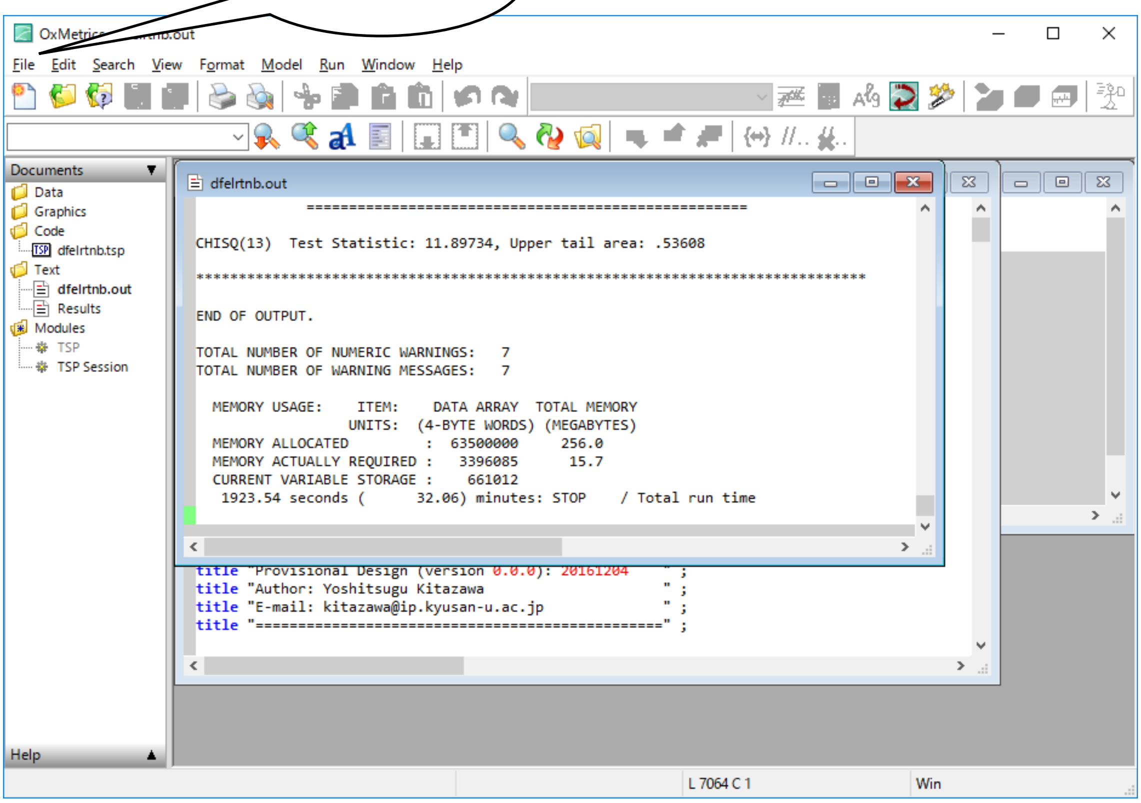


Figure 3.7.2

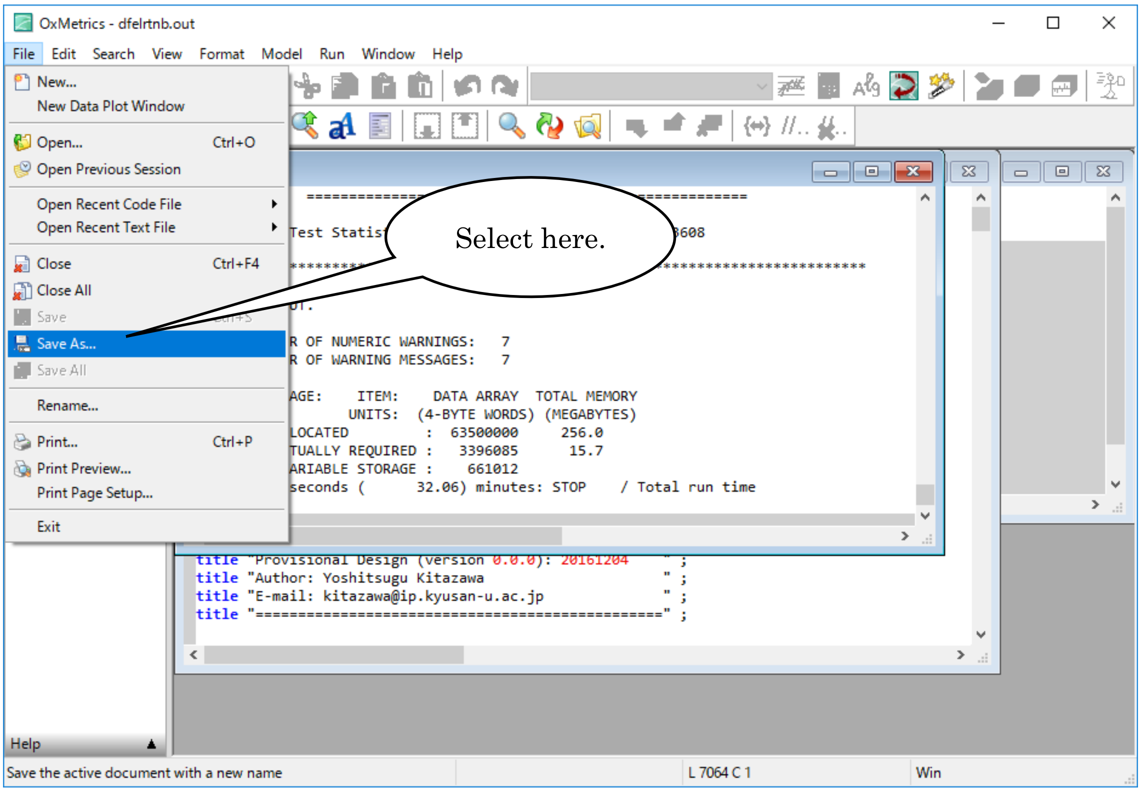
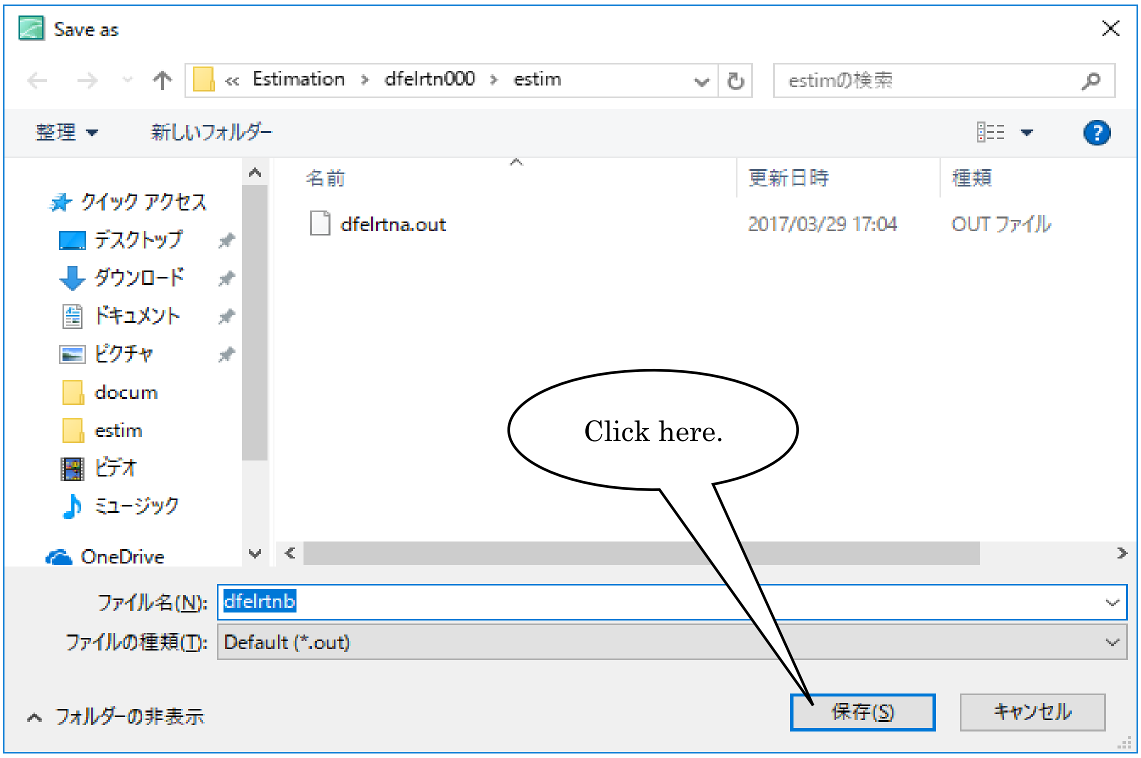


Figure 3.7.3



3.8 Output

The program outputs the files “ghresb.txt” and “ghsrtb.txt” in addition to “dfelrtnb.out”.

The file “dfelrtnb.out” is the main output file of the estimation results, whose final part is illustrated in Exhibition 3.8.1. In the last part, the best estimation results are summarized: the transformed equations, instruments, one-step and two-step estimates, Sargan test statistics, Wald test statistics for the null hypothesis that the time dummies are jointly zero, etc. In the middle of the file, there are a series of estimation results for the optimization trials where different randomly generated starting values are used.

The file “ghresb.txt” summarizes the estimation results. It contains the best estimation results: the one-step and two-step estimates, Sargan test statistics, and Wald test statistics. The file “ghsrtb.txt” holds the randomly generated starting values used for obtaining the best estimation results. Ilustrations of “ghresb.txt” and “ghsrtb.txt” are shown in Exhibitions 3.8.2 and 3.8.3.

Exhibition 3.8.1

Last part of the output file "dfelrtnb.out"

(last part of the results)

```
************************************************************
============================================================
***** Dynamic Fixed Effects Logit Model                  ***
============================================================
***** excluding Regressors                               ***
============================================================
***** with Time Dummies                                  ***
============================================================

  Transformation Used for the root-N Consistent Estimator:
  ========================================================
            g-form + h-form (see Kitazawa, 2016)
            ====================================
```

●Equations used for the estimations (g-form dated 1988-90 and h-form dated 1988-90)

```
                    Equations Transformed (g-form + h-form)
                    =======================================
```

■Equation in g-form dated 1988

```
EQUATION: HTD_ELG1988

     FRML HTD_ELG1988 Y_FLS1988 + (1 - Y_FLS1988)*Y_FLS1989 - (1 -
Y_FLS1988)*Y_FLS1989*EXP(-DTD1989) + -(EXP(G_FLS_LAG1) - 1)*Y_FLS1987*(1 -
Y_FLS1988)*Y_FLS1989*EXP(-DTD1989) - Y_FLS1987 - (EXP(-G_FLS_LAG1*Y_FLS1986 +
DTD1989 + DTD1988) - 1)/(EXP(-G_FLS_LAG1*Y_FLS1986 + DTD1989 + DTD1988) +
1)*(Y_FLS1988 + (1 - Y_FLS1988)*Y_FLS1989 - (1 -
Y_FLS1988)*Y_FLS1989*EXP(-DTD1989) + -(EXP(G_FLS_LAG1) - 1)*Y_FLS1987*(1 -
Y_FLS1988)*Y_FLS1989*EXP(-DTD1989) + Y_FLS1987 - 2*(Y_FLS1988 + (1 -
Y_FLS1988)*Y_FLS1989 - (1 - Y_FLS1988)*Y_FLS1989*EXP(-DTD1989) +
-(EXP(G_FLS_LAG1) - 1)*Y_FLS1987*(1 -
Y_FLS1988)*Y_FLS1989*EXP(-DTD1989))*Y_FLS1987)
```

■Equation in g-form dated 1989

EQUATION: HTD_ELG1989

(abbrev.)

■Equation in g-form dated 1990

EQUATION: HTD_ELG1990

(abbrev.)

■Equation in h-form dated 1988

EQUATION: HTD_ELH1988

```
FRML HTD_ELH1988 Y_FLS1988*Y_FLS1989 + Y_FLS1988*(1 -
Y_FLS1989)*EXP(DTD1989) + (EXP(G_FLS_LAG1) - 1)*(1 - Y_FLS1987)*Y_FLS1988*(1
- Y_FLS1989)*EXP(DTD1989) - Y_FLS1987 - (EXP(G_FLS_LAG1*(1 - Y_FLS1986) +
DTD1989 + DTD1988) - 1)/(EXP(G_FLS_LAG1*(1 - Y_FLS1986) + DTD1989 + DTD1988)
+ 1)*(Y_FLS1988*Y_FLS1989 + Y_FLS1988*(1 - Y_FLS1989)*EXP(DTD1989) +
(EXP(G_FLS_LAG1) - 1)*(1 - Y_FLS1987)*Y_FLS1988*(1 - Y_FLS1989)*EXP(DTD1989)
+ Y_FLS1987 - 2*(Y_FLS1988*Y_FLS1989 + Y_FLS1988*(1 - Y_FLS1989)*EXP(DTD1989)
+ (EXP(G_FLS_LAG1) - 1)*(1 - Y_FLS1987)*Y_FLS1988*(1 -
Y_FLS1989)*EXP(DTD1989))*Y_FLS1987)
```

■Equation in h-form dated 1989

EQUATION: HTD_ELH1989

(abbrev.)

■Equation in h-form dated 1990

EQUATION: HTD_ELH1990

(abbrev.)

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
========================================================
```

●Equations (in g-form dated 1988-90 and in h-form dated 1988-90) and Instruments for each of them

```
Equations and Instruments for Each Time Period
==============================================
```

■Instruments for equation in g-form dated 1988

```
EQUATION = HTD_ELG1988
INSTRUMENTS = Y_FLS1986 C
            ----------------------------------------------------------
            ==========================================================
```

■Instruments for equation in g-form dated 1989

```
EQUATION = HTD_ELG1989
INSTRUMENTS = Y_FLS1986 Y_FLS1987 C
            ----------------------------------------------------------
            ==========================================================
```

■Instruments for equation in g-form dated 1990

```
EQUATION = HTD_ELG1990
INSTRUMENTS = Y_FLS1986 Y_FLS1987 Y_FLS1988 C
            ----------------------------------------------------------
            ==========================================================
```

■Instruments for equation in h-form dated 1988

```
EQUATION = HTD_ELH1988
INSTRUMENTS = Y_FLS1986 C
            ----------------------------------------------------------
            ==========================================================
```

■Instruments for equation in h-form dated 1989

```
EQUATION = HTD_ELH1989
INSTRUMENTS = Y_FLS1986 Y_FLS1987 C
            ----------------------------------------------------------
            ==========================================================
```

■Instruments for equation in h-form dated 1990

```
EQUATION = HTD_ELH1990
INSTRUMENTS = Y_FLS1986 Y_FLS1987 Y_FLS1988 C

            ----------------------------------------------------------
            ==========================================================
```

■Parameters of interest (to be estimated)

```
PARAMETERS = G_FLS_LAG1 DTD1988 DTD1989 DTD1990 DTD1991

            ----------------------------------------------------------
```

==

◆The number of individuals (N) is 15000. At the 20th optimization trial (choice of starting values for the parameters to be estimated) in 100 trials, the two-step GMM criterion function where the weighting matrix is estimated by the two-step estimates is minimized. Accordingly, the GMM estimates for this trial are the best.

■Cross-sectional sample size.

```
                            Crosssectional size, N
                            ======================
CNOB =  15000.00000
```

■Number of trials (ntrial) and Best trial (try_opt)

```
                      Number of trials and Choicest trial
                      ===================================
                NTRIAL        TRY_OPT
Value        100.00000       20.00000
```

●Best one-step estimation results

■Starting values used in the optimization for obtaining the best one-step estimates

```
          Selected Starting values for the best 1-step estimates
          ==========================================================
G_FLS_LAG1_I_OPT1 = 0.55506
DTD1988_I_OPT1 =    1.53555
DTD1989_I_OPT1 =    -1.62214
DTD1990_I_OPT1 =    0.99469
DTD1991_I_OPT1 =    0.21615
```

■Convergence flag for the best one-step estimates: 1 if the estimates have converged; 0 otherwise

```
              Best 1-step estimates: converge (1) or not (0)
              ==============================================
IFCONV_OPT1 =   1.00000
```

■Best one-step GMM estimation result in the selected 20th optimization trial

```
                    <1-step estimation, best estimates>
```

```
                        ========================================
                              Standard
Parameter    Estimate           Error        t-statistic    P-value
G_FLS_LAG1  .561384         .040142        13.9849        [.000]
DTD1988     -1.45327        .030844        -47.1177       [.000]
DTD1989     .512670         .026878        19.0742        [.000]
DTD1990     -.463154        .026431        -17.5228       [.000]
DTD1991     .939882         .030920        30.3971        [.000]
```

■Wald test statistic whose null hypothesis is that the time dummies (DTD1988 - DTD1991) are jointly zero, for the best one-step estimation (with degree of freedom in parentheses)

```
                Wald test for jointly zero Time Dummies, 1-step
                ===============================================
CHISQ(4)  Test Statistic: 3147.808, Upper tail area: .00000
```

●Best two-step estimation results

■Starting values used in the optimization for obtaining the best two-step estimates (In this case, the one-step estimates are used for the starting values, since "ig2 = 1".)

```
          Selected starting values for the best 2-step estimates
          ==========================================================
G_FLS_LAG1_I_OPT2 = 0.56138
DTD1988_I_OPT2 =    -1.45327
DTD1989_I_OPT2 =    0.51267
DTD1990_I_OPT2 =    -0.46315
DTD1991_I_OPT2 =    0.93988
```

■Convergence flag for the best one-step estimates: 1 if the estimates have converged; 0 otherwise

```
              Best 2-step estimates: converge (1) or not (0)
              ==============================================
IFCONV_OPT2 =   1.00000
```

■Best two-step GMM estimation result in the selected 20th optimization trial

```
                    <2-step estimation, best estimates>
                    ===================================
```

Parameter	Estimate	Standard Error	t-statistic	P-value
G_FLS_LAG1	.581363	.028642	20.2978	[.000]
DTD1988	-1.46285	.028008	-52.2293	[.000]
DTD1989	.514506	.026043	19.7563	[.000]
DTD1990	-.461555	.025287	-18.2526	[.000]
DTD1991	.926353	.030204	30.6699	[.000]

■Wald test statistic whose null hypothesis is that the time dummies (DTD1988 - DTD1991) are jointly zero, for the best two-step estimation (with degree of freedom in parentheses)

```
                Wald test for jointly zero Time Dummies, 2-step
                ===============================================
CHISQ(4)  Test Statistic: 3779.349, Upper tail area: .00000
```

■Sargan test statistic where the weighting matrix is estimated by using the best one-step residuals (with degree of freedom in parentheses)

```
             Sargan test for the overidentification, wmat(1-step)
             ====================================================
CHISQ(13)  Test Statistic: 12.01511, Upper tail area: .52641
```

■Sargan test statistic where the weighting matrix is estimated by using the best two-step residuals (with degree of freedom in parentheses)

```
             Sargan test for the overidentification, wmat(2-step)
             ====================================================
CHISQ(13)  Test Statistic: 11.89734, Upper tail area: .53608
```

Exhibition 3.8.2

Contents of the output file "ghresb.txt"

■Only using g-form if "UFM = 1"; only using h-form if "UFM = 2"; using both g-form and h-form if "UFM = 3"

```
 UFM =    3.00000
```

■Cross-sectional size

```
 CNOB =   15000.00000
```

■Number of trials and Best trial

```
                                   NTRIAL_TRYOPT
                       1
        1       100.00000         ■Number of trials
        2        20.00000         ■Best trial
```

■Convergence flag for the best one-step estimates: 1 if the estimates are converged; 0 otherwise

```
IFCONV_OPT1 =    1.00000
```

■Best one-step GMM estimates

```
G_FLS_LAG1 =      0.56138
DTD1988 =    -1.45327
DTD1989 =    0.51267
DTD1990 =    -0.46315
DTD1991 =    0.93988
```

■Best one-step GMM estimates (left, Est.) and their standard errors (right, S.E.) given in the same order as the list of parameters (to be estimated) above

COEF_SES1

	1	2			
1	0.56138	0.040142	■G_FLS_LAG1	Est.	S.E.
2	-1.45327	0.030844	■DTD1988	Est.	S.E.
3	0.51267	0.026878	■DTD1989	Est.	S.E.
4	-0.46315	0.026431	■DTD1990	Est.	S.E.
5	0.93988	0.030920	■DTD1991	Est.	S.E.

■Wald test statistic whose null hypothesis is that the time dummies (DTD1988 - DTD1991) are jointly zero, for the best one-step estimation

WALDOTD_DF_PV1

	1	
1	3147.80833	■Wald test statistic
2	4.00000	■Degree of freedom
3	0.00000	■P-value

■Convergence flag for the best two-step estimates: 1 if the estimates are converged; 0 otherwise

IFCONV_OPT2 = 1.00000

■Best two-step GMM estimates

G_FLS_LAG1 = 0.58136

DTD1988 = -1.46285

DTD1989 = 0.51451

DTD1990 = -0.46156

DTD1991 = 0.92635

■Best two-step GMM estimates (left, Est.) and their standard errors (right, S.E.) given in the same order as the list of parameters (to be estimated) above

COEF_SES2

	1	2	
1	0.58136	0.028642	■G_FLS_LAG1 Est. S.E.
2	-1.46285	0.028008	■DTD1988 Est. S.E.
3	0.51451	0.026043	■DTD1989 Est. S.E.
4	-0.46156	0.025287	■DTD1990 Est. S.E.
5	0.92635	0.030204	■DTD1991 Est. S.E.

■Wald test statistic whose null hypothesis is that the time dummies (DTD1988 - DTD1991) are jointly zero, for the best two-step estimation

WALDOTD_DF_PV2

	1	
1	3779.34916	■Wald test statistic
2	4.00000	■Degree of freedom
3	0.00000	■P-value

■Sargan test statistic where the weighting matrix is estimated using the best one-step residuals

SARGANW1_DF_PV2

	1	
1	12.01511	■Sargan test statistic
2	13.00000	■Degree of freedom
3	0.52641	■P-value

■Sargan test statistic where the weighting matrix is estimated using the best two-step residuals

SARGANW2_DF_PV2

	1	
1	11.89734	■Sargan test statistic
2	13.00000	■Degree of freedom
3	0.53608	■P-value

Exhibition 3.8.3

Contents of the output file “ghsrtb.txt”

■Only using g-form if “UFM = 1”; only using h-form if “UFM = 2"; using both g-form and h-form if “UFM = 3"

```
UFM =    3.00000

NTRIAL =     100.00000  ■Number of trials
TRY_OPT =    20.00000   ■Best trial
```

■Randomly generated starting values used for obtaining the best one-step estimates

```
G_FLS_LAG1_I_OPT1 = 0.55506
DTD1988_I_OPT1 =    1.53555
DTD1989_I_OPT1 =    -1.62214
DTD1990_I_OPT1 =    0.99469
DTD1991_I_OPT1 =    0.21615
```

■Starting values used for obtaining the best two-step estimates; these are the best one-step estimates, since “ig2 = 1”

```
G_FLS_LAG1_I_OPT2 = 0.56138
DTD1988_I_OPT2 =    -1.45327
DTD1989_I_OPT2 =    0.51267
DTD1990_I_OPT2 =    -0.46315
DTD1991_I_OPT2 =    0.93988
```

4 Notes

The default setting of the memory size (in Mb) used by the TSP program “dfelrtnb.tsp” is 256. If the estimations are conducted using standard personal computers and reasonably large datasets, there will be no trouble. However, if old computers or exceedingly large datasets are used, we should revise the special input file “login.tsp”. For the former case, we should decrease the memory size within that of the personal computer. In the latter case, we should increase the allocated memory size, convert EXCEL worksheet file into CSV file after eliminating the headers, and write the adequate statements in the file “detrb.tsp” (see the manual “docum_ex2.pdf” and “detrb.tsp” in the folder “estim_ex2” for more information). For example, when we change the allocated memory size from 256 Mb to 128 Mb, we convert “memory = 256” into “memory = 128” in the statement starting from “options” in the file “login.tsp”.

References

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