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Root-N consistent estimations of time dummies for the dynamic fixed effects logit models: Monte Carlo illustrations

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Root-N consistent estimations of time dummies for the dynamic fixed effects logit models: Monte Carlo illustrations[*]

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Abstract

This paper illustrates the feasibility of the root-N consistent estimations of time dummies for both dynamic fixed effects logit models with strictly exogenous continuous explanatory variables and with no explanatory variable by using some Monte Carlo experiments. The illustrations not only imply the direct rebuttal to the generalization of Hahn's (2001) suggestion, but also pave the way for fathoming the time effects in dynamic binary choice panel data models in a breeze.

Keywords: dynamic fixed effects logit models; time dummies; root-N consistent GMM estimators; Monte Carlo

JEL classification: C23; C25

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1 Introduction

Kitazawa (2013) proposes the root-N consistent GMM (Generalized Method of Moments) estimators for the dynamic fixed effects logit model with strictly exogenous continuous explanatory variables. In addition, Kitazawa (2013) mentions the possibility of the root-N consistent estimations of time dummies when including them for this model, in his footnote. Now, in the field of binary choice panel data analysis, however, the dogma still seems to go unchallenged, in which the root-N consistent estimations of time dummies as well as other parameters of interest are impossible for the dynamic fixed effects logit models.

This paper presents the simple methods of root-N-consistently estimating the dynamic fixed effects logit models including time dummies. Then, illustrations by Monte Carlo experiments are conducted to verify the root-N consistent estimations. Two types of the models are considered: one is that with the strictly exogenous continuous explanatory variable, while another is that with no explanatory variable.

The illustrations for the latter model are the direct rebuttal to the generalization of Hahn's (2001) suggestion. In other word, although Hahn (2001) suggests that no root-N consistent estimation of the dynamic fixed effects logit model with time dummies is feasible, this suggestion is never generalized to the cases with four or more time periods, confined to the case where number of time periods is three and the initial condition is special.

The rest of the paper is organized as follows. Section 2 describes the models and estimation methods. Section 3 exhibits the Monte Carlo results. Finally, section 4 concludes.

2 Models and estimations

The dogma is as follows: If the dynamic fixed effects logit models includes time dummies, no root-N consistent estimation of the time dummies as well as other parameters of interest is feasible. The root-N consistent estimations of the time dummies are however possible on the basis of the moment conditions similar to those proposed by Kitazawa (2013).[1] Two cases are considered: those with strictly exogenous continuous explanatory variables and with no explanatory variables.

Throughout the paper, subscripts i and t denote the individual and the time period, respectively. It is assumed that number of individuals $N \rightarrow \infty$, while number of time periods T is fixed.

[1] The non-root-N consistent estimator proposed by Honoré and Kyriazidou (2000) cannot estimate the time dummies because it uses the kernel weight.

2.1 Case with strictly exogenous continuous explanatory variables

The dynamic fixed effects logit model including time dummies (TD_t for $2 \le t \le T$) with the strictly exogenous continuous explanatory variable is specified as follows:

$$y_{it} = \frac{\exp\left(\eta_i + TD_t + \gamma y_{i,t-1} + \beta x_{it}\right)}{1 + \exp\left(\eta_i + TD_t + \gamma y_{i,t-1} + \beta x_{it}\right)} + v_{it}\,, \qquad \text{for } 2 \le t \le T\,, \tag{2.1.1}$$

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, x_{it} is the strictly exogenous continuous explanatory variable for i at t, γ and β are parameters of interest, and the disturbance for i at t satisfies the following relationship with v_{i1} being empty , $v_i^{t-1} = (v_{i1}, \ldots, v_{i,t-1})$, and $x_i^T = (x_{i1}, \ldots, x_{iT})$:

$$\mathrm{E}[v_{it} \mid \eta_i, y_{i1}, v_i^{t-1}, x_i^T] = 0. \tag{2.1.2}$$

The right side first term of (2.1.1) is the probability with which y_{it} takes one.

The two types of conditional moment conditions are presented for this specification, which are similar to those proposed by Kitazawa (2013) for the model with strictly exogenous continuous explanatory variables and no time dummies: those based on g-form and h-form.[2]

Conditional moment conditions based on g-form

$$\mathrm{E}[\hbar U_{it}^{+} \mid \eta_i, y_{i1}, v_i^{t-2}, x_i^T] = 0, \qquad \text{for } 3 \le t \le T-1, \tag{2.1.3}$$

where

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

with

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

[2] The derivation methods of these moment conditions are almost the same as those shown in Kitazawa (2013) for the model without time dummies.

Conditional moment conditions based on h-form

$$\mathrm{E}[\hbar\Upsilon_{it}^{+} \mid \eta_i, y_{i1}, v_i^{t-2}, x_i^{T}] = 0, \qquad \text{for } 3 \le t \le T-1, \tag{2.1.4}$$

where

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

with

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

The operator Δ is the first-differencing operator such as $\Delta TD_t = TD_t - TD_{t-1}$ and $\Delta x_{it} = x_{it} - x_{i,t-1}$. The parameters to be estimated are γ, β, and ΔTD_t for $3 \le t \le T$ when number of time periods are T, for both of the moment conditions based on g-form (i.e. (2.1.3)) and those based on h-form (i.e. (2.1.4)).

Illustrations of both unconditional moment conditions based on g-form and based on h-form are shown in the first subsection of the next Monte Carlo section.

2.2 Case with no explanatory variable

The dynamic fixed effects logit model including time dummies (TD_t for $2 \le t \le T$) with no explanatory variable is specified as follows:

$$y_{it} = \frac{\exp\left(\eta_i + TD_t + \gamma\, y_{i,t-1}\right)}{1+\exp\left(\eta_i + TD_t + \gamma\, y_{i,t-1}\right)} + v_{it}, \qquad \text{for } 2 \le t \le T, \tag{2.2.1}$$

where the denotations are the same as those in previous subsection and the disturbance for i at t satisfies the following relationship:

$$\mathrm{E}[v_{it} \mid \eta_i, y_{i1}, v_i^{t-1}] = 0. \tag{2.2.2}$$

The right side first term of (2.2.1) is the probability with which y_{it} takes one.

The two types of conditional moment conditions are presented for this specification, which are similar to those proposed by Kitazawa (2013) for the model with strictly exogenous continuous explanatory variables and no time dummies: those based on g-form and h-form:[3]

Conditional moment conditions based on g-form

$$\mathrm{E}[\hbar U_{it}^{-} \mid \eta_i, y_{i1}, v_i^{t-2}] = 0, \qquad \text{for } 3 \le t \le T-1, \tag{2.2.3}$$

where

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

with

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

Conditional moment conditions based on h-form

$$\mathrm{E}[\hbar \Upsilon_{it}^{-} \mid \eta_i, y_{i1}, v_i^{t-2}] = 0, \qquad \text{for } 3 \le t \le T-1, \tag{2.2.4}$$

[3] In the same way as in previous subsection, the derivation methods of these moment conditions are almost the same as those shown in Kitazawa (2013) for the model without time dummies.

where

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

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 parameters to be estimated are γ and ΔTD_t for $3 \le t \le T$ when number of time periods are T, for both of the moment conditions based on g-form (i.e. (2.2.3)) and those based on h-form (i.e. (2.2.4)).

The joint use of the unconditional moment conditions constructed based on g-form and h-form enables the identification of the parameters for the case where number of time periods is four, implying that the root-N consistent estimations of time dummies are possible for four time periods. This contradicts the generalization of Hahn's (2001) suggestion in a straightforward manner.

Illustrations of both unconditional moment conditions based on g-form and based on h-form are shown in the second subsection of the next Monte Carlo section.

3 Monte Carlo

In this section, some Monte Carlo experiments are carried out for corroborating the root-N rate convergences of the estimators presented in previous section. In the estimations, the instruments are curtailed for the transformations, with the aim of enhancing the accuracy and precision of the estimators in small sample (see Bound et al., 1995, Staiger and Stock, 1997, and Mehrhoff, 2009, etc.).[4] The experiments are implemented by using the econometric software TSP version 5.1 (see Hall and Cummins, 2009).

[4] However, no dramatic improvement of the accuracy and precision seems to be found for the cases of the curtailed instruments, compared with those using the full set of valid dependent variables as the instruments for the transformations. Further, it is inferred that the GMM estimators using the curtailed instruments set are asymptotically less efficient than those using the full set, judging from the comparison of the former results with the latter ones when $N = 100,000$. See the Monte Carlo Results Supplement to this paper for the results of the latter cases, which is available at: http://www.ip.kyusan-u.ac.jp/J/kitazawa/CONF/kkkk2014/mcrs_rootndfeltd.pdf

3.1 Case with strictly exogenous explanatory variables

The DGP (Data Generating Process) is as follows:

$$y_{it}=\begin{cases}1 & \text{if } p(\eta_i, y_{i,t-1}, x_{it}, TD_t) > \zeta_{it} \\ 0 & \text{otherwise}\end{cases},$$

$$y_{i1}=\begin{cases}1 & \text{if } q(\eta_i, x_{i1}, TD_1) > \zeta_{i1} \\ 0 & \text{otherwise}\end{cases},$$

$$p(\eta_i, y_{i,t-1}, x_{it}, TD_t)=\exp(\eta_i+\gamma y_{i,t-1}+\beta x_{it}+TD_t)/(1+\exp(\eta_i+\gamma y_{i,t-1}+\beta x_{it}+TD_t)),$$

$$q(\eta_i, x_{i1}, TD_1)=\exp(\eta_i+\beta x_{i1}+TD_1)/(1+\exp(\eta_i+\beta x_{i1}+TD_1)),$$

$$x_{it}=\rho x_{i,t-1}+\tau\eta_i+\varepsilon_{it},$$

$$x_{i1}=(\tau/(1-\rho))\eta_i+(1/(1-\rho^2)^{1/2})\varepsilon_{i1},$$

$$\zeta_{it}\sim \mathrm{U}(0,1);\ \eta_i\sim \mathrm{N}(0,\sigma_\eta^2);\ \varepsilon_{it}\sim \mathrm{N}(0,\sigma_\varepsilon^2).$$

In the DGP, values are set to the time dummies TD_t for $t=1,\dots,T$ in addition to the parameters γ, β, ρ, τ, σ_η^2 and σ_ε^2. The experiments are carried out with cross-sectional sizes $N=1,000$, $10,000$ to $100,000$, numbers of time periods $T=4$ and 8, and number of replications $R_N=2,500$.

The GMM estimators to be investigated use the following unconditional moment conditions constructed from the conditional moment conditions based on g-form and h-form (i.e. (2.1.3) and (2.1.4)):

Unconditional moment conditions based on g-form

$\mathrm{E}[\hbar U_{it}^{+}]=0$,	for $3\le t\le T-1$,	(3.1.1)
$\mathrm{E}[y_{i,t-2}\,\hbar U_{it}^{+}]=0$,	for $3\le t\le T-1$,	(3.1.2)
$\mathrm{E}[\Delta x_{is}\,\hbar U_{it}^{+}]=0$,	for $t-1\le s\le t+1$; $3\le t\le T-1$.	(3.1.3)

Unconditional moment conditions based on h-form

$\mathrm{E}[\hbar \Upsilon_{it}^{+}]=0$,	for $3\le t\le T-1$,	(3.1.4)
$\mathrm{E}[y_{i,t-2}\,\hbar \Upsilon_{it}^{+}]=0$,	for $3\le t\le T-1$,	(3.1.5)
$\mathrm{E}[\Delta x_{is}\,\hbar \Upsilon_{it}^{+}]=0$,	for $t-1\le s\le t+1$; $3\le t\le T-1$.	(3.1.6)

The parameters configured in Simulations (A-a) and (A-b) are as follows and the data of y_{it} and x_{it} in Simulation (A-b) are persistent, compared with those in (A-a):

In Simulation (A-a)

$\gamma = 0.5$, $\beta = 0.5$, $\rho = 0.5$, $\tau = 0.1$, $\sigma_\eta^2 = 0.5$, $\sigma_\varepsilon^2 = 0.5$,

$TD_1 = 0.5$, $TD_2 = 1.0$, $TD_3 = -0.5$, $TD_4 = 0.0$, $TD_5 = -0.5$, $TD_6 = 0.5$, $TD_7 = 0.0$, $TD_8 = -1.0$.

In Simulation (A-b)

$\gamma = 1.1$, $\beta = 1.1$, $\rho = 0.9$, $\tau = 0.1$, $\sigma_\eta^2 = 0.5$, $\sigma_\varepsilon^2 = 0.5$,

$TD_1 = 0.5$, $TD_2 = 1.5$, $TD_3 = -0.5$, $TD_4 = 0.0$, $TD_5 = -1.5$, $TD_6 = 0.5$, $TD_7 = -1.0$, $TD_8 = -0.5$.

Tables 1 and 2 report the Monte Carlo results when $T = 4$ and 8 respectively for GMM(gh-HTD) estimator (i.e. the GMM estimator jointly using the moment conditions (3.1.1) − (3.1.3) based on g-form and (3.1.4) − (3.1.6) based on h-form). In addition, Tables 1g and 2g report those when $T = 4$ and 8 respectively for GMM(g-HTD) estimator (i.e. the GMM estimator only using the moment conditions (3.1.1) − (3.1.3) based on g-form), while Tables 1h and 2h report those when $T = 4$ and 8 respectively for GMM(h-HTD) estimator (i.e. the GMM estimator only using the moment conditions (3.1.4) − (3.1.6) based on h-form).

The bias and rmse (root mean squared error) sizes decrease as cross-sectional sample sizes increase from $N = 1{,}000$, $10{,}000$ to $100{,}000$, while Monte Carlo standard errors (mcse) make the better prediction of Monte Carlo standard deviations (mcsd) for the larger cross-sectional sizes. In addition, the convergence rate indicators of mcsd and rmse are less than or close to -0.5 in almost all cases.[5]

These results bear out the root-N consistency of GMM(gh-HTD), GMM(g-HTD), and GMM(h-HTD) estimators, implying that the root-N consistent estimations of time dummies are possible for the dynamic fixed effects logit model with strictly exogenous continuous explanatory variables, as long as four or more time periods are provided.

When comparing the cases with $T = 4$ and 8, the Monte Carlo statistics for each GMM estimator improve as number of time periods increases, which is due presumably to both of the increases of virtual sample sizes and desirable moment conditions. In addition, when comparing the simulations with the parameter settings being (A-a) and

[5] See Appendix A on the convergence rate indicators.

(A-b), the Monte Carlo statistics for each GMM estimator deteriorate as the data of y_{it} and x_{it} are more persistent, which is considered to reflect the weak instruments problem studied by Bound et al. (1995) and Staiger and Stock (1997).

Further, judging from the Monte Carlo results with $N = 100,000$, GMM(gh-HTD) estimator appears to be asymptotically most efficient among the three GMM estimators. This suggests that the efficiency gains in asymptotics by the joint usage of the moment conditions based on g-form and h-form are large, compared with those by the usage of either of the two types of the moment conditions.

2.2 Case without explanatory variables

The DGP is as follows:

$$y_{it} = \begin{cases} 1 & \text{if } p(\eta_i, y_{i,t-1}, TD_t) > \zeta_{it} \\ 0 & \text{otherwise} \end{cases},$$

$$y_{i1} = \begin{cases} 1 & \text{if } q(\eta_i, TD_t) > \zeta_{i1} \\ 0 & \text{otherwise} \end{cases},$$

$$p(\eta_i, y_{i,t-1}, TD_t) = \exp(\eta_i + \gamma y_{i,t-1} + TD_t) / (1 + \exp(\eta_i + \gamma y_{i,t-1} + TD_t)),$$

$$q(\eta_i, TD_1) = \exp(\eta_i + TD_1) / (1 + \exp(\eta_i + TD_1)),$$

$$\zeta_{it} \sim \mathrm{U}(0,1);\ \eta_i \sim \mathrm{N}(0, \sigma_\eta^2).$$

In the DGP, values are set to the time dummies TD_t for $t = 1, \ldots, T$ in addition to the parameters γ and σ_η^2. The experiments are carried out with cross-sectional sizes $N = 1{,}000$, $10{,}000$ to $100{,}000$, numbers of time periods $T = 4$ and 8, and number of replications $R_N = 2{,}500$.

The GMM estimators to be investigated use the following unconditional moment conditions constructed from the conditional moment conditions based on g-form and h-form (i.e. (2.2.3) and (2.2.4)):

Unconditional moment conditions based on g-form

$$\mathrm{E}[\hbar U_{it}^-] = 0, \qquad \text{for } 3 \le t \le T-1, \qquad (3.2.1)$$

$$\mathrm{E}[y_{i,t-2}\,\hbar U_{it}^-] = 0, \qquad \text{for } 3 \le t \le T-1, \qquad (3.2.2)$$

Unconditional moment conditions based on h-form

$$\mathrm{E}[\hbar \Upsilon_{it}^-] = 0, \qquad \text{for } 3 \le t \le T-1, \qquad (3.2.3)$$

$$\mathrm{E}[y_{i,t-2}\,\hbar \Upsilon_{it}^-] = 0, \qquad \text{for } 3 \le t \le T-1, \qquad (3.2.4)$$

The parameters configured in Simulations (B-a) and (B-b) are as follows and the data of y_{it} in Simulation (B-b) are persistent, compared with those in (B-a):

In Simulation (B-a)

$\gamma = 0.5$ $\sigma_\eta^2 = 0.5$,

$TD_1 = 0.5$, $TD_2 = 1.0$, $TD_3 = -0.5$, $TD_4 = 0.0$, $TD_5 = -0.5$, $TD_6 = 0.5$, $TD_7 = 0.0$, $TD_8 = -1.0$.

In Simulation (B-b)

$\gamma = 1.1$, $\sigma_\eta^2 = 0.5$,

$TD_1 = 0.5$, $TD_2 = 1.5$, $TD_3 = -0.5$, $TD_4 = 0.0$, $TD_5 = -1.5$, $TD_6 = 0.5$, $TD_7 = -1.0$, $TD_8 = -0.5$

Tables 3 and 4 report the Monte Carlo results when $T = 4$ and 8 respectively for GMM(gh-HTD) estimator (i.e. the GMM estimator jointly using the moment conditions (3.2.1) and (3.2.2) based on g-form and (3.2.3) and (3.2.4) based on h-form).

The bias and rmse sizes decrease as cross-sectional sample sizes increase from $N = 1{,}000$, $10{,}000$ to $100{,}000$, while Monte Carlo standard errors (mcse) make the better prediction of Monte Carlo standard deviations (mcsd) for the larger cross-sectional sizes. In addition, the convergence rate indicators of mcsd and rmse are less than or close to -0.5 in almost all cases.

These results bear out the root-N consistency of GMM(gh-HTD) estimator, implying that the root-N consistent estimations of time dummies are possible for the dynamic fixed effects logit model without explanatory variable, as long as four or more time periods are provided.

When comparing the cases with $T = 4$ and 8, the Monte Carlo statistics for GMM(gh-HTD) estimator improve as number of time periods increases, which is due presumably to both of the increases of virtual sample sizes and desirable moment conditions. In addition, when comparing the simulations with the parameter settings being (B-a) and (B-b), the Monte Carlo statistics for GMM(gh-HTD) estimator deteriorate as the data of y_{it} are more persistent, which is considered to reflect the weak instruments problem.

4 Conclusion

In this paper, some Monte Carlo results were exhibited for the GMM estimators concerning the two types of dynamic fixed effects logit models with time dummies: both of the models including strictly exogenous continuous explanatory variables and including no explanatory variable. The results illustrate that the first-differences of time dummies as well as the other parameters of interest are root-N consistently estimated for the dynamic fixed effects logit models, as long as number of time periods is four or more.

For our reference, the cases of excluding time dummies are exhibited in Appendix B. Although the simulations for these cases are conducted in Kitazawa (2013), the curtailed set of lagged dependent variables is used as the instruments for the transformation and the Monte Carlo results are also shown for the GMM estimator jointly using both moment conditions based on g-form and h-form.

Appendix A

The convergence rate indicators for the estimators based on mcsd, mcse and rmse are calculated after obtaining them in the experiments.

If the cross-sectional sample size N grows from m to n (i.e. $N = m \to n$), the convergence rate indicator based on mcsd is calculated as follows:

$$\mathrm{r(mcsd)} = \frac{\ln(\mathrm{mcsd}_m) - \ln(\mathrm{mcsd}_n)}{\ln(m) - \ln(n)},$$

where mcsd_m and mcsd_n are mcsd when the cross-sectional sample sizes are m and n, respectively. If the convergence rate is root-N, $\mathrm{r(mcsd)}$ indicates -0.5, while if it is faster than root-N, $\mathrm{r(mcsd)}$ is less than -0.5.

The convergence rate indicators based on mcse and rmse (i.e. $\mathrm{r(mcse)}$ and $\mathrm{r(rmse)}$) are also calculated in the same fashion.

Appendix B

The binary dependent variable y_{it} for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable x_{it} is specified as follows:

$$y_{it} = p(\eta_i, y_{i,t-1}, x_{it}) + v_{it}, \qquad \text{for } 2 \le t \le T, \tag{B.1}$$

$$\text{with } \mathrm{E}[v_{it} \mid \eta_i, y_{i1}, v_i^{t-1}, x_i^T] = 0, \tag{B.2}$$

where $p(\eta_i, y_{i,t-1}, x_{it}) = \exp(\eta_i + \gamma y_{i,t-1} + \beta x_{it}) / (1 + \exp(\eta_i + \gamma y_{i,t-1} + \beta x_{it}))$ (which is the probability with which y_{it} takes one) with η_i being the fixed effect and γ and β being the parameters of interest, y_{i1} is the initial value of the binary dependent variable, $v_i^{t-1} = (v_{i1}, \ldots, v_{i,t-1})$ with v_{i1} being empty, and $x_i^T = (x_{i1}, \ldots, x_{iT})$.

The two types of conditional moment conditions proposed by Kitazawa (2013) for this specification are as follows:

Conditional moment conditions based on g-form

$$\mathrm{E}[\hbar U_{it} \mid \eta_i, y_{i1}, v_i^{t-2}, x_i^T] = 0, \qquad \text{for } 3 \le t \le T-1, \tag{B.3}$$

where

$$\hbar U_{it} = U_{it} - y_{i,t-1} - \tanh\left(\frac{-\gamma y_{i,t-2} + \beta(\Delta x_{it} + \Delta x_{i,t+1})}{2}\right)(U_{it} + y_{i,t-1} - 2U_{it}\, y_{i,t-1})$$

with

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

Conditional moment conditions based on h-form

$$\mathrm{E}[\hbar \Upsilon_{it} \mid \eta_i, y_{i1}, v_i^{t-2}, x_i^T] = 0, \qquad \text{for } 3 \le t \le T-1, \tag{B.4}$$

where

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

with

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

The parameters to be estimated are γ and β when number of time period are T, which are estimated using both of the moment conditions based on g-form (i.e. (B.3)) and those based on h-form (i.e. (B.4)).

The Monte Carlo experiments for this model are conducted for the following DGP, moment conditions and parameter settings:

The DGP is as follows:

$$
y_{it} = \begin{cases} 1 & \text{if } p(\eta_i, y_{i,t-1}, x_{it}) > \zeta_{it} \\ 0 & \text{otherwise} \end{cases},
$$

$$
y_{i1} = \begin{cases} 1 & \text{if } q(\eta_i, x_{i1}) > \zeta_{i1} \\ 0 & \text{otherwise} \end{cases},
$$

$$
p(\eta_i, y_{i,t-1}, x_{it}) = \exp(\eta_i + \gamma y_{i,t-1} + \beta x_{it}) / (1 + \exp(\eta_i + \gamma y_{i,t-1} + \beta x_{it})),
$$

$$
q(\eta_i, x_{i1}) = 1/(1 + (1 + \exp(\eta_i + \beta x_{i1})) / (\exp(\eta_i + \beta x_{i1})(1 + \exp(\eta_i + \gamma + \beta x_{i1})))),
$$

$$
x_{it} = \rho x_{i,t-1} + \tau \eta_i + \varepsilon_{it},
$$

$$
x_{i1} = (\tau/(1-\rho))\eta_i + (1/(1-\rho^2)^{1/2})\varepsilon_{i1},
$$

$$
\zeta_{it} \sim \mathrm{U}(0,1);\ \eta_i \sim \mathrm{N}(0, \sigma_\eta^2);\ \varepsilon_{it} \sim \mathrm{N}(0, \sigma_\varepsilon^2).
$$

In the DGP, values are set to the parameters γ, β, ρ, τ, σ_η^2 and σ_ε^2. The experiments are carried out with cross-sectional sizes $N = 250$, 500, 750, 1000, 5000 and 10000, numbers of time periods $T = 4$ and 8, and number of replications $R_N = 2{,}500$.

The GMM estimators to be investigated use the following unconditional moment conditions constructed from the conditional moment conditions based on g-form and h-form (i.e. (B.3) and (B.4)):

Unconditional moment conditions based on g-form

$$\mathrm{E}[\hbar U_{it}] = 0, \quad \text{for } 3 \le t \le T-1, \tag{B.5}$$

$$\mathrm{E}[y_{i,t-2}\hbar U_{it}] = 0, \quad \text{for } 3 \le t \le T-1, \tag{B.6}$$

$$\mathrm{E}[\Delta x_{is}\hbar U_{it}] = 0, \quad \text{for } t-1 \le s \le t+1;\ 3 \le t \le T-1. \tag{B.7}$$

Unconditional moment conditions based on h-form

$$\mathrm{E}[\hbar\Upsilon_{it}]=0, \qquad \text{for } 3 \le t \le T-1, \qquad \text{(B.8)}$$
$$\mathrm{E}[y_{i,t-2}\,\hbar\Upsilon_{it}]=0, \qquad \text{for } 3 \le t \le T-1, \qquad \text{(B.9)}$$
$$\mathrm{E}[\Delta x_{is}\,\hbar\Upsilon_{it}]=0, \qquad \text{for } t-1 \le s \le t+1;\ 3 \le t \le T-1. \qquad \text{(B.10)}$$

The parameters configured in Simulations (C-a), (C-b) and (C-c) are as follows and the data of y_{it} and x_{it} are more persistent as the simulations change from (C-a), (C-b) to (C-c):

In Simulation (C-a)

$\gamma = 0.5$, $\beta = 0.5$, $\rho = 0.5$, $\tau = 0.1$, $\sigma_\eta^2 = 0.5$, $\sigma_\varepsilon^2 = 0.5$.

In Simulation (C-b)

$\gamma = 0.8$, $\beta = 0.8$, $\rho = 0.7$, $\tau = 0.1$, $\sigma_\eta^2 = 0.5$, $\sigma_\varepsilon^2 = 0.5$.

In Simulation (C-c)

$\gamma = 1.1$, $\beta = 1.1$, $\rho = 0.9$, $\tau = 0.1$, $\sigma_\eta^2 = 0.5$, $\sigma_\varepsilon^2 = 0.5$.

Tables Xa, Xb, Xc and Ya, Yb, Yc report the Monte Carlo results when $T = 4$ and 8 respectively for GMM(g-HTD) estimator (i.e. the GMM estimator only using the moment conditions (B.5) − (B.7) based on g-form), GMM(h-HTD) estimator (i.e. the GMM estimator only using (B.8) − (B.10) based on h-form), and GMM(gh-HTD) estimator (i.e. the GMM estimator jointly using the moment conditions (B.5) − (B.7) based on g-form and (B.8) − (B.10) based on h-form).

The bias and rmse sizes decrease as cross-sectional sample sizes increase from $N = 250$, 500, 750, $1{,}000$, $10{,}000$ to $100{,}000$, while Monte Carlo standard errors (mcse) make the better prediction of Monte Carlo standard deviations (mcsd) for the larger cross-sectional sizes. In addition, the convergence rate indicators of mcsd and rmse are less than or close to -0.5 in almost all cases for the larger cross-sectional sizes (i.e. $N = 1{,}000$, $10{,}000$ and $100{,}000$).

These results bear out the root-N consistency of GMM(g-HTD), GMM(h-HTD) and GMM(gh-HTD) estimators, implying that the root-N consistent estimations are possible for the dynamic fixed effects logit model with strictly exogenous continuous explanatory variables and no time dummy, as long as four or more time periods are provided.

When comparing the cases with $T = 4$ (i.e. Tables Xa, Xb, Xc) and 8 (i.e. Tables Ya, Yb, Yc), the Monte Carlo statistics for GMM(g-HTD), GMM(h-HTD) and GMM(gh-HTD) estimators improve as number of time periods increases, which is due presumably to both of the increases of virtual sample sizes and desirable moment conditions.

In addition, when comparing the simulations with the parameter settings being (C-a), (C-b) and (C-c), the Monte Carlo statistics in smaller cross-sectional sample sizes for GMM(g-HTD), GMM(h-HTD) and GMM(gh-HTD) estimators deteriorate as the data of y_{it} and x_{it} are more persistent, which is considered to reflect the weak instruments problem. It should be noted that when the data are more persistent and the cross-sectional sample size is smaller, the overidentifying restrictions are considered to be more prone to be rejected, looking at Monte Carlo mean of Sargan test statistics (Sargan).

Especially, when $N = 250$, the considerable downward bias of Monte Carlo mean (mcm) for γ is found for the GMM estimators when the data are more persistent, which is more pronounced for GMM(gh-HTD) estimator.

Further, judging from the Monte Carlo results with $N = 100{,}000$, GMM(gh-HTD) estimator appears to be asymptotically most efficient among the three GMM estimators. This suggests that the efficiency gains in asymptotics by the joint usage of the moment conditions based on g-form and h-form are large, compared with those by the usage of either of the two types of the moment conditions.

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Table 1. Monte Carlo results for the dynamic fixed effects logit model including time dummies with the strictly exogenous continuous explanatory variable, $T = 4$

	N=1,000			*N*=10,000			*N*=100,000	
	true	**mcm**		**true**	**mcm**		**true**	**mcm**
	mcsd	mcse		mcsd	mcse		mcsd	mcse
	bias	rmse		bias	rmse		bias	rmse
Simulation(A-a)								
GMM(gh-HTD) γ	**0.500**	**0.321**		**0.500**	**0.482**		**0.500**	**0.499**
	0.259	0.234		0.076	0.074		0.023	0.023
	-0.179	0.315		-0.018	0.078		-0.001	0.023
β	**0.500**	**0.405**		**0.500**	**0.503**		**0.500**	**0.500**
	0.191	0.117		0.044	0.041		0.014	0.013
	-0.095	0.214		0.003	0.045		0.000	0.014
ΔTD3	**-1.500**	**-1.568**		**-1.500**	**-1.505**		**-1.500**	**-1.500**
	0.143	0.133		0.040	0.039		0.012	0.012
	-0.068	0.159		-0.005	0.040		0.000	0.012
ΔTD4	**0.500**	**0.206**		**0.500**	**0.485**		**0.500**	**0.498**
	0.280	0.135		0.072	0.056		0.018	0.018
	-0.294	0.406		-0.015	0.073		-0.002	0.018
Sargan, df	**5.864**	**6**		**6.166**	**6**		**5.988**	**6**
Simulation(A-b)								
GMM(gh-HTD) γ	**1.100**	**0.592**		**1.100**	**1.052**		**1.100**	**1.097**
	0.542	0.432		0.152	0.141		0.045	0.045
	-0.508	0.743		-0.048	0.159		-0.003	0.045
β	**1.100**	**0.924**		**1.100**	**1.111**		**1.100**	**1.101**
	0.365	0.215		0.089	0.081		0.027	0.027
	-0.176	0.405		0.011	0.090		0.001	0.027
ΔTD3	**-2.000**	**-2.139**		**-2.000**	**-2.008**		**-2.000**	**-2.001**
	0.333	0.249		0.066	0.064		0.020	0.020
	-0.139	0.361		-0.008	0.066		-0.001	0.020
ΔTD4	**0.500**	**0.122**		**0.500**	**0.472**		**0.500**	**0.498**
	0.451	0.197		0.135	0.100		0.033	0.033
	-0.378	0.588		-0.028	0.138		-0.002	0.033
Sargan, df	**8.156**	**6**		**6.740**	**6**		**6.060**	**6**

Notes: 1) Inappropriate replications (i.e. non-convergence replications) are eliminated in calculating the statistics. Their number is small for each GMM estimator in each parameter setting. 2) In each of the GMM estimations, the initial consistent estimate is obtained by using the inverse of cross-sectional average of the SSCP matrix of the instruments matrix as the non-optimal weighting matrix, where the components of the moment conditions used are decomposed into the products of the transformations and the instruments. 3) The values of the Monte Carlo statistics (Monte Carlo mean [mcm], Monte Catlo standard deviation [mcsd], Monte Carlo standard error [mcse], bias [bias] and root mean squared error [rmse] for each of the parameters of interest and Monte Carlo mean of Sargan test statistics of overidentifying restrictions [Sargan] with degree of freedom being [df]) are obtained using the true values of the parameters of interest [true] as the starting values in the optimization for each replication. The values of the statistics obtained using the true values are almost the same as those obtained using two different types of the starting values, especially in larger cross-sectional sizes. 4) The denotations ΔTD3,…,ΔTD8 denote the parameters of interest $\Delta TD_3, \ldots \Delta TD_8$.

Table 1. Monte Carlo results for the dynamic fixed effects logit model including time dummies with the strictly exogenous continuous explanatory variable, $T = 4$ (Convergence Rate Indicators)

	N=1,000->10,000			*N*=10,000->100,000			*N*=1,000->100,000	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(A-a)								
GMM(gh-HTD) γ								
	-0.53	-0.50		-0.51	-0.50		-0.52	-0.50
		-0.61			-0.53			-0.57
β								
	-0.63	-0.46		-0.52	-0.49		-0.57	-0.47
		-0.68			-0.52			-0.60
ΔTD3								
	-0.56	-0.53		-0.51	-0.50		-0.54	-0.52
		-0.60			-0.52			-0.56
ΔTD4								
	-0.59	-0.38		-0.59	-0.50		-0.59	-0.44
		-0.74			-0.60			-0.67
Simulation(A-b)								
GMM(gh-HTD) γ								
	-0.55	-0.49		-0.53	-0.50		-0.54	-0.49
		-0.67			-0.55			-0.61
β								
	-0.61	-0.42		-0.52	-0.48		-0.57	-0.45
		-0.65			-0.53			-0.59
ΔTD3								
	-0.71	-0.59		-0.51	-0.50		-0.61	-0.55
		-0.74			-0.52			-0.63
ΔTD4								
	-0.52	-0.29		-0.61	-0.48		-0.57	-0.39
		-0.63			-0.62			-0.63

Notes: 4) See Appendix A on the convergence rate indicators: r(mcsd), r(mcse) and r(rmse).

Table 1g. Monte Carlo results for the dynamic fixed effects logit model including time dummies with the strictly exogenous continuous explanatory variable, $T = 4$

	N=1,000			*N*=10,000			*N*=100,000	
	true	**mcm**		**true**	**mcm**		**true**	**mcm**
	mcsd	mcse		mcsd	mcse		mcsd	mcse
	bias	rmse		bias	rmse		bias	rmse
Simulation(A-a)								
GMM(g-HTD) γ	**0.500**	**0.464**		**0.500**	**0.496**		**0.500**	**0.500**
	0.357	0.650		0.077	0.080		0.024	0.025
	−0.036	0.359		−0.004	0.078		0.000	0.024
β	**0.500**	**0.528**		**0.500**	**0.502**		**0.500**	**0.500**
	0.165	0.175		0.048	0.048		0.015	0.015
	0.028	0.167		0.002	0.048		0.000	0.015
ΔTD3	**−1.500**	**−1.783**		**−1.500**	**−1.526**		**−1.500**	**−1.502**
	0.467	1.164		0.067	0.066		0.016	0.017
	−0.283	0.546		−0.026	0.071		−0.002	0.016
ΔTD4	**0.500**	**0.628**		**0.500**	**0.517**		**0.500**	**0.499**
	0.808	1.197		0.231	0.226		0.066	0.068
	0.128	0.818		0.017	0.232		−0.001	0.066
Sargan, df	**0.777**	1		**0.959**	1		**0.991**	1
Simulation(A-b)								
GMM(g-HTD) γ	**1.100**	**1.049**		**1.100**	**1.096**		**1.100**	**1.101**
	0.693	0.874		0.148	0.152		0.046	0.047
	−0.051	0.695		−0.004	0.149		0.001	0.046
β	**1.100**	**1.223**		**1.100**	**1.108**		**1.100**	**1.101**
	0.627	0.485		0.099	0.098		0.030	0.030
	0.123	0.639		0.008	0.099		0.001	0.030
ΔTD3	**−2.000**	**−2.408**		**−2.000**	**−2.027**		**−2.000**	**−2.003**
	0.850	1.056		0.087	0.089		0.026	0.026
	−0.408	0.943		−0.027	0.091		−0.003	0.026
ΔTD4	**0.500**	**0.704**		**0.500**	**0.508**		**0.500**	**0.501**
	0.915	1.043		0.217	0.209		0.065	0.065
	0.204	0.937		0.008	0.218		0.001	0.065
Sargan, df	**0.842**	1		**0.914**	1		**1.005**	1

Notes: See Notes in Table 1.

Table 1g. Monte Carlo results for the dynamic fixed effects logit model including time dummies with the strictly exogenous continuous explanatory variable, $T = 4$
(Convergence Rate Indicators)

	N=1,000->10,000			*N*=10,000->100,000			*N*=1,000->100,000	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(A-a)								
GMM(g-HTD) γ								
	-0.66	-0.91		-0.50	-0.51		-0.58	-0.71
		-0.67			-0.50			-0.58
β								
	-0.53	-0.56		-0.50	-0.51		-0.52	-0.53
		-0.54			-0.50			-0.52
ΔTD3								
	-0.85	-1.25		-0.62	-0.60		-0.73	-0.92
		-0.88			-0.65			-0.76
ΔTD4								
	-0.54	-0.72		-0.54	-0.52		-0.54	-0.62
		-0.55			-0.54			-0.55
Simulation(A-b)								
GMM(g-HTD) γ								
	-0.67	-0.76		-0.51	-0.51		-0.59	-0.63
		-0.67			-0.51			-0.59
β								
	-0.80	-0.69		-0.52	-0.51		-0.66	-0.60
		-0.81			-0.52			-0.66
ΔTD3								
	-0.99	-1.07		-0.53	-0.53		-0.76	-0.80
		-1.02			-0.54			-0.78
ΔTD4								
	-0.62	-0.70		-0.52	-0.50		-0.57	-0.60
		-0.63			-0.52			-0.58

Notes: See Notes in Table 1.

Table 1h. Monte Carlo results for the dynamic fixed effects logit model including time dummies with the strictly exogenous continuous explanatory variable, $T = 4$

	N=1,000			*N*=10,000			*N*=100,000	
	true	**mcm**		**true**	**mcm**		**true**	**mcm**
	mcsd	mcse		mcsd	mcse		mcsd	mcse
	bias	rmse		bias	rmse		bias	rmse
Simulation(A-a)								
GMM(h-HTD) γ	**0.500**	**0.388**		**0.500**	**0.480**		**0.500**	**0.499**
	0.450	0.540		0.143	0.137		0.036	0.037
	-0.112	0.463		-0.020	0.144		-0.001	0.036
β	**0.500**	**0.573**		**0.500**	**0.507**		**0.500**	**0.501**
	0.225	0.227		0.065	0.064		0.020	0.020
	0.073	0.237		0.007	0.065		0.001	0.020
ΔTD3	**-1.500**	**-1.283**		**-1.500**	**-1.465**		**-1.500**	**-1.497**
	0.459	1.421		0.162	0.131		0.032	0.032
	0.217	0.508		0.035	0.166		0.003	0.032
ΔTD4	**0.500**	**-0.007**		**0.500**	**0.446**		**0.500**	**0.498**
	0.915	1.695		0.287	0.256		0.076	0.076
	-0.507	1.046		-0.054	0.292		-0.002	0.076
Sargan, df	**0.635**	1		**1.021**	1		**0.972**	1
Simulation(A-b)								
GMM(h-HTD) γ	**1.100**	**0.677**		**1.100**	**1.020**		**1.100**	**1.093**
	1.340	1.416		0.379	0.316		0.088	0.090
	-0.423	1.405		-0.080	0.388		-0.007	0.089
β	**1.100**	**1.422**		**1.100**	**1.152**		**1.100**	**1.104**
	1.075	0.993		0.276	0.167		0.050	0.049
	0.322	1.122		0.052	0.281		0.004	0.050
ΔTD3	**-2.000**	**-1.679**		**-2.000**	**-1.963**		**-2.000**	**-1.998**
	0.949	1.453		0.242	0.192		0.048	0.047
	0.321	1.002		0.037	0.245		0.002	0.048
ΔTD4	**0.500**	**-0.407**		**0.500**	**0.370**		**0.500**	**0.492**
	1.539	1.758		0.537	0.360		0.097	0.094
	-0.907	1.787		-0.130	0.552		-0.008	0.098
Sargan, df	**0.752**	1		**1.029**	1		**0.999**	1

Notes: See Notes in Table 1.

Table 1h. Monte Carlo results for the dynamic fixed effects logit model including time dummies with the strictly exogenous continuous explanatory variable, $T = 4$ (Convergence Rate Indicators)

	N=1,000->10,000			*N*=10,000->100,000			*N*=1,000->100,000	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(A-a)								
GMM(h-HTD) γ								
	-0.50	-0.59		-0.59	-0.58		-0.55	-0.58
		-0.51			-0.60			-0.55
β								
	-0.54	-0.55		-0.50	-0.50		-0.52	-0.53
		-0.56			-0.50			-0.53
ΔTD3								
	-0.45	-1.03		-0.71	-0.61		-0.58	-0.82
		-0.49			-0.72			-0.60
ΔTD4								
	-0.50	-0.82		-0.58	-0.53		-0.54	-0.67
		-0.55			-0.59			-0.57
Simulation(A-b)								
GMM(h-HTD) γ								
	-0.55	-0.65		-0.63	-0.55		-0.59	-0.60
		-0.56			-0.64			-0.60
β								
	-0.59	-0.77		-0.74	-0.54		-0.67	-0.65
		-0.60			-0.75			-0.67
ΔTD3								
	-0.59	-0.88		-0.70	-0.61		-0.65	-0.74
		-0.61			-0.71			-0.66
ΔTD4								
	-0.46	-0.69		-0.74	-0.58		-0.60	-0.64
		-0.51			-0.75			-0.63

Notes: See Notes in Table 1.

Table 2. Monte Carlo results for the dynamic fixed effects logit model including time dummies with the strictly exogenous continuous explanatory variable, $T = 8$

	N=1,000		*N*=10,000		*N*=100,000	
	true	**mcm**	**true**	**mcm**	**true**	**mcm**
	mcsd	mcse	mcsd	mcse	mcsd	mcse
	bias	rmse	bias	rmse	bias	rmse
Simulation(A-a)						
GMM(gh-HTD) γ	**0.500**	**0.391**	**0.500**	**0.490**	**0.500**	**0.499**
	0.111	0.082	0.031	0.030	0.009	0.009
	−0.109	0.156	−0.010	0.033	−0.001	0.009
β	**0.500**	**0.456**	**0.500**	**0.496**	**0.500**	**0.500**
	0.069	0.046	0.017	0.017	0.005	0.005
	−0.044	0.082	−0.004	0.018	0.000	0.005
ΔTD3	**−1.500**	**−1.516**	**−1.500**	**−1.501**	**−1.500**	**−1.501**
	0.125	0.110	0.037	0.036	0.012	0.011
	−0.016	0.126	−0.001	0.037	−0.001	0.012
ΔTD4	**0.500**	**0.427**	**0.500**	**0.492**	**0.500**	**0.499**
	0.115	0.083	0.033	0.032	0.010	0.010
	−0.073	0.136	−0.008	0.034	−0.001	0.010
ΔTD5	**−0.500**	**−0.438**	**−0.500**	**−0.492**	**−0.500**	**−0.499**
	0.113	0.083	0.033	0.032	0.010	0.010
	0.062	0.129	0.008	0.034	0.001	0.010
ΔTD6	**1.000**	**0.963**	**1.000**	**0.996**	**1.000**	**1.000**
	0.119	0.088	0.035	0.033	0.011	0.011
	−0.037	0.125	−0.004	0.035	0.000	0.011
ΔTD7	**−0.500**	**−0.479**	**−0.500**	**−0.499**	**−0.500**	**−0.500**
	0.146	0.084	0.038	0.036	0.012	0.012
	0.021	0.147	0.001	0.038	0.000	0.012
ΔTD8	**−1.000**	**−0.812**	**−1.000**	**−0.998**	**−1.000**	**−1.000**
	0.383	0.102	0.044	0.042	0.014	0.014
	0.188	0.427	0.002	0.044	0.000	0.014
Sargan, df	**51.316**	**42**	**43.213**	**42**	**42.359**	**42**
Simulation(A-b)						
GMM(gh-HTD) γ	**1.100**	**0.677**	**1.100**	**1.079**	**1.100**	**1.098**
	0.284	0.126	0.052	0.050	0.016	0.016
	−0.423	0.509	−0.021	0.057	−0.002	0.016
β	**1.100**	**1.076**	**1.100**	**1.102**	**1.100**	**1.100**
	0.133	0.072	0.029	0.028	0.009	0.009
	−0.024	0.135	0.002	0.029	0.000	0.009
ΔTD3	**−2.000**	**−2.040**	**−2.000**	**−2.001**	**−2.000**	**−2.000**
	0.243	0.164	0.056	0.055	0.018	0.018
	−0.040	0.247	−0.001	0.056	0.000	0.018
ΔTD4	**0.500**	**0.274**	**0.500**	**0.488**	**0.500**	**0.498**
	0.221	0.110	0.049	0.046	0.015	0.015
	−0.226	0.316	−0.012	0.051	−0.002	0.015
ΔTD5	**−1.500**	**−1.443**	**−1.500**	**−1.494**	**−1.500**	**−1.498**
	0.210	0.124	0.050	0.047	0.015	0.015
	0.057	0.218	0.006	0.050	0.002	0.016
ΔTD6	**2.000**	**1.878**	**2.000**	**1.993**	**2.000**	**1.999**
	0.231	0.123	0.053	0.049	0.016	0.016
	−0.122	0.261	−0.007	0.053	−0.001	0.016
ΔTD7	**−1.500**	**−1.305**	**−1.500**	**−1.491**	**−1.500**	**−1.499**
	0.254	0.116	0.051	0.048	0.016	0.016
	0.195	0.320	0.009	0.052	0.001	0.016
ΔTD8	**0.500**	**0.166**	**0.500**	**0.492**	**0.500**	**0.500**
	0.438	0.141	0.103	0.079	0.027	0.027
	−0.334	0.551	−0.008	0.103	0.000	0.027
Sargan, df	**94.012**	**42**	**50.423**	**42**	**43.407**	**42**

Notes: See Notes in Table 1.

Table 2. Monte Carlo results for the dynamic fixed effects logit model including time dummies with the strictly exogenous continuous explanatory variable, $T = 8$ (Convergence Rate Indicators)

	N=1,000->10,000			*N*=10,000->100,000			*N*=1,000->100,000	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(A-a)								
GMM(gh-HTD) γ								
	−0.56	−0.44		−0.52	−0.49		−0.54	−0.47
		−0.68			−0.54			−0.61
β								
	−0.60	−0.44		−0.50	−0.49		−0.55	−0.47
		−0.66			−0.51			−0.59
ΔTD3								
	−0.53	−0.48		−0.51	−0.50		−0.52	−0.49
		−0.53			−0.51			−0.52
ΔTD4								
	−0.54	−0.41		−0.50	−0.49		−0.52	−0.45
		−0.60			−0.52			−0.56
ΔTD5								
	−0.54	−0.42		−0.51	−0.49		−0.52	−0.46
		−0.58			−0.52			−0.55
ΔTD6								
	−0.54	−0.42		−0.52	−0.49		−0.53	−0.46
		−0.55			−0.52			−0.54
ΔTD7								
	−0.58	−0.37		−0.51	−0.49		−0.55	−0.43
		−0.58			−0.51			−0.55
ΔTD8								
	−0.94	−0.39		−0.50	−0.49		−0.72	−0.44
		−0.99			−0.50			−0.75
Simulation(A-b)								
GMM(gh-HTD) γ								
	−0.73	−0.40		−0.51	−0.49		−0.62	−0.45
		−0.95			−0.54			−0.75
β								
	−0.67	−0.41		−0.50	−0.49		−0.58	−0.45
		−0.67			−0.50			−0.58
ΔTD3								
	−0.64	−0.47		−0.49	−0.49		−0.57	−0.48
		−0.64			−0.49			−0.57
ΔTD4								
	−0.65	−0.38		−0.51	−0.49		−0.58	−0.43
		−0.79			−0.53			−0.66
ΔTD5								
	−0.63	−0.42		−0.51	−0.49		−0.57	−0.45
		−0.64			−0.51			−0.57
ΔTD6								
	−0.64	−0.40		−0.53	−0.49		−0.58	−0.44
		−0.69			−0.53			−0.61
ΔTD7								
	−0.70	−0.38		−0.52	−0.49		−0.61	−0.43
		−0.79			−0.52			−0.66
ΔTD8								
	−0.63	−0.25		−0.58	−0.47		−0.60	−0.36
		−0.73			−0.58			−0.65

Notes: See Notes in Table 1.

Table 2g. Monte Carlo results for the dynamic fixed effects logit model including time dummies with the strictly exogenous continuous explanatory variable, $T = 8$

	N=1,000		*N*=10,000		*N*=100,000	
	true	**mcm**	**true**	**mcm**	**true**	**mcm**
	mcsd	mcse	mcsd	mcse	mcsd	mcse
	bias	rmse	bias	rmse	bias	rmse
Simulation(A-a)						
GMM(g-HTD) γ	**0.500**	**0.462**	**0.500**	**0.496**	**0.500**	**0.500**
	0.124	0.117	0.040	0.039	0.012	0.013
	−0.038	0.130	−0.004	0.040	0.000	0.012
β	**0.500**	**0.510**	**0.500**	**0.503**	**0.500**	**0.500**
	0.069	0.066	0.022	0.022	0.007	0.007
	0.010	0.070	0.003	0.022	0.000	0.007
ΔTD3	**−1.500**	**−1.533**	**−1.500**	**−1.504**	**−1.500**	**−1.501**
	0.122	0.117	0.038	0.037	0.012	0.012
	−0.033	0.127	−0.004	0.038	−0.001	0.012
ΔTD4	**0.500**	**0.488**	**0.500**	**0.498**	**0.500**	**0.500**
	0.121	0.113	0.037	0.037	0.012	0.012
	−0.012	0.121	−0.002	0.037	0.000	0.012
ΔTD5	**−0.500**	**−0.488**	**−0.500**	**−0.501**	**−0.500**	**−0.500**
	0.108	0.103	0.034	0.035	0.011	0.011
	0.012	0.109	−0.001	0.034	0.000	0.011
ΔTD6	**1.000**	**1.002**	**1.000**	**1.006**	**1.000**	**1.001**
	0.153	0.135	0.052	0.050	0.017	0.017
	0.002	0.153	0.006	0.052	0.001	0.017
ΔTD7	**−0.500**	**−0.453**	**−0.500**	**−0.462**	**−0.500**	**−0.495**
	0.224	0.203	0.116	0.104	0.042	0.040
	0.047	0.229	0.038	0.122	0.005	0.042
ΔTD8	**−1.000**	**−0.337**	**−1.000**	**−0.888**	**−1.000**	**−0.990**
	0.513	0.500	0.189	0.174	0.053	0.052
	0.663	0.838	0.112	0.219	0.010	0.054
Sargan, df	**19.083**	**17**	**17.371**	**17**	**17.415**	**17**
Simulation(A-b)						
GMM(g-HTD) γ	**1.100**	**0.952**	**1.100**	**1.094**	**1.100**	**1.100**
	0.263	0.194	0.070	0.068	0.022	0.022
	−0.148	0.302	−0.006	0.070	0.000	0.022
β	**1.100**	**1.059**	**1.100**	**1.096**	**1.100**	**1.099**
	0.142	0.110	0.043	0.041	0.013	0.013
	−0.041	0.148	−0.004	0.043	−0.001	0.013
ΔTD3	**−2.000**	**−2.090**	**−2.000**	**−2.006**	**−2.000**	**−2.001**
	0.256	0.226	0.060	0.061	0.020	0.019
	−0.090	0.271	−0.006	0.060	−0.001	0.020
ΔTD4	**0.500**	**0.503**	**0.500**	**0.499**	**0.500**	**0.498**
	0.389	0.251	0.100	0.093	0.031	0.031
	0.003	0.389	−0.001	0.100	−0.002	0.031
ΔTD5	**−1.500**	**−1.488**	**−1.500**	**−1.492**	**−1.500**	**−1.498**
	0.255	0.156	0.062	0.059	0.019	0.019
	0.012	0.256	0.008	0.062	0.002	0.019
ΔTD6	**2.000**	**2.009**	**2.000**	**1.988**	**2.000**	**1.998**
	0.384	0.217	0.088	0.083	0.026	0.027
	0.009	0.384	−0.012	0.089	−0.002	0.027
ΔTD7	**−1.500**	**−1.452**	**−1.500**	**−1.505**	**−1.500**	**−1.500**
	0.267	0.165	0.062	0.061	0.019	0.019
	0.048	0.272	−0.005	0.062	0.000	0.019
ΔTD8	**0.500**	**0.488**	**0.500**	**0.502**	**0.500**	**0.498**
	0.455	0.400	0.177	0.166	0.057	0.055
	−0.012	0.455	0.002	0.177	−0.002	0.057
Sargan, df	**34.192**	**17**	**19.520**	**17**	**17.601**	**17**

Notes: See Notes in Table 1.

Table 2g. Monte Carlo results for the dynamic fixed effects logit model including time dummies with the strictly exogenous continuous explanatory variable, $T = 8$ (Convergence Rate Indicators)

	N=1,000->10,000			*N*=10,000->100,000			*N*=1,000->100,000	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(A-a)								
GMM(g-HTD) γ								
	-0.50	-0.47		-0.52	-0.50		-0.51	-0.49
		-0.51			-0.52			-0.51
β								
	-0.49	-0.47		-0.50	-0.50		-0.50	-0.49
		-0.50			-0.50			-0.50
ΔTD3								
	-0.51	-0.50		-0.50	-0.50		-0.51	-0.50
		-0.52			-0.50			-0.51
ΔTD4								
	-0.52	-0.49		-0.50	-0.50		-0.51	-0.49
		-0.52			-0.50			-0.51
ΔTD5								
	-0.50	-0.47		-0.49	-0.49		-0.49	-0.48
		-0.50			-0.49			-0.50
ΔTD6								
	-0.47	-0.43		-0.48	-0.47		-0.48	-0.45
		-0.47			-0.49			-0.48
ΔTD7								
	-0.29	-0.29		-0.44	-0.41		-0.36	-0.35
		-0.27			-0.46			-0.37
ΔTD8								
	-0.43	-0.46		-0.55	-0.53		-0.49	-0.49
		-0.58			-0.61			-0.60
Simulation(A-b)								
GMM(g-HTD) γ								
	-0.58	-0.46		-0.51	-0.49		-0.54	-0.48
		-0.64			-0.51			-0.57
β								
	-0.52	-0.42		-0.50	-0.49		-0.51	-0.46
		-0.54			-0.51			-0.52
ΔTD3								
	-0.63	-0.57		-0.49	-0.50		-0.56	-0.53
		-0.65			-0.49			-0.57
ΔTD4								
	-0.59	-0.43		-0.50	-0.48		-0.55	-0.46
		-0.59			-0.50			-0.55
ΔTD5								
	-0.62	-0.42		-0.51	-0.49		-0.56	-0.46
		-0.61			-0.51			-0.56
ΔTD6								
	-0.64	-0.42		-0.52	-0.49		-0.58	-0.46
		-0.63			-0.53			-0.58
ΔTD7								
	-0.64	-0.43		-0.50	-0.50		-0.57	-0.47
		-0.64			-0.50			-0.57
ΔTD8								
	-0.41	-0.38		-0.49	-0.48		-0.45	-0.43
		-0.41			-0.49			-0.45

Notes: See Notes in Table 1.

Table 2h. Monte Carlo results for the dynamic fixed effects logit model including time dummies with the strictly exogenous continuous explanatory variable, $T = 8$

	N=1,000		*N*=10,000		*N*=100,000	
	true	**mcm**	**true**	**mcm**	**true**	**mcm**
	mcsd	mcse	mcsd	mcse	mcsd	mcse
	bias	rmse	bias	rmse	bias	rmse
Simulation(A–a)						
GMM(h–HTD) γ	**0.500**	**0.444**	**0.500**	**0.494**	**0.500**	**0.500**
	0.130	0.118	0.039	0.038	0.012	0.012
	−0.056	0.142	−0.006	0.039	0.000	0.012
β	**0.500**	**0.497**	**0.500**	**0.500**	**0.500**	**0.500**
	0.069	0.064	0.021	0.021	0.007	0.007
	−0.003	0.069	0.000	0.021	0.000	0.007
ΔTD3	**−1.500**	**−1.521**	**−1.500**	**−1.502**	**−1.500**	**−1.501**
	0.132	0.121	0.040	0.039	0.012	0.012
	−0.021	0.134	−0.002	0.040	−0.001	0.012
ΔTD4	**0.500**	**0.480**	**0.500**	**0.498**	**0.500**	**0.500**
	0.113	0.104	0.034	0.034	0.011	0.011
	−0.020	0.115	−0.002	0.034	0.000	0.011
ΔTD5	**−0.500**	**−0.487**	**−0.500**	**−0.500**	**−0.500**	**−0.500**
	0.148	0.130	0.040	0.040	0.013	0.013
	0.013	0.149	0.000	0.040	0.000	0.013
ΔTD6	**1.000**	**1.003**	**1.000**	**0.998**	**1.000**	**1.000**
	0.117	0.110	0.035	0.034	0.011	0.011
	0.003	0.117	−0.002	0.035	0.000	0.011
ΔTD7	**−0.500**	**−0.343**	**−0.500**	**−0.480**	**−0.500**	**−0.498**
	0.210	0.217	0.066	0.064	0.021	0.020
	0.157	0.262	0.020	0.069	0.002	0.021
ΔTD8	**−1.000**	**−1.315**	**−1.000**	**−1.031**	**−1.000**	**−1.004**
	0.551	0.484	0.216	0.204	0.068	0.067
	−0.315	0.634	−0.031	0.218	−0.004	0.068
Sargan, df	**19.480**	**17**	**17.479**	**17**	**17.340**	**17**
Simulation(A–b)						
GMM(h–HTD) γ	**1.100**	**0.715**	**1.100**	**1.075**	**1.100**	**1.098**
	0.332	0.210	0.078	0.075	0.025	0.024
	−0.385	0.508	−0.025	0.082	−0.002	0.025
β	**1.100**	**1.094**	**1.100**	**1.102**	**1.100**	**1.100**
	0.155	0.109	0.043	0.041	0.013	0.013
	−0.006	0.155	0.002	0.043	0.000	0.013
ΔTD3	**−2.000**	**−2.028**	**−2.000**	**−2.003**	**−2.000**	**−2.001**
	0.379	0.227	0.074	0.070	0.023	0.023
	−0.028	0.380	−0.003	0.074	−0.001	0.023
ΔTD4	**0.500**	**0.528**	**0.500**	**0.495**	**0.500**	**0.499**
	0.298	0.166	0.064	0.059	0.019	0.019
	0.028	0.299	−0.005	0.064	−0.001	0.020
ΔTD5	**−1.500**	**−1.867**	**−1.500**	**−1.509**	**−1.500**	**−1.499**
	0.514	0.230	0.125	0.112	0.039	0.038
	−0.367	0.632	−0.009	0.126	0.001	0.039
ΔTD6	**2.000**	**1.789**	**2.000**	**1.991**	**2.000**	**1.999**
	0.236	0.151	0.065	0.061	0.020	0.020
	−0.211	0.316	−0.009	0.066	−0.001	0.020
ΔTD7	**−1.500**	**−1.099**	**−1.500**	**−1.480**	**−1.500**	**−1.498**
	0.341	0.284	0.096	0.087	0.030	0.029
	0.401	0.526	0.020	0.098	0.002	0.030
ΔTD8	**0.500**	**−0.571**	**0.500**	**0.380**	**0.500**	**0.498**
	1.153	0.454	0.387	0.206	0.064	0.064
	−1.071	1.574	−0.120	0.406	−0.002	0.064
Sargan, df	**40.689**	**17**	**20.576**	**17**	**17.340**	**17**

Notes: See Notes in Table 1.

Table 2h. Monte Carlo results for the dynamic fixed effects logit model including time dummies with the strictly exogenous continuous explanatory variable, $T = 8$
(Convergence Rate Indicators)

	N=1,000->10,000		*N*=10,000->100,000		*N*=1,000->100,000	
	r(mcsd)	r(mcse)	r(mcsd)	r(mcse)	r(mcsd)	r(mcse)
		r(rmse)		r(rmse)		r(rmse)
Simulation(A-a)						
GMM(h-HTD) γ						
	−0.53	−0.50	−0.50	−0.50	−0.51	−0.50
		−0.56		−0.51		−0.53
β						
	−0.52	−0.49	−0.50	−0.50	−0.51	−0.49
		−0.52		−0.50		−0.51
ΔTD3						
	−0.52	−0.49	−0.51	−0.50	−0.51	−0.50
		−0.53		−0.51		−0.52
ΔTD4						
	−0.53	−0.49	−0.49	−0.50	−0.51	−0.49
		−0.53		−0.49		−0.51
ΔTD5						
	−0.57	−0.51	−0.50	−0.50	−0.53	−0.51
		−0.57		−0.50		−0.54
ΔTD6						
	−0.52	−0.50	−0.51	−0.50	−0.52	−0.50
		−0.52		−0.51		−0.52
ΔTD7						
	−0.50	−0.53	−0.51	−0.50	−0.50	−0.52
		−0.58		−0.52		−0.55
ΔTD8						
	−0.41	−0.38	−0.50	−0.48	−0.46	−0.43
		−0.46		−0.51		−0.49
Simulation(A-b)						
GMM(h-HTD) γ						
	−0.63	−0.45	−0.50	−0.49	−0.57	−0.47
		−0.79		−0.52		−0.66
β						
	−0.56	−0.43	−0.51	−0.49	−0.54	−0.46
		−0.56		−0.51		−0.54
ΔTD3						
	−0.71	−0.51	−0.50	−0.49	−0.61	−0.50
		−0.71		−0.50		−0.61
ΔTD4						
	−0.67	−0.45	−0.52	−0.48	−0.59	−0.47
		−0.67		−0.52		−0.59
ΔTD5						
	−0.61	−0.31	−0.51	−0.47	−0.56	−0.39
		−0.70		−0.51		−0.61
ΔTD6						
	−0.56	−0.40	−0.51	−0.48	−0.54	−0.44
		−0.68		−0.52		−0.60
ΔTD7						
	−0.55	−0.51	−0.51	−0.48	−0.53	−0.49
		−0.73		−0.52		−0.62
ΔTD8						
	−0.47	−0.34	−0.78	−0.51	−0.63	−0.43
		−0.59		−0.80		−0.69

Notes: See Notes in Table 1.

Table 3. Monte Carlo results for the dynamic fixed effects logit model including time dummies with no explanatory variable, $T = 4$

	N=1,000			N=10,000			N=100,000	
	true	**mcm**		**true**	**mcm**		**true**	**mcm**
	mcsd	mcse		mcsd	mcse		mcsd	mcse
	bias	rmse		bias	rmse		bias	rmse
Simulation(B-a)								
GMM(gh-HTD) γ	**0.500**	**0.443**		**0.500**	**0.498**		**0.500**	**0.499**
	0.230	0.222		0.073	0.071		0.022	0.022
	−0.057	0.237		−0.002	0.073		−0.001	0.022
ΔTD3	**−1.500**	**−1.539**		**−1.500**	**−1.503**		**−1.500**	**−1.500**
	0.124	0.131		0.038	0.037		0.012	0.012
	−0.039	0.130		−0.003	0.038		0.000	0.012
ΔTD4	**0.500**	**0.342**		**0.500**	**0.488**		**0.500**	**0.500**
	0.255	0.173		0.074	0.051		0.015	0.015
	−0.158	0.300		−0.012	0.075		0.000	0.015
Sargan, df	**0.558**	1		**0.953**	1		**0.998**	1
Simulation(B-b)								
GMM(gh-HTD) γ	**1.100**	**0.959**		**1.100**	**1.090**		**1.100**	**1.100**
	0.324	0.329		0.097	0.101		0.032	0.031
	−0.141	0.353		−0.010	0.097		0.000	0.032
ΔTD3	**−2.000**	**−2.091**		**−2.000**	**−2.022**		**−2.000**	**−2.001**
	0.201	0.203		0.066	0.058		0.016	0.015
	−0.091	0.221		−0.022	0.070		−0.001	0.016
ΔTD4	**0.500**	**0.292**		**0.500**	**0.430**		**0.500**	**0.498**
	0.341	0.267		0.187	0.114		0.030	0.029
	−0.208	0.400		−0.070	0.199		−0.002	0.030
Sargan, df	**0.813**	1		**0.870**	1		**0.966**	1

Notes: See Notes in Table 1.

Table 3. Monte Carlo results for the dynamic fixed effects logit model including time dummies with no explanatory variable, $T = 4$
(Convergence Rate Indicators)

	N=1,000->10,000			*N*=10,000->100,000			*N*=1,000->100,000	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(B-a)								
GMM(gh-HTD) γ								
	-0.50	-0.49		-0.51	-0.50		-0.51	-0.50
		-0.51			-0.51			-0.51
ΔTD3								
	-0.52	-0.55		-0.51	-0.50		-0.51	-0.53
		-0.54			-0.51			-0.52
ΔTD4								
	-0.54	-0.53		-0.68	-0.53		-0.61	-0.53
		-0.60			-0.69			-0.65
Simulation(B-b)								
GMM(gh-HTD) γ								
	-0.53	-0.51		-0.48	-0.51		-0.50	-0.51
		-0.56			-0.48			-0.52
ΔTD3								
	-0.48	-0.54		-0.62	-0.58		-0.55	-0.56
		-0.50			-0.65			-0.57
ΔTD4								
	-0.26	-0.37		-0.79	-0.60		-0.52	-0.49
		-0.30			-0.82			-0.56

Notes: See Notes in Table 1.

Table 4. Monte Carlo results for the dynamic fixed effects logit model including time dummies with no explanatory variable, $T = 8$

	N=1,000		*N*=10,000		*N*=100,000	
	true	**mcm**	**true**	**mcm**	**true**	**mcm**
	mcsd	mcse	mcsd	mcse	mcsd	mcse
	bias	rmse	bias	rmse	bias	rmse
Simulation(B-a)						
GMM(gh-HTD) γ	**0.500**	**0.450**	**0.500**	**0.495**	**0.500**	**0.499**
	0.099	0.081	0.028	0.027	0.009	0.009
	-0.050	0.111	-0.005	0.029	-0.001	0.009
ΔTD3	**-1.500**	**-1.511**	**-1.500**	**-1.501**	**-1.500**	**-1.501**
	0.115	0.108	0.035	0.035	0.011	0.011
	-0.011	0.116	-0.001	0.035	-0.001	0.011
ΔTD4	**0.500**	**0.463**	**0.500**	**0.495**	**0.500**	**0.500**
	0.108	0.086	0.031	0.031	0.010	0.010
	-0.037	0.115	-0.005	0.031	0.000	0.010
ΔTD5	**-0.500**	**-0.467**	**-0.500**	**-0.495**	**-0.500**	**-0.500**
	0.105	0.086	0.032	0.031	0.010	0.010
	0.033	0.110	0.005	0.032	0.000	0.010
ΔTD6	**1.000**	**0.976**	**1.000**	**0.997**	**1.000**	**1.000**
	0.111	0.089	0.033	0.032	0.010	0.010
	-0.024	0.114	-0.003	0.033	0.000	0.010
ΔTD7	**-0.500**	**-0.454**	**-0.500**	**-0.497**	**-0.500**	**-0.500**
	0.138	0.092	0.035	0.034	0.011	0.011
	0.046	0.146	0.003	0.035	0.000	0.011
ΔTD8	**-1.000**	**-0.986**	**-1.000**	**-1.001**	**-1.000**	**-1.000**
	0.243	0.108	0.037	0.037	0.012	0.012
	0.014	0.244	-0.001	0.037	0.000	0.012
Sargan, df	**12.929**	**13**	**13.111**	**13**	**13.067**	**13**
Simulation(B-b)						
GMM(gh-HTD) γ	**1.100**	**1.010**	**1.100**	**1.096**	**1.100**	**1.100**
	0.138	0.100	0.033	0.033	0.011	0.010
	-0.090	0.165	-0.004	0.034	0.000	0.011
ΔTD3	**-2.000**	**-2.030**	**-2.000**	**-2.003**	**-2.000**	**-2.001**
	0.159	0.141	0.045	0.044	0.014	0.014
	-0.030	0.162	-0.003	0.045	-0.001	0.014
ΔTD4	**0.500**	**0.449**	**0.500**	**0.498**	**0.500**	**0.500**
	0.138	0.101	0.034	0.034	0.011	0.011
	-0.051	0.147	-0.002	0.034	0.000	0.011
ΔTD5	**-1.500**	**-1.501**	**-1.500**	**-1.499**	**-1.500**	**-1.500**
	0.127	0.104	0.036	0.034	0.011	0.011
	-0.001	0.127	0.001	0.036	0.000	0.011
ΔTD6	**2.000**	**2.006**	**2.000**	**1.998**	**2.000**	**2.000**
	0.135	0.109	0.039	0.036	0.012	0.012
	0.006	0.135	-0.002	0.039	0.000	0.012
ΔTD7	**-1.500**	**-1.500**	**-1.500**	**-1.496**	**-1.500**	**-1.500**
	0.129	0.109	0.037	0.035	0.011	0.011
	0.000	0.129	0.004	0.037	0.000	0.011
ΔTD8	**0.500**	**0.341**	**0.500**	**0.486**	**0.500**	**0.499**
	0.279	0.147	0.076	0.059	0.019	0.019
	-0.159	0.321	-0.014	0.078	-0.001	0.019
Sargan, df	**18.037**	**13**	**13.416**	**13**	**12.975**	**13**

Notes: See Notes in Table 1.

Table 4. Monte Carlo results for the dynamic fixed effects logit model including time dummies with no explanatory variable, $T = 8$
(Convergence Rate Indicators)

	N=1,000−>10,000		*N*=10,000−>100,000		*N*=1,000−>100,000	
	r(mcsd)	r(mcse) r(rmse)	r(mcsd)	r(mcse) r(rmse)	r(mcsd)	r(mcse) r(rmse)
Simulation(B−a)						
GMM(gh−HTD) γ						
	−0.55	−0.48	−0.51	−0.50	−0.53	−0.49
		−0.59		−0.51		−0.55
ΔTD3						
	−0.51	−0.49	−0.51	−0.50	−0.51	−0.50
		−0.51		−0.51		−0.51
ΔTD4						
	−0.54	−0.44	−0.49	−0.49	−0.51	−0.47
		−0.56		−0.49		−0.53
ΔTD5						
	−0.52	−0.45	−0.51	−0.50	−0.51	−0.47
		−0.53		−0.51		−0.52
ΔTD6						
	−0.53	−0.45	−0.51	−0.50	−0.52	−0.47
		−0.53		−0.51		−0.52
ΔTD7						
	−0.60	−0.44	−0.51	−0.50	−0.56	−0.47
		−0.62		−0.51		−0.57
ΔTD8						
	−0.82	−0.47	−0.51	−0.50	−0.66	−0.48
		−0.82		−0.51		−0.66
Simulation(B−b)						
GMM(gh−HTD) γ						
	−0.61	−0.49	−0.50	−0.50	−0.56	−0.49
		−0.69		−0.51		−0.60
ΔTD3						
	−0.55	−0.50	−0.50	−0.50	−0.52	−0.50
		−0.56		−0.50		−0.53
ΔTD4						
	−0.60	−0.47	−0.49	−0.50	−0.55	−0.49
		−0.63		−0.49		−0.56
ΔTD5						
	−0.55	−0.48	−0.52	−0.50	−0.54	−0.49
		−0.55		−0.52		−0.54
ΔTD6						
	−0.54	−0.47	−0.52	−0.50	−0.53	−0.49
		−0.54		−0.52		−0.53
ΔTD7						
	−0.54	−0.49	−0.51	−0.50	−0.53	−0.49
		−0.54		−0.52		−0.53
ΔTD8						
	−0.56	−0.40	−0.61	−0.50	−0.58	−0.45
		−0.62		−0.61		−0.62

Notes: See Notes in Table 1.

Table Xa. Monte Carlo results for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable, $T = 4$

	N=250		*N*=500		*N*=750	
	true	**mcm**	**true**	**mcm**	**true**	**mcm**
	mcsd	mcse	mcsd	mcse	mcsd	mcse
	bias	rmse	bias	rmse	bias	rmse
Simulation(C-a)						
GMM(g-HTD) γ	**0.500**	**0.295**	**0.500**	**0.400**	**0.500**	**0.438**
	0.568	0.520	0.379	0.359	0.300	0.291
	−0.205	0.604	−0.100	0.392	−0.062	0.306
β	**0.500**	**0.524**	**0.500**	**0.515**	**0.500**	**0.508**
	0.304	0.277	0.206	0.195	0.164	0.159
	0.024	0.305	0.015	0.207	0.008	0.165
Sargan, df	**3.289**	**3**	**3.184**	**3**	**3.153**	**3**
GMM(h-HTD) γ	**0.500**	**0.346**	**0.500**	**0.416**	**0.500**	**0.446**
	0.542	0.519	0.376	0.362	0.308	0.292
	−0.154	0.563	−0.084	0.385	−0.054	0.313
β	**0.500**	**0.510**	**0.500**	**0.511**	**0.500**	**0.503**
	0.290	0.270	0.204	0.193	0.162	0.157
	0.010	0.290	0.011	0.204	0.003	0.162
Sargan, df	**3.170**	**3**	**3.068**	**3**	**3.234**	**3**
GMM(gh-HTD) γ	**0.500**	**0.127**	**0.500**	**0.234**	**0.500**	**0.307**
	0.335	0.291	0.309	0.242	0.287	0.210
	−0.373	0.501	−0.266	0.408	−0.193	0.346
β	**0.500**	**0.333**	**0.500**	**0.385**	**0.500**	**0.413**
	0.237	0.166	0.194	0.136	0.163	0.118
	−0.167	0.289	−0.115	0.225	−0.087	0.184
Sargan, df	**6.479**	**8**	**6.880**	**8**	**7.225**	**8**

	N=1,000		*N*=10,000		*N*=100,000	
	true	**mcm**	**true**	**mcm**	**true**	**mcm**
	mcsd	mcse	mcsd	mcse	mcsd	mcse
	bias	rmse	bias	rmse	bias	rmse
Simulation(C-a)						
GMM(g-HTD) γ	**0.500**	**0.447**	**0.500**	**0.496**	**0.500**	**0.500**
	0.257	0.251	0.076	0.079	0.025	0.025
	−0.053	0.262	−0.004	0.076	0.000	0.025
β	**0.500**	**0.506**	**0.500**	**0.500**	**0.500**	**0.500**
	0.146	0.137	0.044	0.044	0.014	0.014
	0.006	0.146	0.000	0.044	0.000	0.014
Sargan, df	**3.114**	**3**	**3.038**	**3**	**2.933**	**3**
GMM(h-HTD) γ	**0.500**	**0.459**	**0.500**	**0.497**	**0.500**	**0.500**
	0.262	0.253	0.079	0.079	0.025	0.025
	−0.041	0.265	−0.003	0.079	0.000	0.025
β	**0.500**	**0.505**	**0.500**	**0.500**	**0.500**	**0.500**
	0.143	0.137	0.044	0.044	0.014	0.014
	0.005	0.143	0.000	0.044	0.000	0.014
Sargan, df	**3.035**	**3**	**3.008**	**3**	**2.963**	**3**
GMM(gh-HTD) γ	**0.500**	**0.345**	**0.500**	**0.491**	**0.500**	**0.499**
	0.263	0.190	0.075	0.071	0.023	0.023
	−0.155	0.306	−0.009	0.075	−0.001	0.023
β	**0.500**	**0.431**	**0.500**	**0.495**	**0.500**	**0.500**
	0.147	0.104	0.038	0.036	0.011	0.011
	−0.069	0.162	−0.005	0.038	0.000	0.011
Sargan, df	**7.364**	**8**	**8.035**	**8**	**8.006**	**8**

Notes: See Notes in Table 1.

Table Xa. Monte Carlo results for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable, $T = 4$ (Convergence Rate Indicators)

	N=250−>500			*N*=500−>750			*N*=250−>750	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(C−a)								
GMM(g−HTD) γ								
	−0.58	−0.53		−0.58	−0.52		−0.58	−0.53
		−0.62			−0.61			−0.62
β								
	−0.56	−0.50		−0.56	−0.50		−0.56	−0.50
		−0.56			−0.56			−0.56
GMM(h−HTD) γ								
	−0.53	−0.52		−0.49	−0.53		−0.51	−0.52
		−0.55			−0.51			−0.54
β								
	−0.51	−0.49		−0.57	−0.50		−0.53	−0.49
		−0.51			−0.57			−0.53
GMM(gh−HTD) γ								
	−0.12	−0.26		−0.18	−0.35		−0.14	−0.29
		−0.30			−0.41			−0.34
β								
	−0.29	−0.29		−0.43	−0.35		−0.34	−0.31
		−0.36			−0.50			−0.41

	N=1,000−>10,000			*N*=10,000−>100,000			*N*=1,000−>100,000	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(C−a)								
GMM(g−HTD) γ								
	−0.53	−0.50		−0.48	−0.50		−0.50	−0.50
		−0.54			−0.48			−0.51
β								
	−0.52	−0.50		−0.50	−0.50		−0.51	−0.50
		−0.52			−0.50			−0.51
GMM(h−HTD) γ								
	−0.52	−0.50		−0.49	−0.50		−0.51	−0.50
		−0.53			−0.49			−0.51
β								
	−0.51	−0.50		−0.50	−0.50		−0.51	−0.50
		−0.52			−0.50			−0.51
GMM(gh−HTD) γ								
	−0.55	−0.43		−0.51	−0.49		−0.53	−0.46
		−0.61			−0.51			−0.56
β								
	−0.59	−0.47		−0.52	−0.49		−0.56	−0.48
		−0.63			−0.52			−0.58

Notes: See Notes in Table 1.

Table Xb. Monte Carlo results for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable, $T = 4$

	N=250			*N*=500			*N*=750	
	true	**mcm**		**true**	**mcm**		**true**	**mcm**
	mcsd	mcse		mcsd	mcse		mcsd	mcse
	bias	rmse		bias	rmse		bias	rmse
Simulation(C-b)								
GMM(g-HTD) γ	**0.800**	**0.505**		**0.800**	**0.665**		**0.800**	**0.703**
	0.781	0.662		0.486	0.453		0.392	0.368
	−0.295	0.835		−0.135	0.504		−0.097	0.404
β	**0.800**	**0.866**		**0.800**	**0.832**		**0.800**	**0.826**
	0.431	0.359		0.283	0.257		0.233	0.213
	0.066	0.436		0.032	0.285		0.026	0.234
Sargan, df	**3.570**	**3**		**3.358**	**3**		**3.177**	**3**
GMM(h-HTD) γ	**0.800**	**0.582**		**0.800**	**0.690**		**0.800**	**0.717**
	0.685	0.633		0.475	0.455		0.380	0.365
	−0.218	0.719		−0.110	0.488		−0.083	0.388
β	**0.800**	**0.821**		**0.800**	**0.821**		**0.800**	**0.806**
	0.404	0.340		0.274	0.250		0.216	0.205
	0.021	0.404		0.021	0.275		0.006	0.216
Sargan, df	**3.453**	**3**		**3.252**	**3**		**3.358**	**3**
GMM(gh-HTD) γ	**0.800**	**0.231**		**0.800**	**0.435**		**0.800**	**0.545**
	0.491	0.344		0.450	0.297		0.406	0.258
	−0.569	0.752		−0.365	0.580		−0.255	0.480
β	**0.800**	**0.635**		**0.800**	**0.712**		**0.800**	**0.741**
	0.343	0.213		0.243	0.175		0.198	0.149
	−0.165	0.381		−0.088	0.258		−0.059	0.207
Sargan, df	**8.229**	**8**		**8.711**	**8**		**8.635**	**8**

	N=1,000			*N*=10,000			*N*=100,000	
	true	**mcm**		**true**	**mcm**		**true**	**mcm**
	mcsd	mcse		mcsd	mcse		mcsd	mcse
	bias	rmse		bias	rmse		bias	rmse
Simulation(C-b)								
GMM(g-HTD) γ	**0.800**	**0.735**		**0.800**	**0.794**		**0.800**	**0.800**
	0.341	0.315		0.099	0.099		0.031	0.031
	−0.065	0.347		−0.006	0.100		0.000	0.031
β	**0.800**	**0.815**		**0.800**	**0.801**		**0.800**	**0.800**
	0.198	0.183		0.060	0.059		0.019	0.019
	0.015	0.198		0.001	0.060		0.000	0.019
Sargan, df	**3.166**	**3**		**3.105**	**3**		**2.945**	**3**
GMM(h-HTD) γ	**0.800**	**0.753**		**0.800**	**0.792**		**0.800**	**0.800**
	0.338	0.319		0.102	0.102		0.032	0.032
	−0.047	0.342		−0.008	0.102		0.000	0.032
β	**0.800**	**0.806**		**0.800**	**0.801**		**0.800**	**0.800**
	0.189	0.182		0.061	0.060		0.019	0.019
	0.006	0.189		0.001	0.061		0.000	0.019
Sargan, df	**3.140**	**3**		**3.085**	**3**		**2.911**	**3**
GMM(gh-HTD) γ	**0.800**	**0.617**		**0.800**	**0.790**		**0.800**	**0.799**
	0.370	0.235		0.094	0.088		0.028	0.028
	−0.183	0.412		−0.010	0.095		−0.001	0.028
β	**0.800**	**0.757**		**0.800**	**0.799**		**0.800**	**0.800**
	0.170	0.133		0.048	0.047		0.015	0.015
	−0.043	0.176		−0.001	0.048		0.000	0.015
Sargan, df	**8.622**	**8**		**8.309**	**8**		**8.027**	**8**

Notes: See Notes in Table 1.

Table Xb. Monte Carlo results for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable, $T = 4$
(Convergence Rate Indicators)

	N=250−>500		*N*=500−>750		*N*=250−>750	
	r(mcsd)	r(mcse)	r(mcsd)	r(mcse)	r(mcsd)	r(mcse)
		r(rmse)		r(rmse)		r(rmse)
Simulation(C−b)						
GMM(g−HTD) γ						
	−0.68	−0.55	−0.53	−0.52	−0.63	−0.53
		−0.73		−0.55		−0.66
β						
	−0.60	−0.48	−0.49	−0.47	−0.56	−0.48
		−0.61		−0.49		−0.57
GMM(h−HTD) γ						
	−0.53	−0.48	−0.55	−0.54	−0.54	−0.50
		−0.56		−0.56		−0.56
β						
	−0.56	−0.44	−0.59	−0.49	−0.57	−0.46
		−0.56		−0.60		−0.57
GMM(gh−HTD) γ						
	−0.12	−0.21	−0.25	−0.34	−0.17	−0.26
		−0.37		−0.47		−0.41
β						
	−0.50	−0.29	−0.50	−0.40	−0.50	−0.33
		−0.56		−0.54		−0.55

	N=1,000−>10,000		*N*=10,000−>100,000		*N*=1,000−>100,000	
	r(mcsd)	r(mcse)	r(mcsd)	r(mcse)	r(mcsd)	r(mcse)
		r(rmse)		r(rmse)		r(rmse)
Simulation(C−b)						
GMM(g−HTD) γ						
	−0.54	−0.50	−0.51	−0.50	−0.52	−0.50
		−0.54		−0.51		−0.53
β						
	−0.52	−0.49	−0.51	−0.50	−0.51	−0.49
		−0.52		−0.51		−0.51
GMM(h−HTD) γ						
	−0.52	−0.50	−0.50	−0.50	−0.51	−0.50
		−0.52		−0.50		−0.51
β						
	−0.49	−0.48	−0.50	−0.50	−0.50	−0.49
		−0.49		−0.50		−0.50
GMM(gh−HTD) γ						
	−0.59	−0.43	−0.52	−0.49	−0.56	−0.46
		−0.64		−0.53		−0.58
β						
	−0.55	−0.45	−0.50	−0.49	−0.52	−0.47
		−0.56		−0.50		−0.53

Notes: See Notes in Table 1.

Table Xc. Monte Carlo results for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable, $T=4$

	N=250		*N*=500		*N*=750	
	true	**mcm**	**true**	**mcm**	**true**	**mcm**
	mcsd	mcse	mcsd	mcse	mcsd	mcse
	bias	rmse	bias	rmse	bias	rmse
Simulation(C−c)						
GMM(g−HTD) γ	**1.100**	**0.514**	**1.100**	**0.804**	**1.100**	**0.891**
	1.095	0.990	0.756	0.685	0.630	0.558
	−0.586	1.242	−0.296	0.812	−0.209	0.664
β	**1.100**	**1.249**	**1.100**	**1.154**	**1.100**	**1.147**
	0.744	0.544	0.437	0.372	0.368	0.313
	0.149	0.759	0.054	0.441	0.047	0.371
Sargan, df	**3.873**	**3**	**3.709**	**3**	**3.448**	**3**
GMM(h−HTD) γ	**1.100**	**0.564**	**1.100**	**0.852**	**1.100**	**0.934**
	1.031	0.975	0.761	0.675	0.616	0.553
	−0.536	1.162	−0.248	0.800	−0.166	0.638
β	**1.100**	**1.186**	**1.100**	**1.153**	**1.100**	**1.120**
	0.612	0.501	0.438	0.365	0.334	0.301
	0.086	0.618	0.053	0.442	0.020	0.334
Sargan, df	**4.018**	**3**	**3.723**	**3**	**3.600**	**3**
GMM(gh−HTD) γ	**1.100**	**0.185**	**1.100**	**0.464**	**1.100**	**0.605**
	0.664	0.416	0.673	0.375	0.607	0.343
	−0.915	1.130	−0.636	0.926	−0.495	0.783
β	**1.100**	**0.959**	**1.100**	**1.028**	**1.100**	**1.057**
	0.512	0.284	0.342	0.235	0.270	0.204
	−0.141	0.531	−0.072	0.350	−0.043	0.274
Sargan, df	**9.683**	**8**	**9.863**	**8**	**9.964**	**8**

	N=1,000		*N*=10,000		*N*=100,000	
	true	**mcm**	**true**	**mcm**	**true**	**mcm**
	mcsd	mcse	mcsd	mcse	mcsd	mcse
	bias	rmse	bias	rmse	bias	rmse
Simulation(C−c)						
GMM(g−HTD) γ	**1.100**	**0.959**	**1.100**	**1.090**	**1.100**	**1.099**
	0.539	0.484	0.154	0.154	0.048	0.049
	−0.141	0.557	−0.010	0.155	−0.001	0.048
β	**1.100**	**1.133**	**1.100**	**1.104**	**1.100**	**1.100**
	0.320	0.273	0.095	0.094	0.031	0.030
	0.033	0.321	0.004	0.096	0.000	0.031
Sargan, df	**3.474**	**3**	**3.115**	**3**	**3.016**	**3**
GMM(h−HTD) γ	**1.100**	**0.979**	**1.100**	**1.086**	**1.100**	**1.099**
	0.544	0.483	0.158	0.159	0.050	0.050
	−0.121	0.557	−0.014	0.159	−0.001	0.050
β	**1.100**	**1.121**	**1.100**	**1.105**	**1.100**	**1.100**
	0.312	0.271	0.099	0.094	0.031	0.030
	0.021	0.312	0.005	0.099	0.000	0.031
Sargan, df	**3.359**	**3**	**3.140**	**3**	**2.915**	**3**
GMM(gh−HTD) γ	**1.100**	**0.746**	**1.100**	**1.079**	**1.100**	**1.098**
	0.553	0.319	0.142	0.131	0.042	0.043
	−0.354	0.656	−0.021	0.144	−0.002	0.042
β	**1.100**	**1.071**	**1.100**	**1.103**	**1.100**	**1.100**
	0.244	0.184	0.076	0.072	0.025	0.024
	−0.029	0.246	0.003	0.076	0.000	0.025
Sargan, df	**9.900**	**8**	**8.636**	**8**	**8.039**	**8**

Notes: See Notes in Table 1.

Table Xc. Monte Carlo results for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable, $T = 4$ (Convergence Rate Indicators)

	N=250->500		*N*=500->750		*N*=250->750	
	r(mcsd)	r(mcse)	r(mcsd)	r(mcse)	r(mcsd)	r(mcse)
		r(rmse)		r(rmse)		r(rmse)
Simulation(C-c)						
GMM(g-HTD) γ						
	−0.53	−0.53	−0.45	−0.51	−0.50	−0.52
		−0.61		−0.50		−0.57
β						
	−0.77	−0.55	−0.42	−0.42	−0.64	−0.50
		−0.78		−0.42		−0.65
GMM(h-HTD) γ						
	−0.44	−0.53	−0.52	−0.49	−0.47	−0.52
		−0.54		−0.56		−0.55
β						
	−0.48	−0.46	−0.67	−0.48	−0.55	−0.46
		−0.49		−0.69		−0.56
GMM(gh-HTD) γ						
	0.02	−0.15	−0.25	−0.22	−0.08	−0.18
		−0.29		−0.41		−0.33
β						
	−0.58	−0.27	−0.58	−0.35	−0.58	−0.30
		−0.60		−0.60		−0.60

	N=1,000->10,000		*N*=10,000->100,000		*N*=1,000->100,000	
	r(mcsd)	r(mcse)	r(mcsd)	r(mcse)	r(mcsd)	r(mcse)
		r(rmse)		r(rmse)		r(rmse)
Simulation(C-c)						
GMM(g-HTD) γ						
	−0.54	−0.50	−0.51	−0.50	−0.53	−0.50
		−0.56		−0.51		−0.53
β						
	−0.52	−0.46	−0.49	−0.49	−0.51	−0.48
		−0.53		−0.49		−0.51
GMM(h-HTD) γ						
	−0.54	−0.48	−0.50	−0.50	−0.52	−0.49
		−0.55		−0.50		−0.52
β						
	−0.50	−0.46	−0.50	−0.49	−0.50	−0.48
		−0.50		−0.50		−0.50
GMM(gh-HTD) γ						
	−0.59	−0.39	−0.53	−0.49	−0.56	−0.44
		−0.66		−0.53		−0.59
β						
	−0.51	−0.41	−0.49	−0.48	−0.50	−0.44
		−0.51		−0.49		−0.50

Notes: See Notes in Table 1.

Table Ya. Monte Carlo results for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable, $T=8$

	N=250			*N*=500			*N*=750	
	true	**mcm**		**true**	**mcm**		**true**	**mcm**
	mcsd	mcse		mcsd	mcse		mcsd	mcse
	bias	rmse		bias	rmse		bias	rmse
Simulation(C-a)								
GMM(g-HTD) γ	**0.500**	**0.309**		**0.500**	**0.415**		**0.500**	**0.439**
	0.239	0.188		0.161	0.141		0.130	0.118
	−0.191	0.306		−0.085	0.183		−0.061	0.144
β	**0.500**	**0.509**		**0.500**	**0.506**		**0.500**	**0.505**
	0.128	0.100		0.089	0.076		0.071	0.064
	0.009	0.129		0.006	0.089		0.005	0.071
Sargan, df	**26.524**	**23**		**25.271**	**23**		**24.632**	**23**
GMM(h-HTD) γ	**0.500**	**0.348**		**0.500**	**0.435**		**0.500**	**0.450**
	0.227	0.187		0.161	0.141		0.129	0.118
	−0.152	0.273		−0.065	0.174		−0.050	0.139
β	**0.500**	**0.494**		**0.500**	**0.499**		**0.500**	**0.500**
	0.127	0.098		0.087	0.076		0.071	0.064
	−0.006	0.127		−0.001	0.087		0.000	0.071
Sargan, df	**25.910**	**23**		**24.873**	**23**		**24.465**	**23**
GMM(gh-HTD) γ	**0.500**	**0.166**		**0.500**	**0.260**		**0.500**	**0.304**
	0.155	0.073		0.133	0.081		0.121	0.078
	−0.334	0.368		−0.240	0.275		−0.196	0.230
β	**0.500**	**0.375**		**0.500**	**0.407**		**0.500**	**0.426**
	0.106	0.048		0.081	0.049		0.068	0.046
	−0.125	0.164		−0.093	0.123		−0.074	0.101
Sargan, df	**50.620**	**48**		**49.983**	**48**		**50.007**	**48**

	N=1,000			*N*=10,000			*N*=100,000	
	true	**mcm**		**true**	**mcm**		**true**	**mcm**
	mcsd	mcse		mcsd	mcse		mcsd	mcse
	bias	rmse		bias	rmse		bias	rmse
Simulation(C-a)								
GMM(g-HTD) γ	**0.500**	**0.456**		**0.500**	**0.497**		**0.500**	**0.500**
	0.112	0.103		0.034	0.034		0.011	0.011
	−0.044	0.120		−0.003	0.034		0.000	0.011
β	**0.500**	**0.505**		**0.500**	**0.500**		**0.500**	**0.500**
	0.060	0.057		0.019	0.019		0.006	0.006
	0.005	0.060		0.000	0.019		0.000	0.006
Sargan, df	**24.421**	**23**		**23.180**	**23**		**23.135**	**23**
GMM(h-HTD) γ	**0.500**	**0.464**		**0.500**	**0.497**		**0.500**	**0.500**
	0.110	0.104		0.034	0.034		0.011	0.011
	−0.036	0.115		−0.003	0.034		0.000	0.011
β	**0.500**	**0.501**		**0.500**	**0.500**		**0.500**	**0.500**
	0.061	0.056		0.019	0.019		0.006	0.006
	0.001	0.061		0.000	0.019		0.000	0.006
Sargan, df	**24.218**	**23**		**23.076**	**23**		**23.030**	**23**
GMM(gh-HTD) γ	**0.500**	**0.339**		**0.500**	**0.485**		**0.500**	**0.499**
	0.111	0.075		0.033	0.031		0.010	0.010
	−0.161	0.195		−0.015	0.036		−0.001	0.010
β	**0.500**	**0.442**		**0.500**	**0.494**		**0.500**	**0.499**
	0.060	0.044		0.018	0.017		0.005	0.005
	−0.058	0.083		−0.006	0.019		−0.001	0.005
Sargan, df	**49.665**	**48**		**48.493**	**48**		**48.101**	**48**

Notes: See Notes in Table 1.

Table Ya. Monte Carlo results for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable, $T=8$ (Convergence Rate Indicators)

	N=250->500			*N*=500->750			*N*=250->750	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(C-a)								
GMM(g-HTD) γ								
	-0.57	-0.41		-0.53	-0.45		-0.55	-0.43
		-0.75			-0.59			-0.69
β								
	-0.54	-0.39		-0.55	-0.43		-0.54	-0.41
		-0.54			-0.55			-0.54
GMM(h-HTD) γ								
	-0.50	-0.41		-0.54	-0.43		-0.51	-0.42
		-0.65			-0.56			-0.62
β								
	-0.56	-0.37		-0.48	-0.42		-0.53	-0.39
		-0.56			-0.48			-0.53
GMM(gh-HTD) γ								
	-0.22	0.14		-0.25	-0.07		-0.23	0.06
		-0.42			-0.43			-0.43
β								
	-0.38	0.05		-0.43	-0.16		-0.40	-0.02
		-0.41			-0.50			-0.44

	N=1,000->10,000			*N*=10,000->100,000			*N*=1,000->100,000	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(C-a)								
GMM(g-HTD) γ								
	-0.52	-0.48		-0.50	-0.50		-0.51	-0.49
		-0.54			-0.50			-0.52
β								
	-0.50	-0.48		-0.51	-0.50		-0.50	-0.49
		-0.50			-0.51			-0.50
GMM(h-HTD) γ								
	-0.51	-0.48		-0.49	-0.50		-0.50	-0.49
		-0.53			-0.49			-0.51
β								
	-0.50	-0.48		-0.51	-0.50		-0.51	-0.49
		-0.50			-0.51			-0.51
GMM(gh-HTD) γ								
	-0.53	-0.38		-0.50	-0.49		-0.52	-0.44
		-0.73			-0.54			-0.64
β								
	-0.52	-0.42		-0.52	-0.49		-0.52	-0.45
		-0.64			-0.54			-0.59

Notes: See Notes in Table 1.

Table Yb. Monte Carlo results for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable, $T=8$

	N=250			*N*=500			*N*=750	
	true	**mcm**		**true**	**mcm**		**true**	**mcm**
	mcsd	mcse		mcsd	mcse		mcsd	mcse
	bias	rmse		bias	rmse		bias	rmse
Simulation(C-b)								
GMM(g-HTD) γ	**0.800**	**0.501**		**0.800**	**0.662**		**0.800**	**0.709**
	0.303	0.217		0.204	0.169		0.166	0.143
	−0.299	0.426		−0.138	0.246		−0.091	0.190
β	**0.800**	**0.822**		**0.800**	**0.817**		**0.800**	**0.812**
	0.166	0.119		0.121	0.094		0.095	0.081
	0.022	0.168		0.017	0.123		0.012	0.096
Sargan, df	**29.636**	**23**		**27.882**	**23**		**26.564**	**23**
GMM(h-HTD) γ	**0.800**	**0.575**		**0.800**	**0.697**		**0.800**	**0.724**
	0.282	0.216		0.203	0.168		0.166	0.144
	−0.225	0.361		−0.103	0.228		−0.076	0.182
β	**0.800**	**0.785**		**0.800**	**0.797**		**0.800**	**0.800**
	0.162	0.116		0.114	0.093		0.099	0.080
	−0.015	0.162		−0.003	0.114		0.000	0.099
Sargan, df	**29.002**	**23**		**27.290**	**23**		**26.619**	**23**
GMM(gh-HTD) γ	**0.800**	**0.287**		**0.800**	**0.430**		**0.800**	**0.513**
	0.204	0.091		0.194	0.102		0.183	0.100
	−0.513	0.552		−0.370	0.418		−0.287	0.341
β	**0.800**	**0.640**		**0.800**	**0.712**		**0.800**	**0.742**
	0.141	0.069		0.108	0.068		0.090	0.062
	−0.160	0.213		−0.088	0.139		−0.058	0.107
Sargan, df	**61.705**	**48**		**61.084**	**48**		**59.970**	**48**

	N=1,000			*N*=10,000			*N*=100,000	
	true	**mcm**		**true**	**mcm**		**true**	**mcm**
	mcsd	mcse		mcsd	mcse		mcsd	mcse
	bias	rmse		bias	rmse		bias	rmse
Simulation(C-b)								
GMM(g-HTD) γ	**0.800**	**0.733**		**0.800**	**0.794**		**0.800**	**0.799**
	0.142	0.126		0.044	0.042		0.013	0.013
	−0.067	0.157		−0.006	0.044		−0.001	0.013
β	**0.800**	**0.812**		**0.800**	**0.802**		**0.800**	**0.800**
	0.081	0.072		0.026	0.025		0.008	0.008
	0.012	0.082		0.002	0.026		0.000	0.008
Sargan, df	**26.035**	**23**		**23.728**	**23**		**23.307**	**23**
GMM(h-HTD) γ	**0.800**	**0.746**		**0.800**	**0.794**		**0.800**	**0.799**
	0.139	0.127		0.044	0.043		0.014	0.014
	−0.054	0.149		−0.006	0.044		−0.001	0.014
β	**0.800**	**0.801**		**0.800**	**0.801**		**0.800**	**0.800**
	0.081	0.072		0.026	0.025		0.008	0.008
	0.001	0.081		0.001	0.026		0.000	0.008
Sargan, df	**25.853**	**23**		**23.602**	**23**		**23.442**	**23**
GMM(gh-HTD) γ	**0.800**	**0.584**		**0.800**	**0.786**		**0.800**	**0.799**
	0.166	0.097		0.040	0.039		0.012	0.012
	−0.216	0.272		−0.014	0.043		−0.001	0.012
β	**0.800**	**0.765**		**0.800**	**0.799**		**0.800**	**0.800**
	0.075	0.057		0.022	0.021		0.007	0.007
	−0.035	0.083		−0.001	0.022		0.000	0.007
Sargan, df	**57.838**	**48**		**50.490**	**48**		**48.750**	**48**

Notes: See Notes in Table 1.

Table Yb. Monte Carlo results for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable, $T = 8$ (Convergence Rate Indicators)

	N=250–>500			*N*=500–>750			*N*=250–>750	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(C-b)								
GMM(g-HTD) γ								
	-0.57	-0.36		-0.50	-0.41		-0.55	-0.38
		-0.79			-0.64			-0.73
β								
	-0.45	-0.34		-0.59	-0.38		-0.51	-0.35
		-0.45			-0.60			-0.51
GMM(h-HTD) γ								
	-0.47	-0.36		-0.50	-0.39		-0.48	-0.37
		-0.66			-0.55			-0.62
β								
	-0.50	-0.32		-0.36	-0.36		-0.45	-0.33
		-0.51			-0.36			-0.45
GMM(gh-HTD) γ								
	-0.07	0.15		-0.15	-0.03		-0.10	0.08
		-0.40			-0.50			-0.44
β								
	-0.38	-0.03		-0.44	-0.24		-0.41	-0.11
		-0.62			-0.65			-0.63

	N=1,000–>10,000			*N*=10,000–>100,000			*N*=1,000–>100,000	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(C-b)								
GMM(g-HTD) γ								
	-0.51	-0.47		-0.51	-0.50		-0.51	-0.49
		-0.55			-0.52			-0.53
β								
	-0.49	-0.46		-0.50	-0.49		-0.50	-0.48
		-0.50			-0.50			-0.50
GMM(h-HTD) γ								
	-0.50	-0.47		-0.50	-0.50		-0.50	-0.48
		-0.53			-0.51			-0.52
β								
	-0.49	-0.45		-0.51	-0.49		-0.50	-0.47
		-0.49			-0.51			-0.50
GMM(gh-HTD) γ								
	-0.61	-0.40		-0.52	-0.49		-0.56	-0.45
		-0.80			-0.54			-0.67
β								
	-0.53	-0.43		-0.50	-0.49		-0.52	-0.46
		-0.58			-0.50			-0.54

Notes: See Notes in Table 1.

Table Yc. Monte Carlo results for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable, $T = 8$

	N=250			*N*=500			*N*=750	
	true	**mcm**		**true**	**mcm**		**true**	**mcm**
	mcsd	mcse		mcsd	mcse		mcsd	mcse
	bias	rmse		bias	rmse		bias	rmse
Simulation(C-c)								
GMM(g-HTD) γ	**1.100**	**0.518**		**1.100**	**0.789**		**1.100**	**0.885**
	0.429	0.276		0.330	0.229		0.268	0.199
	−0.582	0.723		−0.311	0.453		−0.215	0.343
β	**1.100**	**1.161**		**1.100**	**1.145**		**1.100**	**1.136**
	0.262	0.150		0.181	0.124		0.150	0.110
	0.061	0.269		0.045	0.186		0.036	0.154
Sargan, df	**32.791**	**23**		**31.969**	**23**		**30.550**	**23**
GMM(h-HTD) γ	**1.100**	**0.600**		**1.100**	**0.846**		**1.100**	**0.907**
	0.418	0.273		0.322	0.226		0.266	0.199
	−0.500	0.652		−0.254	0.410		−0.193	0.329
β	**1.100**	**1.101**		**1.100**	**1.112**		**1.100**	**1.121**
	0.247	0.145		0.176	0.121		0.152	0.108
	0.001	0.247		0.012	0.176		0.021	0.154
Sargan, df	**33.067**	**23**		**31.952**	**23**		**31.102**	**23**
GMM(gh-HTD) γ	**1.100**	**0.313**		**1.100**	**0.471**		**1.100**	**0.583**
	0.258	0.092		0.274	0.116		0.278	0.120
	−0.787	0.828		−0.629	0.686		−0.517	0.587
β	**1.100**	**0.912**		**1.100**	**1.008**		**1.100**	**1.057**
	0.203	0.080		0.151	0.084		0.130	0.079
	−0.188	0.277		−0.092	0.177		−0.043	0.137
Sargan, df	**70.287**	**48**		**73.576**	**48**		**72.671**	**48**

	N=1,000			*N*=10,000			*N*=100,000	
	true	**mcm**		**true**	**mcm**		**true**	**mcm**
	mcsd	mcse		mcsd	mcse		mcsd	mcse
	bias	rmse		bias	rmse		bias	rmse
Simulation(C-c)								
GMM(g-HTD) γ	**1.100**	**0.942**		**1.100**	**1.087**		**1.100**	**1.099**
	0.228	0.179		0.069	0.064		0.021	0.021
	−0.158	0.277		−0.013	0.070		−0.001	0.021
β	**1.100**	**1.124**		**1.100**	**1.105**		**1.100**	**1.101**
	0.128	0.100		0.041	0.039		0.013	0.013
	0.024	0.130		0.005	0.041		0.001	0.013
Sargan, df	**29.589**	**23**		**24.648**	**23**		**23.452**	**23**
GMM(h-HTD) γ	**1.100**	**0.960**		**1.100**	**1.088**		**1.100**	**1.099**
	0.228	0.179		0.070	0.066		0.021	0.021
	−0.140	0.267		−0.012	0.071		−0.001	0.022
β	**1.100**	**1.115**		**1.100**	**1.104**		**1.100**	**1.101**
	0.129	0.098		0.042	0.039		0.013	0.013
	0.015	0.130		0.004	0.043		0.001	0.013
Sargan, df	**29.688**	**23**		**24.459**	**23**		**23.259**	**23**
GMM(gh-HTD) γ	**1.100**	**0.682**		**1.100**	**1.079**		**1.100**	**1.098**
	0.272	0.120		0.063	0.056		0.018	0.018
	−0.418	0.499		−0.021	0.067		−0.002	0.018
β	**1.100**	**1.076**		**1.100**	**1.105**		**1.100**	**1.101**
	0.106	0.073		0.034	0.031		0.011	0.010
	−0.024	0.109		0.005	0.034		0.001	0.011
Sargan, df	**70.318**	**48**		**53.151**	**48**		**49.004**	**48**

Notes: See Notes in Table 1.

Table Yc. Monte Carlo results for the dynamic fixed effects logit model excluding time dummies with the strictly exogenous continuous explanatory variable, $T = 8$

(Convergence Rate Indicators)

	N=250−>500			*N*=500−>750			*N*=250−>750	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(C−c)								
GMM(g−HTD) γ								
	−0.38	−0.27		−0.51	−0.35		−0.43	−0.30
		−0.67			−0.68			−0.68
β								
	−0.54	−0.27		−0.46	−0.31		−0.51	−0.28
		−0.53			−0.47			−0.51
GMM(h−HTD) γ								
	−0.38	−0.27		−0.47	−0.31		−0.41	−0.29
		−0.67			−0.55			−0.62
β								
	−0.49	−0.25		−0.35	−0.29		−0.44	−0.27
		−0.49			−0.33			−0.43
GMM(gh−HTD) γ								
	0.08	0.33		0.04	0.10		0.07	0.24
		−0.27			−0.38			−0.31
β								
	−0.43	0.07		−0.38	−0.16		−0.41	−0.02
		−0.65			−0.63			−0.64

	N=1,000−>10,000			*N*=10,000−>100,000			*N*=1,000−>100,000	
	r(mcsd)	r(mcse)		r(mcsd)	r(mcse)		r(mcsd)	r(mcse)
		r(rmse)			r(rmse)			r(rmse)
Simulation(C−c)								
GMM(g−HTD) γ								
	−0.52	−0.44		−0.52	−0.49		−0.52	−0.47
		−0.60			−0.53			−0.56
β								
	−0.50	−0.41		−0.49	−0.48		−0.49	−0.45
		−0.50			−0.49			−0.50
GMM(h−HTD) γ								
	−0.51	−0.43		−0.51	−0.49		−0.51	−0.46
		−0.58			−0.52			−0.55
β								
	−0.48	−0.40		−0.51	−0.48		−0.49	−0.44
		−0.48			−0.51			−0.50
GMM(gh−HTD) γ								
	−0.63	−0.33		−0.54	−0.49		−0.58	−0.41
		−0.87			−0.56			−0.72
β								
	−0.50	−0.37		−0.50	−0.48		−0.50	−0.43
		−0.50			−0.50			−0.50

Notes: See Notes in Table 1.