Online Supplement for "Testing for Correlation between the Regressors and Factor Loadings in Heterogeneous Panels with Interactive Effects"

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This supplement presents additional Monte Carlo and empirical results, complementing the results already reported in the main paper. Section 1 reports the simulations results related to the Hausman test as in Bai (2009). Section 2 shows small sample performance of FE, CCE and PC estimators when β's are homogeneous. Section 3 presents Monte Carlo evidence on the performance of the principal component estimator evaluated using the AIC_1 criterion by Bai and Ng (2002). Section 4 reports the additional simulation results for the Hausman-type statistics. Section 5 examines the small sample performance of the *pretest* estimator. Finally, in Section 6, we show further results on empirical applications, namely the results of the empirical applications when estimating by the bias uncorrected PC estimator.

1 Simulations results of the Bai (2009)'s Hausman test

In Bai (2009) the Hausman statistic is defined as follows

$$H = (\hat{\boldsymbol{\beta}}_{PC} - \hat{\boldsymbol{\beta}}_{FE})' \hat{V}^{-1} (\hat{\boldsymbol{\beta}}_{PC} - \hat{\boldsymbol{\beta}}_{FE}). \tag{1}$$

Bai (2009) shows that $\hat{V} = \hat{V}\left(\hat{\boldsymbol{\beta}}_{FE} - \hat{\boldsymbol{\beta}}_{PC}\right) = \hat{V}\left(\hat{\boldsymbol{\beta}}_{FE}\right) - \hat{V}\left(\hat{\boldsymbol{\beta}}_{PC}\right)$, such that

$$H = NT\left(\hat{\boldsymbol{\beta}}_{PC} - \hat{\boldsymbol{\beta}}_{FE}\right)\left(\hat{V}\left(\hat{\boldsymbol{\beta}}_{FE}\right) - \hat{V}\left(\hat{\boldsymbol{\beta}}_{PC}\right)\right)^{-1}\left(\hat{\boldsymbol{\beta}}_{PC} - \hat{\boldsymbol{\beta}}_{FE}\right) \sim \chi^2_k \tag{2}$$

where k is the number of regressors. The variance of the FE estimators is derived as

$$Var\left(\hat{\boldsymbol{\beta}}_{FE}\right) = \hat{\sigma}^2 \left(\frac{1}{NT}\sum_{i=1}^{N} \ddot{\boldsymbol{X}}_i' \ddot{\boldsymbol{X}}_i\right)^{-1}$$

and

$$\hat{\sigma}^2 = \frac{1}{NT - (N+T) - k}\sum_{i=1}^{N}\sum_{t=1}^{T} \hat{\varepsilon}_{it}^2,$$

Further, the variance of the PC estimator is evaluated by

$$Var\left(\hat{\boldsymbol{\beta}}_{PC}\right) = \hat{\sigma}^2 \left(\frac{1}{NT}\sum_{i=1}^{N} \hat{\boldsymbol{Z}}_i' \hat{\boldsymbol{Z}}_i\right)^{-1}$$

where

$$\hat{\boldsymbol{Z}}_i = \boldsymbol{M}_{\hat{F}} \boldsymbol{X}_i - \frac{1}{N}\sum_{k=1}^{N} \boldsymbol{M}_{\hat{F}} \boldsymbol{X}_k \hat{a}_{ik} \text{ with } \hat{a}_{ik} = \hat{\boldsymbol{\gamma}}_i'(\hat{\boldsymbol{\Gamma}}'\hat{\boldsymbol{\Gamma}}/N)^{-1}\hat{\boldsymbol{\gamma}}_k$$

$\hat{\boldsymbol{\Gamma}}' = (\hat{\boldsymbol{\gamma}}_1, \hat{\boldsymbol{\gamma}}_2, ...\hat{\boldsymbol{\gamma}}_N)'$, $\boldsymbol{M}_{\hat{F}} = \boldsymbol{I}_T - \hat{\boldsymbol{F}}(\hat{\boldsymbol{F}}'\hat{\boldsymbol{F}})^{-1}\hat{\boldsymbol{F}}'$ and $\hat{\boldsymbol{F}}' = \left(\mathbf{1}_T, \hat{\boldsymbol{f}}_t\right), \mathbf{1}_T = (1, ..., 1)'$ is a $T \times 1$ vector of ones, and $\hat{\boldsymbol{f}}_t$ the $T \times r$ matrix of factors estimated by the iterative PC procedure.

Tables 1-4 show results on size and power at 95% level including the cases of heterogeneous betas and serially correlated errors. It turns out that in the case where errors are serially correlated and betas are heterogeneous, the size of the test is lower than the nominal level, especially for large samples.

Table 1: Size and power of the H statistic as in Bai (2009) at 95 % level.

	Experiment 1						Experiment 3				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.091	0.073	0.076	0.066	0.062	50	1	1	1	1	1
100	0.088	0.071	0.063	0.080	0.043	100	1	1	1	1	1
150	0.066	0.063	0.067	0.060	0.053	150	1	1	1	1	1
200	0.066	0.061	0.062	0.067	0.048	200	1	1	1	1	1
500	0.077	0.062	0.043	0.060	0.046	500	1	1	1	1	1
	Experiment 2						Experiment 4				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.088	0.076	0.068	0.071	0.046	50	1	1	1	1	1
100	0.073	0.070	0.063	0.063	0.070	100	1	1	1	1	1
150	0.071	0.071	0.057	0.069	0.055	150	1	1	1	1	1
200	0.078	0.067	0.064	0.055	0.049	200	1	1	1	1	1
500	0.056	0.053	0.068	0.065	0.051	500	1	1	1	1	1

Table 2: Size and power of the H statistic as in Bai (2009) at 95 % level for serially correlated errors.

	Experiment 1						Experiment 3				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.078	0.075	0.091	0.074	0.081	50	1	1	1	1	1
100	0.086	0.055	0.066	0.077	0.071	100	1	1	1	1	1
150	0.069	0.059	0.043	0.068	0.054	150	1	1	1	1	1
200	0.071	0.046	0.049	0.059	0.053	200	1	1	1	1	1
500	0.078	0.067	0.063	0.044	0.055	500	1	1	1	1	1
	Experiment 2						Experiment 4				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.088	0.076	0.068	0.071	0.046	50	1	1	1	1	1
100	0.073	0.070	0.063	0.063	0.070	100	1	1	1	1	1
150	0.071	0.071	0.057	0.069	0.055	150	1	1	1	1	1
200	0.078	0.067	0.064	0.055	0.049	200	1	1	1	1	1
500	0.056	0.053	0.068	0.065	0.051	500	1	1	1	1	1

Table 3: Size and power of the H statistic as in Bai (2009) at 95 % level for heterogeous betas.

	Experiment 1						Experiment 3				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.054	0.052	0.061	0.042	0.049	50	1	1	1	1	1
100	0.061	0.045	0.042	0.047	0.054	100	1	1	1	1	1
150	0.053	0.047	0.047	0.052	0.043	150	1	1	1	1	1
200	0.052	0.043	0.04	0.039	0.032	200	1	1	1	1	1
500	0.064	0.047	0.043	0.042	0.045	500	1	1	1	1	1
	Experiment 2						Experiment 4				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.063	0.047	0.053	0.057	0.053	50	1	1	1	1	1
100	0.062	0.047	0.046	0.044	0.041	100	1	1	1	1	1
150	0.05	0.048	0.037	0.04	0.046	150	1	1	1	1	1
200	0.039	0.048	0.036	0.037	0.046	200	1	1	1	1	1
500	0.058	0.038	0.034	0.034	0.043	500	1	1	1	1	1

Table 4: Size and power of the H statistic as in Bai (2009) at 95 % level for heterogeous betas and serially correlated errors.

	Experiment 1						Experiment 3				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.061	0.059	0.041	0.055	0.035	50	1	1	1	1	1
100	0.054	0.036	0.039	0.045	0.036	100	1	1	1	1	1
150	0.047	0.035	0.038	0.025	0.027	150	1	1	1	1	1
200	0.056	0.053	0.028	0.032	0.029	200	1	1	1	1	1
500	0.041	0.037	0.041	0.039	0.033	500	1	1	1	1	1
	Experiment 2						Experiment 4				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.064	0.057	0.063	0.042	0.051	50	1	1	1	1	1
100	0.050	0.041	0.048	0.024	0.034	100	1	1	1	1	1
150	0.046	0.049	0.045	0.043	0.041	150	1	1	1	1	1
200	0.050	0.044	0.042	0.033	0.019	200	1	1	1	1	1
500	0.044	0.040	0.029	0.033	0.035	500	1	1	1	1	1

2 Small sample performance of FE, CCE and PC estimators for homogeneous β's

Here we show simulation results related to the sample performance of FE, CCE and PC estimators for homogeneous β's imposing homogeneous β's for the four experiments presented in Section 4.2. Results are qualitatively similar to what observed in the case of heterogeneous β's.

Table 5: Simulation results for Experiment 1 with uncorrelated loadings and the full rank.

T/N	20	30	50	100	200	20	30	50	100	200
	β_{CCEP}					β_{CCEMG}				
	Bias									
20	0.0011	-0.0013	0.0003	-0.0007	-0.0007	0.0018	-0.0014	0.0009	-0.0009	-0.0009
30	-0.0015	0.0009	-0.0007	-0.0004	0.0003	-0.0013	0.0003	-0.0007	-0.0003	0.0005
50	-0.0001	-0.0017	0.0003	0.0009	0.0007	-0.0003	-0.0018	0.0002	0.0008	0.0007
100	-0.0011	0.0000	-0.0004	-0.0002	-0.0002	-0.0010	-0.0001	-0.0004	-0.0002	-0.0002
200	-0.0005	-0.0003	-0.0003	-0.0002	-0.0002	-0.0003	-0.0003	-0.0003	-0.0002	-0.0002
	RMSE									
20	0.0578	0.0473	0.0351	0.0236	0.0163	0.0612	0.0494	0.0377	0.0252	0.0171
30	0.0492	0.0374	0.0274	0.0190	0.0134	0.0501	0.0389	0.0285	0.0195	0.0140
50	0.0391	0.0301	0.0213	0.0148	0.0101	0.0387	0.0307	0.0217	0.0152	0.0103
100	0.0308	0.0213	0.0154	0.0109	0.0074	0.0295	0.0212	0.0155	0.0110	0.0075
200	0.0261	0.0161	0.0114	0.0071	0.0049	0.0239	0.0158	0.0114	0.0072	0.0050
	β_{FEP}					β_{FEMG}				
	Bias									
20	0.0028	-0.0003	-0.0001	-0.0015	-0.0004	0.0039	-0.0015	0.0011	-0.0010	0.0000
30	-0.0012	-0.0028	-0.0002	-0.0011	-0.0004	0.0025	0.0001	0.0006	-0.0011	0.0000
50	0.0047	0.0019	0.0017	0.0000	0.0016	0.0032	0.0016	0.0008	-0.0005	0.0012
100	-0.0068	0.0017	-0.0007	-0.0002	-0.0016	-0.0066	0.0004	-0.0019	0.0003	-0.0004
200	-0.0002	-0.0010	-0.0007	-0.0021	-0.0001	-0.0009	-0.0006	-0.0004	-0.0018	-0.0003
	RMSE									
20	0.1224	0.0906	0.0752	0.0507	0.0355	0.1167	0.0914	0.0730	0.0509	0.0355
30	0.1124	0.0901	0.0723	0.0493	0.0345	0.1066	0.0868	0.0687	0.0486	0.0333
50	0.1109	0.0914	0.0713	0.0486	0.0342	0.1064	0.0881	0.0677	0.0452	0.0327
100	0.1111	0.0908	0.0681	0.0509	0.0325	0.1010	0.0848	0.0639	0.0474	0.0316
200	0.1097	0.0849	0.0694	0.0470	0.0350	0.1012	0.0789	0.0639	0.0439	0.0330
	β_{PC}									
	Bias									
20	-0.0041	-0.0021	0.0002	-0.0006	0.0005					
30	0.0010	0.0007	0.0009	0.0009	-0.0008					
50	0.0016	0.0003	-0.0009	0.0009	0.0000					
100	0.0001	0.0004	0.0000	0.0001	-0.0004					
200	-0.0002	0.0005	0.0001	0.0001	-0.0002					
	RMSE									
20	0.0595	0.0477	0.0349	0.0244	0.0171					
30	0.0476	0.0369	0.0289	0.0199	0.0140					
50	0.0371	0.0278	0.0209	0.0145	0.0102					
100	0.0250	0.0201	0.0147	0.0104	0.0070					
200	0.0175	0.0137	0.0104	0.0074	0.0051					

Notes: CCEP and CCEMG are the pooled and mean group common correlated estimators by Pesaran (2006); FEP and FEMG denote the pooled and mean group two-way fixed effects estimators. PC is the iterative principal component estimator in CHNY. The PC estimator is bias-corrected and evaluated using the IC_{p1} criterion by Bai and Ng (2002).

Table 6: Simulation results for Experiment 2 with uncorrelated loadings and the rank deficiency.

T/N	20	30	50	100	200	20	30	50	100	200
	β_{CCEP}					β_{CCEMG}				
	Bias									
20	-0.0019	0.0014	0.0049	0.0016	0.0004	0.0010	0.0021	0.0033	0.0002	0.0010
30	0.0015	-0.0012	0.0010	-0.0008	-0.0004	0.0023	-0.0010	0.0012	-0.0001	-0.0004
50	0.0019	0.0019	0.0018	0.0012	0.0012	0.0014	0.0007	0.0002	-0.0002	0.0010
100	0.0059	0.0032	0.0008	0.0006	0.0011	0.0033	0.0034	0.0015	0.0010	0.0011
200	0.0052	0.0012	-0.0011	-0.0001	0.0005	0.0039	0.0015	0.0002	0.0001	0.0001
	RMSE									
20	0.1067	0.0855	0.0612	0.0457	0.0327	0.0982	0.0796	0.0571	0.0417	0.0297
30	0.0986	0.0809	0.0619	0.0419	0.0322	0.0861	0.0700	0.0532	0.0379	0.0284
50	0.0967	0.0766	0.0574	0.0420	0.0288	0.0820	0.0623	0.0482	0.0356	0.0243
100	0.0939	0.0791	0.0545	0.0421	0.0293	0.0768	0.0653	0.0445	0.0340	0.0235
200	0.0902	0.0722	0.0583	0.0383	0.0295	0.0725	0.0559	0.0460	0.0314	0.0233
	β_{FEP}					β_{FEMG}				
	Bias									
20	-0.0032	-0.0005	0.0018	0.0016	0.0009	0.0010	0.0016	0.0020	0.0018	0.0013
30	-0.0006	-0.0005	-0.0001	-0.0005	-0.0002	-0.0003	-0.0006	0.0009	-0.0006	0.0000
50	0.0003	-0.0020	0.0020	0.0014	0.0006	0.0001	-0.0021	0.0015	0.0005	0.0011
100	-0.0002	0.0049	-0.0005	0.0006	0.0001	-0.0007	0.0056	0.0002	0.0016	0.0003
200	0.0069	0.0053	-0.0014	-0.0023	0.0007	0.0053	0.0047	-0.0010	-0.0019	0.0000
	RMSE									
20	0.1235	0.0943	0.0737	0.0518	0.0366	0.1237	0.0926	0.0728	0.0505	0.0362
30	0.1169	0.0954	0.0715	0.0513	0.0355	0.1124	0.0888	0.0663	0.0500	0.0346
50	0.1160	0.0883	0.0674	0.0504	0.0331	0.1065	0.0833	0.0657	0.0488	0.0318
100	0.1112	0.0939	0.0679	0.0500	0.0347	0.1030	0.0866	0.0649	0.0469	0.0320
200	0.1099	0.0856	0.0700	0.0499	0.0345	0.1005	0.0806	0.0653	0.0459	0.0327
	β_{PC}									
	Bias									
20	-0.0021	-0.0026	0.0020	0.0010	-0.0005					
30	-0.0009	-0.0004	-0.0006	0.0001	0.0004					
50	0.0010	-0.0014	0.0001	0.0004	-0.0002					
100	0.0014	0.0005	0.0007	0.0003	0.0001					
200	0.0009	-0.0002	-0.0003	0.0001	0.0001					
	RMSE									
20	0.0607	0.0464	0.0345	0.0240	0.0171					
30	0.0484	0.0377	0.0289	0.0196	0.0141					
50	0.0344	0.0281	0.0211	0.0153	0.0105					
100	0.0263	0.0198	0.0150	0.0103	0.0073					
200	0.0177	0.0133	0.0108	0.0074	0.0052					

Notes: See notes to Table 1.

Table 7: Simulation results for Experiment 3 with correlated loadings and the full rank.

T/N	20	30	50	100	200	20	30	50	100	200
	β_{CCEP}					β_{CCEMG}				
	Bias									
20	0.0749	0.0496	0.0297	0.0131	0.0071	0.0689	0.0462	0.0282	0.0124	0.0069
30	0.0736	0.0510	0.0312	0.0145	0.0079	0.0677	0.0476	0.0304	0.0141	0.0078
50	0.0743	0.0501	0.0304	0.0151	0.0071	0.0682	0.0471	0.0292	0.0148	0.007
100	0.0740	0.0482	0.0308	0.0149	0.0074	0.0670	0.0451	0.0296	0.0145	0.0073
200	0.0727	0.0493	0.0300	0.0151	0.0075	0.0662	0.0460	0.0287	0.0148	0.0074
	RMSE									
20	0.1020	0.0727	0.0472	0.0276	0.0184	0.0966	0.0716	0.0479	0.0287	0.0192
30	0.0910	0.0673	0.0428	0.0243	0.0159	0.0848	0.0641	0.0426	0.0249	0.0161
50	0.0889	0.0611	0.0381	0.0215	0.0125	0.0820	0.0582	0.0373	0.0214	0.0126
100	0.0865	0.0552	0.0352	0.0182	0.0104	0.0774	0.0517	0.034	0.0179	0.0104
200	0.0819	0.0548	0.0327	0.0171	0.0091	0.0735	0.0508	0.0314	0.0168	0.0091
	β_{FEP}					β_{FEMG}				
	Bias									
20	0.6510	0.6523	0.6556	0.6577	0.6578	0.54	0.5371	0.5383	0.5376	0.5379
30	0.6566	0.6605	0.6624	0.6596	0.6621	0.5402	0.5425	0.5428	0.5381	0.5398
50	0.6605	0.6584	0.6603	0.6633	0.6615	0.5416	0.5385	0.5376	0.5401	0.5373
100	0.6574	0.662	0.6609	0.6642	0.6648	0.5377	0.5405	0.538	0.5396	0.5385
200	0.6568	0.6617	0.6624	0.6647	0.6647	0.5373	0.539	0.5383	0.5389	0.5377
	RMSE									
20	0.6562	0.6564	0.6591	0.6604	0.6601	0.5462	0.5419	0.5422	0.5404	0.5401
30	0.6605	0.6636	0.6647	0.6615	0.6636	0.5449	0.5463	0.5456	0.5402	0.5414
50	0.6637	0.661	0.662	0.6644	0.6625	0.5456	0.5415	0.5396	0.5414	0.5384
100	0.6600	0.6639	0.6621	0.665	0.6654	0.541	0.5428	0.5394	0.5405	0.5391
200	0.6592	0.6633	0.6634	0.6652	0.6651	0.5402	0.5412	0.5395	0.5396	0.5381
	β_{PC}									
	Bias									
20	0.0068	0.0031	-0.0007	0.0008	0.0005					
30	0.0023	0.0010	0.0008	0.0001	0.0006					
50	0.0005	-0.0001	0.0004	0.0001	0.0003					
100	0.0007	-0.0003	-0.0004	0.0003	0.0002					
200	0.0006	0.0001	0.0001	-0.0003	0.0000					
	RMSE									
20	0.0596	0.0461	0.0356	0.0238	0.0173					
30	0.0465	0.0369	0.0282	0.0198	0.0138					
50	0.0352	0.0279	0.0208	0.0149	0.0102					
100	0.0235	0.0190	0.0147	0.0100	0.0073					
200	0.0168	0.0134	0.0105	0.0072	0.0050					

Notes: See notes to Table 1.

Table 8: Simulation results for Experiment 4 with correlated loadings and the rank deficiency.

T/N	20	30	50	100	200	20	30	50	100	200
	β_{CCEP}					β_{CCEMG}				
	Bias									
20	0.4771	0.4831	0.4848	0.4858	0.4863	0.3502	0.3504	0.3479	0.3472	0.3450
30	0.4809	0.4843	0.4876	0.4912	0.4906	0.3522	0.3463	0.3469	0.3473	0.3451
50	0.4865	0.4880	0.4934	0.4905	0.4966	0.3520	0.3475	0.3488	0.3437	0.3468
100	0.4891	0.4906	0.4953	0.4947	0.4987	0.3513	0.3483	0.3484	0.3444	0.3458
200	0.4856	0.4929	0.4972	0.4957	0.4977	0.3471	0.3468	0.3480	0.3448	0.3450
	RMSE									
20	0.4922	0.4960	0.4957	0.4945	0.4940	0.3628	0.3603	0.3558	0.3529	0.3498
30	0.4925	0.4935	0.4952	0.4971	0.4964	0.3615	0.3536	0.3524	0.3512	0.3487
50	0.4966	0.4954	0.4990	0.4945	0.5000	0.3602	0.3532	0.3531	0.3465	0.3490
100	0.4971	0.4963	0.4992	0.4972	0.5005	0.3574	0.3527	0.3513	0.3462	0.3470
200	0.4926	0.4974	0.5004	0.4976	0.4990	0.3528	0.3504	0.3505	0.3462	0.3459
	β_{FEP}					β_{FEMG}				
	Bias									
20	0.6515	0.6542	0.6573	0.6614	0.6588	0.5401	0.5387	0.5397	0.5421	0.5388
30	0.6548	0.6583	0.6598	0.6614	0.6612	0.5418	0.5390	0.5398	0.5398	0.5389
50	0.6568	0.6581	0.6595	0.6611	0.6648	0.5390	0.5384	0.5378	0.5375	0.5407
100	0.6589	0.6605	0.6618	0.6633	0.6645	0.5384	0.5391	0.5377	0.5376	0.5379
200	0.6555	0.6613	0.6630	0.6641	0.6655	0.5366	0.5385	0.5384	0.5380	0.5387
	RMSE									
20	0.6572	0.6584	0.6606	0.6640	0.6610	0.5465	0.5435	0.5435	0.5448	0.5411
30	0.6589	0.6614	0.6622	0.6631	0.6628	0.5467	0.5426	0.5426	0.5417	0.5406
50	0.6600	0.6604	0.6613	0.6623	0.6658	0.5432	0.5411	0.5398	0.5389	0.5417
100	0.6615	0.6625	0.6630	0.6641	0.6650	0.5416	0.5415	0.5392	0.5385	0.5385
200	0.6581	0.6628	0.6641	0.6647	0.6659	0.5399	0.5405	0.5398	0.5387	0.5391
	β_{PC}									
	Bias									
20	0.0064	0.0013	0.0016	-0.0006	0.0006					
30	-0.0019	0.0025	0.0003	0.0002	0.0004					
50	0.0008	-0.0003	0.0005	0.0008	0.0001					
100	0.0001	0.0006	0.0003	0.0005	-0.0001					
200	0.0002	0.0001	-0.0002	0.0001	0.0001					
	RMSE									
20	0.0593	0.0460	0.0345	0.0245	0.0171					
30	0.0453	0.0371	0.0278	0.0192	0.0133					
50	0.0346	0.0276	0.0214	0.0149	0.0106					
100	0.0247	0.0189	0.0150	0.0101	0.0072					
200	0.0168	0.0134	0.0103	0.0072	0.0050					

Notes: See notes to Table 1.

3 Simulations results for the PC estimators based on the alternative information criterion

Here we report the additional simulation results for the bias corrected PC estimators discussed in Section 4.3, which are evaluated using the AIC_1 criterion by Bai and Ng (2002). In this case we find that the performance of the PC estimator is relatively poor in terms of bias and RMSE unless both N and T become large. This demonstrates that the performance of the PC estimator would rely crucially upon the selection of the appropriate information criterion in practice.

Table 9: Simulation results for Experiment 1 with uncorrelated loadings and the full rank for homogeneous β=1

T/N	20	30	50	100	200
	β_{PC}				
	Bias				
20	-0.0622	-0.0714	-0.0583	0.0887	0.0062
30	-0.0980	0.0183	-0.1216	0.0069	-0.1130
50	-0.1228	-0.0175	-0.0304	-0.0015	-0.0002
100	-0.0939	-0.0296	-0.0123	-0.0017	-0.0001
200	-0.0653	-0.0527	-0.0074	-0.0010	-0.0002
	RMSE				
20	0.1215	0.1526	0.1754	0.1012	0.0464
30	0.1410	0.0877	0.1612	0.0635	0.1178
50	0.1680	0.0883	0.0722	0.0179	0.0115
100	0.1374	0.0963	0.0370	0.0104	0.0074
200	0.1411	0.1053	0.0251	0.0077	0.0051

Notes: PC is the iterative principal component in CHNY. The pooled PC estimator is bias-corrected and evaluated using the AIC_1 criterion by Bai and Ng (2002).

Table 10: Simulation results for Experiment 1 with uncorrelated loadings and the full rank for heterogeneous $\beta_i = 1 + \eta_i$, $\eta_i \sim iidN(0, 0.04)$

T/N	20	30	50	100	200
	β_{PC}				
	Bias				
20	-0.0999	-0.0943	-0.1285	-0.0951	0.1211
30	-0.1142	-0.0408	-0.0126	-0.0113	-0.0106
50	-0.1225	-0.0416	-0.0108	-0.0133	-0.0011
100	-0.1026	-0.0681	-0.0071	-0.0020	-0.0012
200	-0.0834	-0.0270	-0.0037	-0.0037	-0.0014
	RMSE				
20	0.1637	0.1335	0.1665	0.1084	0.1314
30	0.1821	0.1212	0.1214	0.0654	0.0397
50	0.1826	0.1219	0.0667	0.0481	0.0160
100	0.1787	0.1129	0.0390	0.0202	0.0154
200	0.1687	0.0945	0.0341	0.0226	0.0152

Notes: See notes to Table 9.

Table 11: Simulation results for Experiment 2 with uncorrelated loadings and the rank deficiency for homogeneous β=1

T/N	20	30	50	100	200
	β_{PC}				
	Bias				
20	-0.0914	-0.1256	-0.0448	-0.0752	-0.0311
30	-0.1090	-0.0086	-0.0648	0.0432	-0.0226
50	-0.0262	-0.1031	0.0078	-0.0020	0.0003
100	-0.0951	-0.0743	-0.0091	-0.0019	-0.0008
200	-0.0638	-0.0508	-0.0061	-0.0011	-0.0009
	RMSE				
20	0.1779	0.1943	0.0920	0.0898	0.0417
30	0.1588	0.0874	0.1123	0.0709	0.0523
50	0.1040	0.1468	0.0558	0.0188	0.0109
100	0.1409	0.1129	0.0410	0.0108	0.0070
200	0.1547	0.1060	0.0206	0.0072	0.0051

Notes: See notes to Table 9.

Table 12: Simulation results for Experiment 2 with uncorrelated loadings and the rank deficiency for heterogeneous $\beta_i = 1 + \eta_i$, $\eta_i \sim iidN(0, 0.04)$

T/N	20	30	50	100	200
	β_{PC}				
	Bias				
20	-0.1578	-0.1110	0.0388	-0.1459	-0.0829
30	-0.1061	-0.0493	-0.0780	-0.0803	-0.0102
50	0.0644	-0.0560	0.0156	-0.0014	-0.0001
100	-0.0804	-0.0393	-0.0034	-0.0018	-0.0011
200	-0.0793	-0.0262	-0.0061	0.0004	-0.0009
	RMSE				
20	0.2126	0.1905	0.0830	0.1574	0.0925
30	0.1853	0.1295	0.1112	0.0924	0.0411
50	0.1770	0.1176	0.0756	0.0298	0.0182
100	0.1549	0.1087	0.0365	0.0225	0.0160
200	0.1648	0.0824	0.0374	0.0206	0.0160

Notes: See notes to Table 9.

Table 13: Simulation results for Experiment 3 with correlated loadings and the full rank for homogeneous β=1

T/N	20	30	50	100	200
			β_{PC}		
			Bias		
20	0.4802	0.4640	0.3552	0.0620	0.5039
30	0.4096	0.4426	0.4336	0.2282	0.4183
50	0.4310	0.2863	0.2826	0.0430	0.0007
100	0.4189	0.3580	0.0849	-0.0004	-0.0004
200	0.4164	0.2747	-0.0012	-0.0005	0.0000
			RMSE		
20	0.4892	0.4696	0.3594	0.1991	0.5047
30	0.4185	0.4595	0.4469	0.3378	0.4194
50	0.4710	0.3737	0.3489	0.1334	0.0107
100	0.4505	0.3835	0.1812	0.0109	0.0070
200	0.4260	0.3440	0.0160	0.0073	0.0049

Notes: See notes to Table 9.

Table 14: Simulation results for Experiment 3 with correlated loadings and the full rank for heterogeneous $\beta_i = 1 + \eta_i$, $\eta_i \sim iidN(0, 0.04)$

T/N	20	30	50	100	200
			β_{PC}		
			Bias		
20	0.5022	0.4743	0.4656	0.4456	0.3559
30	0.4216	0.3305	0.4143	0.4285	0.4288
50	0.3789	0.3791	0.3490	0.0037	-0.0015
100	0.4207	0.3375	0.0512	-0.0017	-0.0026
200	0.4326	0.2649	0.0203	-0.0018	0.0016
			RMSE		
20	0.5308	0.4832	0.4714	0.4480	0.3573
30	0.4343	0.3379	0.4465	0.4384	0.4482
50	0.3915	0.4147	0.3816	0.0502	0.0187
100	0.4382	0.3773	0.1530	0.0244	0.0164
200	0.4516	0.3429	0.0957	0.0214	0.0146

Notes: See notes to Table 9.

Table 15: Simulation results for Experiment 4 with correlated loadings and the rank deficiency for homogeneous β=1

T/N	20	30	50	100	200
	β_{PC}				
	Bias				
20	0.1682	0.3039	0.2566	0.3033	0.4474
30	0.3116	0.3096	0.2330	0.1456	0.0725
50	0.3121	0.2416	0.1828	0.1705	0.0142
100	0.2933	0.1522	0.0081	-0.0007	-0.0002
200	0.2781	0.1546	0.0090	-0.0001	-0.0003
	RMSE				
20	0.1828	0.3200	0.2623	0.3066	0.4487
30	0.3367	0.3323	0.2984	0.2370	0.1604
50	0.3244	0.2810	0.1541	0.2271	0.0630
100	0.3091	0.2164	0.0534	0.0108	0.0074
200	0.3084	0.2158	0.0521	0.0071	0.0051

Notes: See notes to Table 9.

Table 16: Simulation results for Experiment 4 with correlated loadings and the rank deficiency for heterogeneous $\beta_i = 1 + \eta_i$, $\eta_i \sim iidN(0, 0.04)$

T/N	20	30	50	100	200
	β_{PC}				
	Bias				
20	0.2498	0.3094	0.3432	0.3648	0.3720
30	0.2116	0.2406	0.2611	0.0319	0.2745
50	0.2796	0.2523	0.1988	-0.0003	0.0042
100	0.2588	0.1005	0.0242	0.0006	-0.0005
200	0.2485	0.1611	-0.0142	-0.0025	-0.0009
	RMSE				
20	0.2691	0.3221	0.3501	0.3802	0.3740
30	0.2318	0.2537	0.2924	0.1076	0.2758
50	0.3185	0.2956	0.2253	0.0398	0.0423
100	0.2928	0.1774	0.0889	0.0282	0.0153
200	0.2915	0.2189	0.0302	0.0214	0.0138

Notes: See notes to Table 9.

4 Additional simulations results for the Hausman-type statistic

Here, we examine the two additional cases:

- Case 3: Homogeneous β's and serial correlation; see Tables 17 and 18 for H^{NON} and H^{HAC} test results.
- Case 4: Heterogeneous β's and no serial correlation; see Tables 19 and 20 for H^{NON} and H^{HAC} test results.

We find that the test performance as well as the coverage rates reported here, are satisfactory and qualitatively similar to those reported in Section 4.3 in the main text.

Table 17: Size and power of the H^{NON} statistic and coverage rates at 95 % level.

	Experiment 1						Experiment 3				
	Size						Power				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.061	0.053	0.042	0.054	0.053	50	1	1	1	1	1
100	0.070	0.058	0.052	0.050	0.059	100	1	1	1	1	1
150	0.066	0.062	0.040	0.046	0.061	150	1	1	1	1	1
200	0.061	0.061	0.062	0.051	0.040	200	1	1	1	1	1
500	0.062	0.049	0.051	0.048	0.046	500	1	1	1	1	1
	Coverage rates β_{FE}						Coverage rates β_{FE}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.946	0.947	0.957	0.947	0.954	50	0	0	0	0	0
100	0.930	0.937	0.939	0.952	0.943	100	0	0	0	0	0
150	0.951	0.941	0.954	0.955	0.945	150	0	0	0	0	0
200	0.939	0.939	0.937	0.948	0.958	200	0	0	0	0	0
500	0.946	0.955	0.951	0.953	0.951	500	0	0	0	0	0
	Coverage rates β_{PC}						Coverage rates β_{PC}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.915	0.941	0.948	0.947	0.941	50	0.920	0.936	0.939	0.942	0.943
100	0.909	0.944	0.941	0.944	0.936	100	0.910	0.944	0.944	0.945	0.946
150	0.898	0.936	0.945	0.941	0.956	150	0.932	0.945	0.943	0.960	0.955
200	0.924	0.935	0.938	0.952	0.947	200	0.922	0.943	0.942	0.952	0.942
500	0.910	0.939	0.945	0.938	0.948	500	0.927	0.940	0.949	0.945	0.949
	Experiment 2						Experiment 4				
	Size						Power				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.052	0.052	0.074	0.043	0.050	50	1	1	1	1	1
100	0.076	0.051	0.050	0.054	0.046	100	1	1	1	1	1
150	0.074	0.057	0.059	0.056	0.062	150	1	1	1	1	1
200	0.069	0.052	0.062	0.051	0.060	200	1	1	1	1	1
500	0.067	0.062	0.055	0.050	0.044	500	1	1	1	1	1
	Coverage rates β_{FE}						Coverage rates β_{FE}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.941	0.939	0.925	0.946	0.948	50	0	0	0	0	0
100	0.933	0.943	0.950	0.944	0.950	100	0	0	0	0	0
150	0.940	0.943	0.935	0.951	0.939	150	0	0	0	0	0
200	0.931	0.944	0.942	0.951	0.947	200	0	0	0	0	0
500	0.934	0.940	0.949	0.956	0.954	500	0	0	0	0	0
	Coverage rates β_{PC}						Coverage rates β_{PC}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.883	0.942	0.937	0.952	0.951	50	0.927	0.942	0.951	0.942	0.929
100	0.890	0.933	0.947	0.931	0.947	100	0.748	0.941	0.938	0.933	0.95
150	0.914	0.914	0.936	0.937	0.948	150	0.822	0.644	0.944	0.951	0.944
200	0.916	0.917	0.923	0.943	0.963	200	0.799	0.762	0.721	0.941	0.956
500	0.921	0.929	0.926	0.935	0.948	500	0.878	0.847	0.823	0.786	0.951

Notes: see notes to Table 5 in the main text.

Table 18: Size and power of the H^{HAC} statistic and coverage rates at 95 % level for serially correlated errors.

	Experiment 1						Experiment 3				
	Size						Power				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.066	0.055	0.056	0.044	0.047	50	1	1	1	1	1
100	0.081	0.060	0.055	0.061	0.045	100	1	1	1	1	1
150	0.059	0.058	0.053	0.051	0.046	150	1	1	1	1	1
200	0.072	0.068	0.057	0.044	0.051	200	1	1	1	1	1
500	0.073	0.069	0.053	0.059	0.047	500	1	1	1	1	1
	Coverage rates β_{FE}						Coverage rates β_{FE}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.933	0.936	0.937	0.945	0.962	50	0	0	0	0	0
100	0.931	0.940	0.945	0.950	0.955	100	0	0	0	0	0
150	0.943	0.946	0.943	0.954	0.961	150	0	0	0	0	0
200	0.932	0.936	0.944	0.955	0.947	200	0	0	0	0	0
500	0.926	0.932	0.950	0.946	0.957	500	0	0	0	0	0
	Coverage rates β_{PC}						Coverage rates β_{PC}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.929	0.945	0.947	0.945	0.939	50	0.938	0.939	0.920	0.950	0.950
100	0.914	0.945	0.950	0.936	0.955	100	0.924	0.948	0.943	0.946	0.935
150	0.919	0.916	0.931	0.927	0.946	150	0.924	0.939	0.924	0.939	0.941
200	0.92	0.931	0.950	0.943	0.945	200	0.925	0.937	0.943	0.949	0.930
500	0.923	0.950	0.954	0.951	0.954	500	0.916	0.934	0.945	0.957	0.941
	Experiment 2						Experiment 4				
	Size						Power				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.062	0.052	0.049	0.063	0.051	50	1	1	1	1	1
100	0.062	0.059	0.047	0.05	0.053	100	1	1	1	1	1
150	0.077	0.061	0.058	0.045	0.054	150	1	1	1	1	1
200	0.065	0.068	0.067	0.046	0.049	200	1	1	1	1	1
500	0.059	0.067	0.067	0.05	0.064	500	1	1	1	1	1
	Coverage rates β_{FE}						Coverage rates β_{FE}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.938	0.937	0.952	0.946	0.945	50	0	0	0	0	0
100	0.943	0.945	0.957	0.945	0.956	100	0	0	0	0	0
150	0.928	0.941	0.952	0.951	0.939	150	0	0	0	0	0
200	0.936	0.934	0.938	0.952	0.947	200	0	0	0	0	0
500	0.942	0.937	0.931	0.948	0.94	500	0	0	0	0	0
	Coverage rates β_{PC}						Coverage rates β_{PC}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.896	0.940	0.952	0.940	0.958	50	0.914	0.926	0.943	0.953	0.951
100	0.875	0.947	0.939	0.932	0.955	100	0.706	0.941	0.948	0.945	0.949
150	0.903	0.907	0.936	0.939	0.946	150	0.785	0.717	0.951	0.940	0.948
200	0.906	0.905	0.925	0.942	0.950	200	0.833	0.790	0.711	0.936	0.946
500	0.92	0.923	0.926	0.930	0.957	500	0.894	0.835	0.801	0.789	0.949

Notes: see notes to Table 6 in the main text.

Table 19: Size and power of the H^{NON} statistic and coverage rates at 95 % level.

	Experiment 1						Experiment 3				
	Size						Power				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.061	0.053	0.050	0.058	0.057	50	1	1	1	1	1
100	0.054	0.063	0.047	0.054	0.049	100	1	1	1	1	1
150	0.079	0.067	0.062	0.064	0.045	150	1	1	1	1	1
200	0.065	0.062	0.058	0.057	0.047	200	1	1	1	1	1
500	0.058	0.053	0.066	0.051	0.057	500	1	1	1	1	1
	Coverage rates β_{FE}						Coverage rates β_{FE}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.942	0.948	0.942	0.940	0.946	50	0	0	0	0	0
100	0.951	0.938	0.950	0.943	0.955	100	0	0	0	0	0
150	0.939	0.941	0.950	0.938	0.954	150	0	0	0	0	0
200	0.936	0.946	0.949	0.945	0.945	200	0	0	0	0	0
500	0.944	0.946	0.935	0.944	0.947	500	0	0	0	0	0
	Coverage rates β_{PC}						Coverage rates β_{PC}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.918	0.923	0.940	0.948	0.935	50	0.924	0.930	0.938	0.946	0.943
100	0.913	0.937	0.945	0.949	0.952	100	0.834	0.936	0.943	0.946	0.952
150	0.926	0.933	0.945	0.936	0.948	150	0.809	0.777	0.938	0.944	0.947
200	0.899	0.930	0.934	0.942	0.948	200	0.884	0.856	0.815	0.947	0.942
500	0.928	0.928	0.936	0.944	0.937	500	0.896	0.913	0.901	0.907	0.952
	Experiment 2						Experiment 4				
	Size						Power				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.061	0.054	0.047	0.046	0.046	50	1	1	1	1	1
100	0.063	0.057	0.056	0.066	0.043	100	1	1	1	1	1
150	0.069	0.069	0.045	0.050	0.047	150	1	1	1	1	1
200	0.064	0.062	0.061	0.060	0.057	200	1	1	1	1	1
500	0.073	0.049	0.074	0.051	0.042	500	1	1	1	1	1
	Coverage rates β_{FE}						Coverage rates β_{FE}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.931	0.951	0.950	0.953	0.952	50	0	0	0	0	0
100	0.928	0.943	0.937	0.939	0.941	100	0	0	0	0	0
150	0.940	0.928	0.954	0.952	0.948	150	0	0	0	0	0
200	0.927	0.948	0.945	0.945	0.944	200	0	0	0	0	0
500	0.930	0.948	0.936	0.954	0.956	500	0	0	0	0	0
	Coverage rates β_{PC}						Coverage rates β_{PC}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.906	0.927	0.942	0.955	0.955	50	0.919	0.946	0.939	0.946	0.944
100	0.915	0.938	0.937	0.932	0.941	100	0.865	0.935	0.946	0.945	0.950
150	0.909	0.926	0.933	0.954	0.939	150	0.889	0.875	0.935	0.942	0.949
200	0.921	0.934	0.936	0.946	0.945	200	0.910	0.906	0.911	0.942	0.935
500	0.931	0.932	0.935	0.935	0.947	500	0.910	0.924	0.932	0.935	0.951

Notes: see notes to Table 5 in the main text.

Table 20: Size and power of the H^{HAC} statistic and coverage rates at 95 % level.

	Experiment 1						Experiment 3				
	Size						Power				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.076	0.057	0.052	0.064	0.044	50	1	1	1	1	1
100	0.070	0.068	0.044	0.049	0.040	100	1	1	1	1	1
150	0.069	0.054	0.046	0.054	0.053	150	1	1	1	1	1
200	0.076	0.071	0.053	0.055	0.044	200	1	1	1	1	1
500	0.064	0.078	0.061	0.067	0.053	500	1	1	1	1	1
	Coverage rates β_{FE}						Coverage rates β_{FE}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.931	0.933	0.941	0.928	0.949	50	0	0	0	0	0
100	0.926	0.936	0.943	0.955	0.954	100	0	0	0	0	0
150	0.932	0.940	0.952	0.940	0.949	150	0	0	0	0	0
200	0.931	0.951	0.940	0.947	0.957	200	0	0	0	0	0
500	0.929	0.939	0.943	0.940	0.951	500	0	0	0	0	0
	Coverage rates β_{PC}						Coverage rates β_{PC}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.907	0.931	0.944	0.946	0.949	50	0.922	0.932	0.940	0.940	0.960
100	0.927	0.928	0.928	0.950	0.950	100	0.616	0.928	0.950	0.944	0.952
150	0.916	0.935	0.957	0.940	0.945	150	0.828	0.746	0.960	0.944	0.960
200	0.918	0.931	0.939	0.954	0.936	200	0.850	0.880	0.828	0.938	0.948
500	0.923	0.925	0.932	0.945	0.951	500	0.922	0.918	0.914	0.890	0.964
	Experiment 2						Experiment 4				
	Size						Power				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.074	0.074	0.066	0.066	0.050	50	1	1	1	1	1
100	0.064	0.052	0.042	0.052	0.040	100	1	1	1	1	1
150	0.062	0.042	0.058	0.058	0.040	150	1	1	1	1	1
200	0.086	0.066	0.072	0.046	0.048	200	1	1	1	1	1
500	0.062	0.074	0.078	0.052	0.036	500	1	1	1	1	1
	Coverage rates β_{FE}						Coverage rates β_{FE}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.944	0.934	0.934	0.936	0.940	50	0	0	0	0	0
100	0.944	0.942	0.942	0.942	0.952	100	0	0	0	0	0
150	0.936	0.952	0.942	0.940	0.948	150	0	0	0	0	0
200	0.916	0.940	0.942	0.948	0.948	200	0	0	0	0	0
500	0.944	0.930	0.920	0.930	0.952	500	0	0	0	0	0
	Coverage rates β_{PC}						Coverage rates β_{PC}				
T/N	50	100	150	200	500	T/N	50	100	150	200	500
50	0.916	0.956	0.952	0.936	0.944	50	0.932	0.936	0.957	0.941	0.948
100	0.928	0.946	0.944	0.934	0.966	100	0.880	0.944	0.943	0.942	0.954
150	0.900	0.932	0.946	0.952	0.948	150	0.897	0.901	0.944	0.943	0.940
200	0.908	0.936	0.940	0.928	0.936	200	0.877	0.901	0.926	0.948	0.956
500	0.914	0.948	0.940	0.952	0.926	500	0.926	0.935	0.939	0.931	0.946

Notes: see notes to Table 6 in the main text.

5 The *pretest* estimator

We now propose to construct a *pretest* estimator as follows. The *pretest* estimator, denoted $\hat{\beta}_{pretest}$, selects either the FE or the PC estimator depending on the Hausman-type test results. To be more specific, we first evaluate the $H^{NON}$and H^{HAC} statistics. If the null hypothesis of uncorrelated factor loadings is not rejected, then we select $\hat{\beta}_{pretest} = \hat{\beta}_{FE}$ while, if the null is rejected, we set $\hat{\beta}_{pretest} = \hat{\beta}_{PC}$.

We examine the finite sample performance a *pretest* estimator under the same four experiments considered in Section 4.3, and evaluate the bias, $RMSE$ and the coverage rates at 95% of significance, evaluated using the robust nonparametric variance estimators defined in (27) and (28). We consider the cases with homogeneous βs and heterogeneous βs with $\beta_i = \beta + \eta_i$ and $\eta_i \sim iidN(0, 0.04)$, in conjunction with serially correlated errors, *i.e.* $\varepsilon_{it} = \rho_\varepsilon \varepsilon_{it} + v_{\varepsilon it}$ and $u_{it} = \rho_u u_{it} + v_{uit}$ with $\rho_\varepsilon = \rho_u = 0.5$.

The performance of the *pretest* estimator is similar across all the experiments, showing that the *pretest* estimator is consistent and that the nonparametric covariance estimators are robust to the presence of serially correlated errors as well as heterogeneous βs, see Tables (21)-(27). In Experiments 1 and 2, when factor loadings are not correlated, the *pretest* estimator tends to select $\hat{\beta}_{FE}$ mostly (about 95% times) in which case the bias is negligible and $RMSE$ declines sharply with N. The coverage rates are slightly higher than the nominal level. Turning to Experiments 3 and 4, when factor loadings are correlated, the *pretest* estimator almost always selects $\hat{\beta}_{PC}$. The bias of of the *pretest* estimator is negligible, $RMSE$ declines with N and T, and the coverage rates approaches the nominal level.

Table 21: Performance of the $\beta pretest$ estimator, selected between β_{FE} and β_{PC} using H^{NON}

	Experiment 1						Experiment 3				
	Bias						*Bias*				
T/N	20	30	50	100	200	T/N	20	30	50	100	200
20	-0.002	-0.002	-0.005	-0.001	0.001	20	0.010	0.000	0.000	0.002	0.001
30	0.004	0.002	-0.003	-0.002	0.000	30	0.003	0.002	0.000	0.000	0.000
50	0.001	-0.002	0.000	0.000	-0.001	50	0.003	-0.001	0.002	-0.001	0.000
100	-0.003	0.003	-0.002	0.002	0.000	100	0.001	0.000	0.000	0.000	0.000
200	0.002	-0.003	-0.002	-0.001	-0.001	200	0.000	0.000	0.000	0.000	0.000
	RMSE						*RMSE*				
20	0.102	0.088	0.067	0.047	0.035	20	0.075	0.049	0.036	0.025	0.017
30	0.088	0.080	0.068	0.044	0.032	30	0.063	0.037	0.028	0.019	0.014
50	0.089	0.076	0.056	0.040	0.029	50	0.035	0.028	0.022	0.015	0.010
100	0.088	0.073	0.061	0.041	0.029	100	0.025	0.019	0.015	0.010	0.007
200	0.088	0.073	0.057	0.040	0.029	200	0.017	0.013	0.010	0.007	0.005
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.956	0.968	0.963	0.972	0.976	20	0.880	0.886	0.916	0.936	0.954
30	0.947	0.958	0.976	0.974	0.985	30	0.852	0.900	0.923	0.933	0.938
50	0.941	0.977	0.983	0.976	0.980	50	0.876	0.901	0.919	0.941	0.948
100	0.964	0.978	0.982	0.983	0.986	100	0.875	0.910	0.933	0.931	0.950
200	0.972	0.986	0.987	0.988	0.985	200	0.906	0.927	0.914	0.938	0.951
	Experiment 2						Experiment 4				
	Bias						*Bias*				
20	0.005	-0.002	0.001	-0.004	0.001	20	0.006	0.001	0.002	0.001	0.000
30	-0.002	0.001	-0.001	-0.002	0.000	30	-0.002	0.001	0.003	0.000	0.001
50	-0.004	-0.005	-0.002	0.002	0.001	50	0.002	0.000	0.001	-0.001	0.000
100	0.007	-0.003	0.002	-0.001	-0.002	100	0.002	0.001	-0.001	0.000	0.000
200	-0.001	-0.003	0.001	0.000	-0.001	200	0.000	0.000	0.000	0.000	0.000
	RMSE						*RMSE*				
20	0.097	0.075	0.070	0.046	0.031	20	0.066	0.046	0.036	0.025	0.017
30	0.092	0.078	0.058	0.044	0.029	30	0.045	0.037	0.028	0.019	0.014
50	0.099	0.073	0.058	0.046	0.031	50	0.036	0.027	0.021	0.015	0.010
100	0.094	0.072	0.055	0.040	0.030	100	0.024	0.020	0.015	0.011	0.007
200	0.095	0.073	0.054	0.040	0.028	200	0.017	0.014	0.011	0.007	0.005
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.933	0.967	0.975	0.973	0.978	20	0.863	0.909	0.918	0.940	0.942
30	0.954	0.956	0.962	0.976	0.976	30	0.885	0.899	0.921	0.939	0.938
50	0.964	0.975	0.983	0.986	0.977	50	0.871	0.904	0.914	0.935	0.947
100	0.973	0.980	0.981	0.989	0.984	100	0.898	0.900	0.915	0.930	0.939
200	0.982	0.984	0.990	0.991	0.989	200	0.872	0.899	0.919	0.948	0.948

Notes: FE is the two-way pooled fixed effects estimator; PC is the iteractive principal component estimator in CHNY. The PC estimator is computed using the IC_{p1} criterion and is corrected for the bias. H^{NON} denotes the H-statistic evaluated using the non parametric NON variance-covariance estimators.

Table 22: Performance of the $\beta pretest$ estimator, selected between β_{FE} and β_{PC} using H^{HAC}

	Experiment 1						Experiment 3				
	Bias						*Bias*				
T/N	20	30	50	100	200	T/N	20	30	50	100	200
20	0.000	-0.003	0.001	-0.002	0.001	20	-0.001	0.002	0.001	0.000	0.001
30	-0.003	-0.001	0.001	-0.001	0.001	30	0.001	0.002	0.000	0.001	-0.001
50	-0.004	0.003	-0.001	0.001	0.001	50	0.002	0.000	0.000	0.000	0.000
100	-0.004	0.001	0.000	0.002	0.000	100	0.001	0.001	0.001	0.000	0.000
200	0.004	0.003	0.001	0.000	-0.001	200	-0.001	0.000	0.000	-0.001	0.000
	RMSE						*RMSE*				
20	0.100	0.079	0.065	0.048	0.032	20	0.059	0.047	0.035	0.024	0.017
30	0.101	0.082	0.059	0.040	0.034	30	0.046	0.038	0.027	0.020	0.014
50	0.080	0.071	0.051	0.042	0.031	50	0.036	0.029	0.021	0.014	0.011
100	0.085	0.070	0.056	0.043	0.029	100	0.024	0.019	0.015	0.010	0.007
200	0.084	0.073	0.056	0.040	0.031	200	0.017	0.013	0.010	0.007	0.005
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.931	0.943	0.954	0.973	0.974	20	0.866	0.900	0.928	0.937	0.952
30	0.948	0.972	0.971	0.984	0.977	30	0.884	0.895	0.926	0.942	0.932
50	0.966	0.962	0.976	0.970	0.988	50	0.851	0.900	0.935	0.953	0.942
100	0.970	0.965	0.985	0.982	0.988	100	0.875	0.926	0.931	0.949	0.939
200	0.981	0.983	0.984	0.989	0.991	200	0.888	0.906	0.927	0.934	0.932
	Experiment 2						Experiment 4				
	Bias						*Bias*				
20	-0.001	0.001	0.000	0.000	0.000	20	0.002	-0.001	-0.001	0.000	0.001
30	-0.001	-0.002	0.001	0.001	0.000	30	-0.001	0.002	0.001	0.000	0.001
50	-0.001	-0.002	0.000	0.001	-0.001	50	0.000	-0.001	0.001	0.001	0.000
100	-0.003	0.003	-0.001	0.000	-0.001	100	0.000	0.001	-0.001	0.000	0.000
200	0.003	-0.001	0.001	-0.001	-0.001	200	0.002	0.000	0.000	0.000	0.000
	RMSE						*RMSE*				
20	0.091	0.072	0.064	0.049	0.034	20	0.056	0.046	0.035	0.024	0.018
30	0.095	0.073	0.067	0.045	0.031	30	0.047	0.038	0.027	0.020	0.014
50	0.091	0.068	0.057	0.044	0.032	50	0.034	0.027	0.021	0.015	0.010
100	0.090	0.073	0.060	0.042	0.029	100	0.025	0.019	0.015	0.010	0.007
200	0.091	0.073	0.057	0.040	0.029	200	0.018	0.013	0.010	0.007	0.005
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.949	0.958	0.964	0.957	0.972	20	0.885	0.903	0.921	0.953	0.939
30	0.956	0.961	0.974	0.969	0.976	30	0.859	0.898	0.935	0.937	0.925
50	0.959	0.976	0.975	0.977	0.983	50	0.894	0.919	0.928	0.945	0.951
100	0.971	0.971	0.986	0.981	0.980	100	0.882	0.923	0.928	0.934	0.940
200	0.969	0.981	0.980	0.983	0.988	200	0.863	0.908	0.926	0.940	0.943

Notes: H^{HAC} denotes the H-statistic evaluated using the non parametric HAC variance-covariance estimators.

Table 23: Performance of the $\beta pretest$ estimator, selected between β_{FE} and β_{PC} using H^{NON}, heterogeneous βs.

	Experiment 1						Experiment 3				
	Bias						*Bias*				
T/N	20	30	50	100	200	T/N	20	30	50	100	200
20	0.001	0.004	0.002	-0.002	0.001	20	0.007	-0.001	0.000	0.001	-0.001
30	-0.003	0.000	0.000	0.000	0.000	30	0.006	0.000	-0.001	0.001	0.000
50	-0.004	0.002	0.002	-0.001	0.000	50	0.002	-0.002	-0.003	0.000	0.001
100	-0.002	-0.001	-0.003	-0.001	0.002	100	0.000	-0.002	-0.001	-0.001	0.000
200	0.002	-0.002	0.001	0.001	0.000	200	-0.004	-0.003	-0.001	0.000	0.000
	RMSE						*RMSE*				
20	0.119	0.096	0.071	0.052	0.036	20	0.111	0.060	0.046	0.032	0.023
30	0.109	0.084	0.066	0.045	0.034	30	0.094	0.054	0.040	0.030	0.021
50	0.105	0.085	0.070	0.051	0.034	50	0.077	0.049	0.035	0.025	0.017
100	0.103	0.088	0.067	0.047	0.033	100	0.058	0.043	0.032	0.023	0.017
200	0.098	0.084	0.069	0.046	0.032	200	0.054	0.040	0.031	0.022	0.015
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.930	0.963	0.953	0.963	0.968	20	0.846	0.901	0.922	0.947	0.947
30	0.945	0.942	0.958	0.972	0.973	30	0.866	0.880	0.928	0.926	0.931
50	0.957	0.953	0.980	0.967	0.975	50	0.861	0.887	0.924	0.934	0.953
100	0.958	0.969	0.974	0.984	0.970	100	0.855	0.880	0.921	0.942	0.941
200	0.951	0.961	0.963	0.968	0.982	200	0.860	0.889	0.918	0.927	0.944
	Experiment 2						Experiment 4				
	Bias						*Bias*				
20	0.007	0.002	-0.001	0.001	-0.002	20	0.012	0.006	0.001	0.000	0.000
30	-0.004	-0.004	0.000	-0.001	0.000	30	-0.002	-0.004	-0.003	-0.002	-0.002
50	0.006	0.000	0.003	-0.001	0.002	50	-0.002	-0.004	-0.002	-0.002	0.000
100	0.000	-0.005	0.000	0.001	0.001	100	-0.004	-0.004	-0.002	0.000	-0.001
200	-0.005	0.000	0.001	0.000	0.001	200	-0.005	-0.005	-0.005	-0.002	-0.001
	RMSE						*RMSE*				
20	0.114	0.091	0.071	0.056	0.039	20	0.099	0.063	0.046	0.033	0.023
30	0.107	0.091	0.071	0.045	0.034	30	0.077	0.053	0.041	0.030	0.020
50	0.103	0.084	0.066	0.046	0.033	50	0.068	0.046	0.036	0.024	0.017
100	0.103	0.084	0.065	0.050	0.035	100	0.057	0.042	0.031	0.023	0.016
200	0.094	0.085	0.068	0.048	0.032	200	0.047	0.039	0.030	0.022	0.015
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.935	0.946	0.954	0.967	0.971	20	0.834	0.907	0.931	0.933	0.934
30	0.952	0.952	0.967	0.973	0.962	30	0.871	0.892	0.902	0.930	0.950
50	0.957	0.961	0.958	0.979	0.972	50	0.876	0.900	0.917	0.947	0.943
100	0.961	0.962	0.973	0.971	0.978	100	0.874	0.904	0.929	0.945	0.947
200	0.950	0.966	0.967	0.980	0.985	200	0.871	0.903	0.92	0.94	0.944

Notes: See notes to Table 21.

Table 24: Performance of the $\beta pretest$ estimator, selected between β_{FE} and β_{PC} using H^{HAC}, heterogeneous βs.

	Experiment 1						Experiment 3				
	Bias						*Bias*				
T/N	20	30	50	100	200	T/N	20	30	50	100	200
20	-0.002	0.002	-0.002	0.000	0.001	20	-0.003	0.002	0.001	0.001	0.000
30	0.001	0.002	-0.002	0.002	-0.001	30	-0.003	-0.003	0.001	0.000	0.000
50	0.003	-0.003	-0.001	0.001	0.000	50	-0.002	-0.001	0.000	-0.001	0.001
100	0.000	-0.001	0.000	-0.001	0.000	100	0.000	-0.001	-0.001	-0.001	-0.001
200	-0.001	0.002	0.000	-0.002	-0.001	200	-0.002	-0.001	-0.002	-0.002	0.000
	RMSE						*RMSE*				
20	0.121	0.102	0.072	0.047	0.037	20	0.075	0.063	0.046	0.031	0.022
30	0.101	0.087	0.075	0.050	0.037	30	0.068	0.054	0.041	0.029	0.020
50	0.105	0.089	0.063	0.051	0.034	50	0.058	0.046	0.037	0.026	0.018
100	0.102	0.079	0.070	0.045	0.033	100	0.052	0.041	0.032	0.023	0.016
200	0.103	0.086	0.064	0.047	0.033	200	0.048	0.039	0.030	0.021	0.015
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.912	0.947	0.953	0.974	0.972	20	0.868	0.890	0.919	0.954	0.950
30	0.938	0.950	0.955	0.961	0.970	30	0.861	0.897	0.917	0.925	0.944
50	0.941	0.951	0.965	0.967	0.973	50	0.862	0.901	0.908	0.939	0.937
100	0.949	0.959	0.968	0.979	0.966	100	0.869	0.915	0.926	0.926	0.946
200	0.949	0.955	0.964	0.975	0.976	200	0.873	0.897	0.928	0.941	0.957
	Experiment 2						Experiment 4				
	Bias						*Bias*				
20	-0.002	-0.002	-0.002	-0.003	0.001	20	0.000	0.000	-0.002	-0.001	0.001
30	-0.002	0.001	-0.002	-0.003	0.001	30	-0.005	0.001	-0.001	0.000	0.000
50	-0.005	0.001	0.000	0.000	0.001	50	-0.005	-0.005	-0.001	-0.002	-0.001
100	-0.003	0.003	0.000	-0.001	0.000	100	-0.005	-0.003	-0.003	-0.001	-0.001
200	-0.003	-0.002	-0.004	-0.001	0.001	200	-0.006	-0.004	-0.002	-0.002	-0.001
	RMSE						*RMSE*				
20	0.105	0.106	0.077	0.054	0.035	20	0.075	0.061	0.045	0.033	0.024
30	0.111	0.092	0.069	0.051	0.039	30	0.065	0.052	0.042	0.028	0.020
50	0.107	0.082	0.066	0.049	0.033	50	0.055	0.048	0.036	0.024	0.018
100	0.099	0.087	0.067	0.047	0.033	100	0.051	0.043	0.032	0.023	0.016
200	0.101	0.087	0.067	0.047	0.033	200	0.047	0.042	0.032	0.022	0.015
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.934	0.933	0.947	0.955	0.970	20	0.863	0.888	0.929	0.923	0.928
30	0.935	0.946	0.956	0.972	0.970	30	0.866	0.901	0.905	0.941	0.946
50	0.939	0.958	0.970	0.968	0.969	50	0.887	0.902	0.918	0.942	0.951
100	0.951	0.963	0.972	0.970	0.984	100	0.878	0.883	0.923	0.932	0.936
200	0.947	0.965	0.965	0.979	0.979	200	0.873	0.886	0.902	0.94	0.942

Notes: See notes to Table 22.

Table 25: Performance of the $\beta pretest$ estimator, selected between β_{FE} and β_{PC} using H^{NON}, serially correlated errors.

	Experiment 1						Experiment 3				
	Bias						*Bias*				
T/N	20	30	50	100	200	T/N	20	30	50	100	200
20	0.001	-0.003	-0.002	0.000	0.001	20	0.028	0.012	0.003	0.008	0.009
30	-0.003	0.001	-0.004	0.000	0.002	30	0.013	0.005	0.002	0.003	0.002
50	-0.003	-0.002	0.001	0.000	0.000	50	0.005	0.002	0.004	0.000	0.000
100	0.006	0.002	-0.001	0.000	0.001	100	0.001	0.002	0.000	0.000	0.000
200	0.001	0.005	0.005	0.000	0.000	200	0.000	0.000	0.000	0.000	0.000
	RMSE						*RMSE*				
20	0.109	0.081	0.066	0.046	0.033	20	0.127	0.068	0.046	0.032	0.024
30	0.091	0.072	0.057	0.042	0.034	30	0.082	0.046	0.035	0.025	0.017
50	0.099	0.074	0.055	0.042	0.028	50	0.051	0.036	0.027	0.019	0.014
100	0.083	0.066	0.052	0.039	0.027	100	0.030	0.025	0.019	0.013	0.009
200	0.078	0.069	0.052	0.036	0.026	200	0.021	0.017	0.013	0.009	0.006
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.925	0.956	0.958	0.960	0.966	20	0.826	0.878	0.895	0.904	0.910
30	0.943	0.938	0.969	0.965	0.977	30	0.855	0.890	0.922	0.938	0.934
50	0.957	0.963	0.971	0.979	0.979	50	0.879	0.900	0.908	0.932	0.937
100	0.959	0.970	0.979	0.984	0.984	100	0.893	0.914	0.923	0.929	0.945
200	0.972	0.974	0.989	0.987	0.984	200	0.887	0.904	0.930	0.932	0.945
	Experiment 2						Experiment 4				
	Bias						*Bias*				
20	0.006	0.002	0.000	0.001	0.002	20	0.019	0.007	0.007	0.005	0.006
30	-0.001	-0.002	0.005	0.000	-0.001	30	0.005	0.006	0.003	0.003	0.003
50	0.000	0.000	0.000	0.001	0.001	50	0.000	0.002	0.002	0.001	0.001
100	0.000	0.004	0.002	0.000	0.001	100	0.003	0.001	0.000	0.000	0.000
200	-0.001	-0.001	0.003	0.001	-0.001	200	0.000	0.001	0.001	0.000	0.000
	RMSE						*RMSE*				
20	0.100	0.085	0.065	0.043	0.032	20	0.100	0.056	0.045	0.031	0.023
30	0.092	0.081	0.059	0.043	0.033	30	0.066	0.045	0.036	0.024	0.017
50	0.092	0.075	0.055	0.037	0.030	50	0.044	0.034	0.027	0.019	0.014
100	0.085	0.067	0.054	0.035	0.028	100	0.031	0.024	0.018	0.013	0.009
200	0.076	0.072	0.053	0.038	0.027	200	0.023	0.018	0.013	0.010	0.006
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.927	0.953	0.957	0.960	0.968	20	0.830	0.916	0.901	0.935	0.931
30	0.947	0.951	0.954	0.962	0.975	30	0.864	0.912	0.928	0.951	0.933
50	0.962	0.963	0.974	0.982	0.973	50	0.878	0.914	0.921	0.938	0.940
100	0.952	0.975	0.975	0.984	0.982	100	0.889	0.913	0.938	0.935	0.943
200	0.967	0.977	0.983	0.983	0.983	200	0.865	0.911	0.924	0.925	0.948

Notes: See notes to Table 21.

Table 26: Performance of the $\beta pretest$ estimator, selected between β_{FE} and β_{PC} using H^{HAC}, serially correlated errors.

	Experiment 1						Experiment 3				
	Bias						*Bias*				
T/N	20	30	50	100	200	T/N	20	30	50	100	200
20	0.000	-0.001	0.000	0.000	0.000	20	0.018	0.015	0.008	0.003	0.002
30	0.006	-0.001	0.001	0.001	0.001	30	0.002	0.006	0.003	0.002	0.001
50	0.000	0.003	0.001	-0.001	0.001	50	0.003	0.002	0.003	0.001	0.001
100	0.001	0.001	-0.001	-0.001	0.000	100	0.002	0.001	-0.001	0.001	0.000
200	-0.004	-0.002	-0.001	0.001	0.001	200	0.001	0.001	0.000	0.000	0.000
	RMSE						*RMSE*				
20	0.102	0.078	0.064	0.041	0.032	20	0.087	0.065	0.044	0.031	0.021
30	0.095	0.077	0.060	0.047	0.029	30	0.059	0.046	0.036	0.025	0.017
50	0.085	0.074	0.059	0.041	0.031	50	0.042	0.036	0.027	0.019	0.013
100	0.088	0.066	0.049	0.036	0.027	100	0.030	0.025	0.019	0.013	0.009
200	0.083	0.065	0.051	0.035	0.026	200	0.023	0.017	0.014	0.009	0.006
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.918	0.931	0.951	0.959	0.959	20	0.842	0.861	0.916	0.932	0.947
30	0.935	0.946	0.953	0.966	0.973	30	0.871	0.894	0.920	0.935	0.950
50	0.953	0.953	0.972	0.965	0.973	50	0.901	0.885	0.914	0.937	0.959
100	0.957	0.969	0.970	0.985	0.973	100	0.893	0.905	0.934	0.945	0.953
200	0.972	0.980	0.982	0.982	0.985	200	0.869	0.917	0.918	0.939	0.952
	Experiment 2						Experiment 4				
	Bias						*Bias*				
20	0.005	0.001	0.002	0.000	-0.002	20	0.014	0.011	0.012	0.007	0.003
30	-0.006	0.003	-0.004	0.001	0.001	30	0.007	0.012	0.005	0.002	0.001
50	-0.001	-0.001	0.001	-0.001	0.000	50	0.002	0.002	0.001	0.001	0.000
100	0.003	0.004	0.001	0.001	0.001	100	0.001	0.002	0.001	0.001	0.000
200	-0.001	0.003	-0.002	0.001	-0.001	200	0.001	0.000	0.001	0.000	0.000
	RMSE						*RMSE*				
20	0.094	0.080	0.066	0.047	0.030	20	0.078	0.061	0.047	0.032	0.022
30	0.088	0.072	0.061	0.047	0.031	30	0.061	0.050	0.036	0.024	0.017
50	0.082	0.070	0.059	0.041	0.027	50	0.044	0.035	0.028	0.019	0.013
100	0.085	0.070	0.049	0.037	0.027	100	0.031	0.025	0.019	0.013	0.009
200	0.079	0.065	0.052	0.036	0.027	200	0.022	0.017	0.013	0.010	0.007
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.932	0.940	0.950	0.966	0.957	20	0.857	0.882	0.903	0.926	0.947
30	0.945	0.937	0.965	0.962	0.970	30	0.855	0.882	0.904	0.938	0.951
50	0.947	0.957	0.973	0.961	0.978	50	0.875	0.909	0.907	0.930	0.944
100	0.950	0.969	0.975	0.982	0.978	100	0.875	0.909	0.924	0.933	0.931
200	0.956	0.976	0.980	0.989	0.984	200	0.881	0.899	0.921	0.931	0.944

Notes: See notes to Table 22.

Table 27: Performance of the $\beta pretest$ estimator, selected between β_{FE} and β_{PC} using H^{NON}, heterogeneous βs and serially correlated errors.

	Experiment 1						Experiment 3				
	Bias						*Bias*				
T/N	20	30	50	100	200	T/N	20	30	50	100	200
20	0.003	0.001	-0.001	-0.001	-0.001	20	0.024	0.007	0.002	0.003	0.001
30	0.003	0.001	0.002	0.000	-0.001	30	0.016	-0.001	0.003	0.000	0.001
50	0.002	0.005	0.000	0.000	0.002	50	0.010	0.002	-0.002	0.002	0.000
100	0.003	0.004	0.003	0.001	0.000	100	0.002	-0.002	0.001	0.000	0.000
200	-0.003	0.002	0.004	-0.001	-0.002	200	-0.004	-0.002	-0.003	0.000	0.001
	RMSE						*RMSE*				
20	0.103	0.096	0.072	0.049	0.036	20	0.129	0.077	0.053	0.037	0.027
30	0.112	0.085	0.063	0.044	0.036	30	0.120	0.058	0.046	0.031	0.023
50	0.107	0.079	0.060	0.048	0.034	50	0.091	0.058	0.040	0.029	0.020
100	0.093	0.084	0.062	0.046	0.031	100	0.085	0.045	0.034	0.024	0.018
200	0.092	0.079	0.061	0.043	0.032	200	0.058	0.041	0.031	0.023	0.016
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.922	0.944	0.956	0.967	0.951	20	0.836	0.909	0.915	0.937	0.940
30	0.940	0.952	0.946	0.961	0.961	30	0.846	0.912	0.917	0.946	0.942
50	0.952	0.960	0.955	0.967	0.970	50	0.845	0.890	0.925	0.928	0.946
100	0.955	0.967	0.964	0.968	0.977	100	0.854	0.892	0.928	0.940	0.946
200	0.955	0.955	0.971	0.971	0.971	200	0.864	0.899	0.927	0.939	0.944
	Experiment 2						Experiment 4				
	Bias						*Bias*				
20	-0.001	-0.001	-0.005	0.002	0.001	20	0.029	0.003	0.004	0.006	0.004
30	-0.003	0.004	0.000	0.001	0.000	30	0.014	0.001	0.001	0.000	0.002
50	0.005	0.001	0.001	-0.001	0.001	50	0.002	-0.001	-0.004	-0.001	0.000
100	0.000	0.004	0.001	-0.001	0.001	100	-0.006	-0.004	-0.003	-0.003	-0.001
200	-0.008	-0.002	-0.001	0.002	0.001	200	-0.007	-0.006	-0.002	-0.002	-0.002
	RMSE						*RMSE*				
20	0.112	0.097	0.063	0.060	0.036	20	0.136	0.073	0.053	0.038	0.027
30	0.111	0.093	0.065	0.047	0.034	30	0.100	0.062	0.047	0.034	0.023
50	0.099	0.089	0.066	0.044	0.031	50	0.084	0.056	0.040	0.027	0.020
100	0.093	0.076	0.063	0.045	0.032	100	0.060	0.044	0.035	0.024	0.017
200	0.092	0.076	0.059	0.045	0.031	200	0.056	0.040	0.031	0.023	0.016
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.927	0.968	0.953	0.971	0.970	20	0.819	0.889	0.922	0.925	0.928
30	0.921	0.952	0.949	0.956	0.966	30	0.845	0.897	0.917	0.914	0.935
50	0.940	0.946	0.968	0.970	0.970	50	0.848	0.914	0.921	0.939	0.941
100	0.952	0.965	0.963	0.969	0.969	100	0.876	0.905	0.914	0.941	0.944
200	0.951	0.951	0.965	0.978	0.973	200	0.852	0.902	0.919	0.941	0.946

Notes: See notes to Table 21.

Table 28: Performance of the $\beta pretest$ estimator, selected between β_{FE} and β_{PC} using H^{HAC}, heterogeneous βs and serially correlated errors.

	Experiment 1						Experiment 3				
	Bias						*Bias*				
T/N	20	30	50	100	200	T/N	20	30	50	100	200
20	-0.005	0.000	0.000	0.001	0.000	20	0.004	0.006	0.000	0.003	0.003
30	0.006	-0.002	-0.001	0.001	0.000	30	0.003	0.003	-0.001	0.001	0.001
50	-0.001	0.005	-0.001	0.002	0.003	50	-0.004	-0.004	0.001	0.000	-0.001
100	0.000	0.001	0.001	0.003	0.001	100	0.000	-0.002	-0.002	-0.001	0.000
200	-0.007	-0.006	0.000	0.000	0.000	200	-0.002	-0.002	-0.003	-0.001	0.000
	RMSE						*RMSE*				
20	0.115	0.082	0.074	0.050	0.034	20	0.085	0.071	0.053	0.036	0.027
30	0.108	0.080	0.064	0.044	0.035	30	0.076	0.059	0.047	0.032	0.022
50	0.107	0.086	0.061	0.044	0.033	50	0.064	0.054	0.041	0.028	0.020
100	0.090	0.076	0.061	0.048	0.031	100	0.056	0.046	0.034	0.024	0.018
200	0.095	0.077	0.061	0.042	0.031	200	0.051	0.040	0.033	0.023	0.016
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.934	0.936	0.950	0.949	0.966	20	0.860	0.883	0.919	0.932	0.934
30	0.932	0.954	0.953	0.971	0.971	30	0.866	0.913	0.921	0.935	0.948
50	0.947	0.949	0.950	0.966	0.968	50	0.853	0.895	0.918	0.938	0.945
100	0.956	0.953	0.967	0.962	0.977	100	0.860	0.897	0.915	0.934	0.931
200	0.943	0.962	0.978	0.968	0.974	200	0.853	0.913	0.910	0.924	0.943
	Experiment 2						Experiment 4				
	Bias						*Bias*				
20	0.004	0.002	0.003	0.001	0.001	20	0.014	0.004	0.003	0.006	0.004
30	0.006	-0.005	-0.003	0.001	0.001	30	-0.007	-0.001	0.001	0.000	0.002
50	0.000	-0.003	0.001	-0.003	0.001	50	-0.003	-0.007	-0.001	0.000	0.000
100	-0.002	0.003	0.001	-0.001	0.002	100	-0.005	-0.004	-0.003	0.000	0.000
200	-0.004	0.001	-0.001	0.000	0.000	200	-0.003	-0.003	-0.003	-0.001	-0.001
	RMSE						*RMSE*				
20	0.114	0.096	0.077	0.049	0.036	20	0.096	0.073	0.052	0.038	0.026
30	0.103	0.091	0.068	0.050	0.035	30	0.075	0.060	0.046	0.032	0.024
50	0.104	0.084	0.062	0.048	0.033	50	0.064	0.049	0.040	0.028	0.020
100	0.091	0.082	0.065	0.043	0.032	100	0.054	0.045	0.034	0.024	0.017
200	0.095	0.079	0.059	0.043	0.030	200	0.049	0.041	0.031	0.022	0.015
	Coverage rate $\beta pretest$						Coverage rate $\beta pretest$				
20	0.932	0.929	0.951	0.964	0.969	20	0.840	0.889	0.921	0.930	0.938
30	0.921	0.945	0.961	0.961	0.967	30	0.862	0.905	0.924	0.929	0.923
50	0.941	0.949	0.965	0.964	0.963	50	0.866	0.921	0.911	0.938	0.935
100	0.954	0.963	0.962	0.978	0.978	100	0.862	0.891	0.921	0.947	0.945
200	0.945	0.958	0.969	0.979	0.979	200	0.875	0.89	0.919	0.937	0.948

Notes: See notes to Table 22.

6 Further results on empirical applications

Table 29 shows results on the ten empirical applications when H^{NON} and H^{HAC} are computed using the bias uncorrected PC estimators.

Table 29: Bias uncorrected PC estimates.

		β_{PC}
Production function as in (39)		
OECD	$\beta_{\frac{k}{l}}$	0.632
EU27	$\beta_{\frac{k}{l}}$	0.688
ITA	$\beta_{\frac{k}{l}}$	0.355
US	$\beta_{\frac{k}{l}}$	0.102
UNIDO	$\beta_{\frac{k}{l}}$	0.544
Production function as in (40)		
$k = 3$	β_l	0.509
	β_k	0.443
	β_{rd}	0.082
Gravity model as in (41)		
EU14	β_{gdp}	1.808
$k = 6$	β_{rer}	-0.043
	β_{sim}	1.230
	β_{rlf}	0.014
	β_{cee}	0.369
	β_{emu}	0.179
Gasoline demand function as in (42)		
	β_p	-0.101
	β_{inc}	0.391
Income elasticity as in (43)		
US States	β_{inc}	0.608
US MSAs	β_{inc}	0.564

Notes: PC denotes the PC estimator in CHNY. The PC estimators are not bias-corrected. Four factors are extracted in the gravity model application EU14 while two factors are extracted in all other cases.

References

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