# Online Appendix: Accounting for unobserved heterogeneity in panel time series models*


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This Online Appendix contains the detailed Monte Carlo simulation setups and results for the above research note introducing the Augmented Mean Group (AMG) estimator. We present four sets of simulation DGPs and results, starting with the setups of Coakley, Fuertes, and Smith (2006) and Kapetanios, Pesaran, and Yamagata (2011). Our own simulation setups which form the centre of attention in the maintext of the paper are presented next, followed by some robustness checks with large values for slope and factor loading distributions, among other changes. Each of these four sets of simulations will be introduced in turn.


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# A Coakley, Fuertes and Smith (2006)

The authors introduce the following DGP:

$$\begin{aligned} y_{it} &= \alpha_i + \beta x_{it} + u_{it} \qquad u_{it} = \rho_{ui} u_{i,t-1} + \lambda_i f_t + \varepsilon_{u,it} \\ & \varepsilon_{u,it} \sim \text{i.i.d. } N(0, \sigma_{ui}^2), \text{ where } \sigma_{ui}^2 = 1 \end{aligned} \tag{1}$$

for $i = 1, \ldots, N$ and $t = 1, \ldots, T$, where we adjust the notation to concentrate on the nonstationary observables settings with homogeneous $\beta$ (Cases A-G). Coakley et al. (2006) do not report any simulation results for heterogeneous $\beta$ but suggest that findings were rather similar to those for the homogeneous setup. The single regressor is defined as

$$\begin{aligned} x_{it} &= \rho_{xi} x_{i,t-1} + \phi_i f_t + \psi_i \chi_t + \varepsilon_{x,it} \\ & \varepsilon_{x,it} \sim \text{i.i.d. } N(0, \sigma_{xi}^2), \text{ where } \sigma_{xi} = \text{i.i.d. } U[0.5, 1.5] \end{aligned} \tag{2}$$

The unobserved common factors are generated as

$$f_t = \rho_f f_{t-1} + \varepsilon_{ft} \qquad \varepsilon_{ft} \sim \text{iid } N(0, \sigma_f^2), \text{ where } \sigma_f^2 = 1 \tag{3}$$

$$\chi_t = \rho_\chi \chi_{t-1} + \varepsilon_{\chi t} \qquad \varepsilon_{\chi t} \sim \text{iid } N(0, \sigma_\chi^2), \text{ where } \sigma_\chi^2 = 1 \tag{4}$$

Heterogeneous intercepts are distributed $\alpha_i \sim$ iid $U[-0.5, 0.5]$ s.t. $\bar{\alpha} = 0$. Unless indicated the independently drawn factor loadings are heterogeneous across countries: $\lambda_i \sim$ iid $U[0.5, 1.5]$, $\phi_i \sim$ iid $U[0.5, 1.5]$ and $\psi_i \sim$ iid $U[0.5, 1.5]$. Regressors are nonstationary ($\rho_{xi} = 1$) in all the cases presented here, and unless indicated $\rho_f = \rho_\chi = 0$ (stationary common factors). The variation in the regressors ($\sigma_{xi}$) differs uniformly across countries. The slope coefficient is common and set to unity ($\beta = 1$).

With reference to our own empirical model in equations (1) to (3), we can highlight the following points of departure: *firstly*, in equation (1) Coakley et al. (2006) allow for serially correlated errors from *other* sources than the presence of unobserved common factors, which includes nonstationary $u_{it}$ (noncointegration) regardless of the nature of the unobserved common factors $f_t$. *Secondly*, in equation (2) the single regressor $x$ is nonstationary for reasons *other than* the presence of I(1) common factors: this allows Coakley et al. (2006) to focus their investigation on the impact of *stationary common factors* $f_t$ and $\chi_t$ on estimation and inference in a model with two *nonstationary observables* which do or do not cointegrate. *Thirdly*, the authors only allow for cointegration between $y$ and $x$, but not between these observables and the unobservable common factors $f$ — the presence of the latter is treated as a nuisance in the consistent estimation of the slope coefficient $\beta$.

As our later analysis shows, none of these issues lead to fundamental differences in the simulation results. With empirical cross-country production functions in mind (Eberhardt & Teal, 2013, 2014) we have highlighted the desirability of modelling unobservables (TFP) as a unit root process, as well as the heterogeneous nature of production technology ($\beta_i$) across countries, which will both be addressed in our own simulations as well as those by Kapetanios et al. (2011).

In detail, Coakley et al. (2006) consider the following scenarios:

**Case $\boldsymbol{A}$:** $\rho_{ui} = 0$, $\lambda_i = \phi_i = \psi_i = 0$: Cointegration between $y$ and $x$. No common factors and thus no cross-section dependence (CSD).

**Case $\boldsymbol{B}$:** $\rho_{ui} = 1$, $\lambda_i = \phi_i = \psi_i = 0$: No cointegration between $y$ and $x$. No CSD.

**Case $\boldsymbol{C}$:** $\rho_{ui} = 1$, $\phi_i = 0$: No cointegration between $y$ and $x$. An I(0) factor $f_t$ drives the errors, a different I(0) factor $\chi_t$ drives the regressors.

**Case $\boldsymbol{D}$:** $\rho_{ui} = 1$, $\psi_i = 0$: No cointegration between $y$ and $x$. An I(0) factor $f_t$ drives both the errors and the regressors.

**Case $\tilde{\boldsymbol{D}}$:** Like Case D, but $\lambda_i = \phi_i$ for all $i$ — factor loading dependence.

**Case $\boldsymbol{E}$:** $\rho_{ui} = 0$, $\psi_i = 0$: Cointegration between $y$ and $x$. An I(0) factor $f_t$ drives both the errors and the regressors.

**Case $\boldsymbol{F}$:** $\rho_{ui} = 1$: No cointegration between $y$ and $x$. An I(0) factor $f_t$ drives both the errors and the regressors, a different I(0) factor $\chi_t$ drives the regressors.

**Case $\boldsymbol{G}$:** $\rho_f = \rho_\chi = 1$, $\rho_{ui} = 0$: No cointegration between $y$ and $x$. An I(1) factor $f_t$ drives both the errors and the regressors, a different I(1) factor $\chi_t$ drives the regressors.

By construction the simulations are primarily interested in the cointegrating relationship (or lack thereof) between $y$ and $x$, and exclude the possibility of a three-way cointegrating relation ($y$, $x$, $f$). Furthermore, in most of the scenarios the unobserved common factors are stationary.

In the present and all the following Monte Carlo simulations we compare the small sample performance of the following estimators:

**Pooled estimators:** POLS — pooled OLS, FE — pooled OLS with Fixed Effects, CCEP — pooled version of the Pesaran (2006) Common Correlated Effects estimator, FD-OLS — pooled OLS with variables in first differences. The estimation equations are augmented with year dummies as indicated in the results tables.

**MG-type estimators:** CMG — Mean Groups version of the Pesaran (2006) Common Correlated Effects estimator, AMG(i) — Augmented Mean Groups estimator with 'common dynamic process' imposed with unit coefficient, AMG(ii) with 'common dynamic process' included as additional regressor, MG — Pesaran and Smith (1995) Mean Groups estimator. All of these are based on averaged country-regression estimates, and we include linear trends in all but the CMG.

We present the simulation results across the sample of 5,000 replications for the panel dimensions $N = 30$, $T = 20$ in Table A-1 in the Appendix. For each estimator we provide the mean, median and ('empirical') standard error of the 5,000 estimates, as well as the sample mean of the standard errors. This replicates the results in Table 3(II) of Coakley et al. (2006).

- In the baseline **Case A** with cointegration and cross-section independence all estimators are unbiased and due to the large variance in the I(1) regressors rather precise.

- The setup with nonstationary errors (**Case B**) represents a 'spurious panel regression' — as established by Phillips and Moon (1999) the pooled estimators in effect average across spurious regressions and provide unbiased estimates, although the empirical standard errors are much larger now, e.g. .1351 instead of .0182 for pooled FE without year dummies ('one-way FE', marked FE†).

- If we introduce cross-section dependence to the non-cointegration scenario (**Case C**) nothing much changes. This is because the omitted factors in the errors and the regressors are independent. The exceptions are the FE estimator without year dummies (FE†) and the MG estimator, for which the factor $f_t$ in the errors leads to a doubling of the empirical standard errors.

- In **Case D** the correlation between the regressors and the errors via the common factor $f_t$ leads to serious bias in the pooled OLS and FE without year dummies (POLS†, FE†) and the MG estimator. POLS is much less biased at .0766 than FE at .4157. In either case the bias virtually disappears once year dummies are included in the estimation equation (POLS‡, FE‡) — we will speculate about the source of this benign correction in the conclusion of this paper. The CCE and AMG estimators are unbiased and remain comparatively precise, though not dramatically more so than the POLS‡ or FE‡.

- Factor loading dependence between the errors and regressors (**Case $\tilde{\boldsymbol{D}}$**) we observe a similar pattern of results across estimators, with the bias in POLS† and FE† slightly elevated. FD-OLS is biased for the first time and this bias naturally carries over to our AMG estimates, although the latter display only mild distortion.

- If $y$ and $x$ are cointegrated any correlation between the regressors and the errors via the common factor $f_t$ leads to only modest bias in FE† and MG (**Case E**), since the correlation between the I(1) regressors and I(0) errors goes to zero with $T$.

- If several, rather than a single factor drive the regressors in the case of no cointegration between $y$ and $x$ and correlation between regressors and the errors (**Case F**) nothing much changes compared to the single factor scenario in Case D, except that the higher variation in the $x$ leads to more precise estimates.

- Finally, the scenario where the unobserved factors are I(1), residuals are nonstationary and a common factor drives both $y$ and $x$ (**Case G**) we can observe the most serious bias of all cases considered here. The POLS† and FE† are biased by .2273 and .4374 respectively, while the bias for the MG is .5110 — all of these estimators are further very imprecise. Once we use year dummies for the pooled estimators, however, their bias goes to zero (POLS‡, FE‡) and the estimators are highly efficient. The CCE estimators are unbiased with relative precision, while the bias in the FD-OLS leads to bias in the AMG estimators — this time of similar magnitude.

In summary, our replication of the Monte Carlo results by Coakley et al. (2006) with alternative POLS‡ and FE‡ estimators, as well as our own AMG-type estimators for the cases considered cannot reveal any serious bias in the standard pooled estimators, provided year dummies are added to the estimation equation. The AMG estimators commonly perform similarly well to the Pesaran (2006) CCE estimators, with the notable exception of Case G (noncointegration even after nonstationary factors are accounted for).

## Table A-1: Coakley, Fuertes and Smith (2006)

**Monte Carlo Results — replicating Coakley, Fuertes and Smith (2006)**

5,000 replications; $N = 30$, $T = 20$; year dummies in the POLS or FE estimation equations: † — no, ‡ — yes; AMG-estimators are constructed from FD-OLS year dummy coefficients

| | **Case $A$** Cointegration, no CSD | | | | **Case $B$** No cointegration, no CSD | | | | **Case $C$** No cointegration, CSD | | | | **Case $D$** No cointegration, CSD, endogenous $x$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS† | 1.0001 | 1.0001 | 0.0109 | 0.0055 | 0.9986 | 1.0005 | 0.2155 | 0.0397 | 0.9971 | 1.0013 | 0.2071 | 0.0399 | 1.0766 | 1.0774 | 0.2099 | 0.0397 |
| POLS‡ | 1.0002 | 1.0002 | 0.0088 | 0.0054 | 0.9987 | 0.9995 | 0.2165 | 0.0407 | 0.9981 | 0.9983 | 0.2182 | 0.0409 | 1.0169 | 1.0170 | 0.2185 | 0.0409 |
| FE† | 1.0003 | 1.0004 | 0.0182 | 0.0180 | 1.0037 | 1.0038 | 0.1351 | 0.0404 | 0.9973 | 1.0038 | 0.2808 | 0.0410 | 1.4157 | 1.4065 | 0.2012 | 0.0363 |
| FE‡ | 1.0004 | 1.0005 | 0.0186 | 0.0185 | 1.0041 | 1.0026 | 0.1381 | 0.0414 | 1.0034 | 1.0009 | 0.1389 | 0.0415 | 1.0208 | 1.0182 | 0.1420 | 0.0416 |
| CCEP | 1.0003 | 1.0003 | 0.0232 | 0.0226 | 1.0049 | 1.0039 | 0.1154 | 0.0421 | 1.0029 | 1.0043 | 0.1137 | 0.0418 | 1.0034 | 1.0041 | 0.1148 | 0.0420 |
| FD-OLS | 1.0014 | 1.0006 | 0.0574 | 0.0573 | 1.0010 | 1.0013 | 0.0413 | 0.0405 | 1.0006 | 1.0003 | 0.0413 | 0.0406 | 1.0120 | 1.0124 | 0.0442 | 0.0406 |
| *MG-type Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 0.9998 | 1.0002 | 0.0335 | 0.0321 | 1.0045 | 1.0062 | 0.1314 | 0.1260 | 1.0027 | 1.0011 | 0.1281 | 0.1239 | 1.0035 | 1.0022 | 0.1303 | 0.1255 |
| AMG(i) | 1.0001 | 0.9997 | 0.0392 | 0.0373 | 1.0022 | 1.0031 | 0.1104 | 0.1072 | 1.0009 | 1.0018 | 0.0689 | 0.0727 | 1.0069 | 1.0071 | 0.0695 | 0.0788 |
| AMG(ii) | 1.0000 | 0.9995 | 0.0289 | 0.0273 | 1.0051 | 1.0052 | 0.1410 | 0.1379 | 1.0025 | 1.0022 | 0.0828 | 0.0897 | 1.0056 | 1.0084 | 0.1327 | 0.1319 |
| MG | 1.0001 | 0.9998 | 0.0283 | 0.0274 | 1.0047 | 1.0039 | 0.1626 | 0.1595 | 0.9985 | 1.0054 | 0.3017 | 0.1338 | 1.5059 | 1.4880 | 0.2196 | 0.1306 |

| | **Case $\tilde{D}$** like Case $D$, factor loading dependence | | | | **Case $E$** Cointegration, CSD, endogenous $x$ | | | | **Case $F$** like Case $D$, additional I(0) factor in $x$ | | | | **Case $G$** No cointegration, I(1) factors | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS† | 1.1317 | 1.1288 | 0.2181 | 0.0394 | 1.0072 | 1.0066 | 0.0109 | 0.0071 | 1.0648 | 1.0679 | 0.1938 | 0.0374 | 1.2273 | 1.2128 | 0.2439 | 0.0251 |
| POLS‡ | 1.0088 | 1.0088 | 0.2174 | 0.0408 | 1.0003 | 1.0003 | 0.0106 | 0.0055 | 1.0078 | 1.0098 | 0.2101 | 0.0394 | 1.0016 | 1.0010 | 0.0049 | 0.0010 |
| FE† | 1.4437 | 1.4352 | 0.2096 | 0.0356 | 1.0516 | 1.0510 | 0.0345 | 0.0188 | 1.2775 | 1.2685 | 0.2069 | 0.0319 | 1.4374 | 1.4640 | 0.5928 | 0.0217 |
| FE‡ | 1.0133 | 1.0123 | 0.1398 | 0.0415 | 1.0015 | 1.0014 | 0.0185 | 0.0185 | 1.0124 | 1.0105 | 0.1352 | 0.0401 | 1.0006 | 1.0004 | 0.0077 | 0.0028 |
| CCEP | 1.0051 | 1.0051 | 0.1147 | 0.0420 | 1.0004 | 1.0006 | 0.0234 | 0.0228 | 1.0035 | 1.0046 | 0.1135 | 0.0416 | 1.0031 | 1.0037 | 0.0934 | 0.0416 |
| FD-OLS | 1.0725 | 1.0707 | 0.0477 | 0.0405 | 1.0125 | 1.0122 | 0.0599 | 0.0574 | 1.0111 | 1.0102 | 0.0425 | 0.0392 | 1.0647 | 1.0456 | 0.1323 | 0.0303 |
| *MG-type Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0056 | 1.0035 | 0.1300 | 0.1256 | 0.9998 | 0.9995 | 0.0336 | 0.0322 | 1.0034 | 1.0029 | 0.1271 | 0.1234 | 1.0021 | 1.0030 | 0.1037 | 0.0988 |
| AMG(i) | 1.0381 | 1.0394 | 0.0690 | 0.0782 | 1.0068 | 1.0064 | 0.0447 | 0.0272 | 1.0090 | 1.0101 | 0.0564 | 0.0608 | 1.0627 | 1.0444 | 0.1308 | 0.0490 |
| AMG(ii) | 1.0170 | 1.0180 | 0.1314 | 0.1309 | 1.0071 | 1.0059 | 0.0396 | 0.0186 | 1.0088 | 1.0104 | 0.0806 | 0.0877 | 1.0654 | 1.0479 | 0.1341 | 0.0252 |
| MG | 1.5057 | 1.4972 | 0.2060 | 0.1238 | 1.0812 | 1.0796 | 0.0456 | 0.0259 | 1.3266 | 1.3134 | 0.2112 | 0.1018 | 1.5110 | 1.4921 | 0.7386 | 0.1585 |

**Notes:** For each estimator we report the mean and median for the 5,000 estimates of $\beta$. $*$ emp. ste refers to the empirical standard error, the standard deviation of the 5,000 estimates of $\beta$; mean ste refers to the sample mean of the estimated standard errors in the 5,000 estimations of $\beta$. See main text for simulation setup and detailed description of the cases.

# B Kapetanios, Pesaran and Yamagata (2009)

The authors introduce the following DGP:

$$y_{it} = \beta_i x_{it} + u_{it} \qquad u_{it} = \alpha_i + \lambda^y_{i1} f_{1t} + \lambda^y_{i2} f_{2t} + \varepsilon_{it} \tag{5}$$

$$x_{it} = a_{i1} + a_{i1} d_t + \lambda^x_{i1} f_{1t} + \lambda^x_{i3} f_{3t} + v_{it} \tag{6}$$

for $i = 1, \ldots, N$ unless indicated below and $t = 1, \ldots, T$, where we adjust the notation by Kapetanios et al. (2011) since we limit our analysis to the case with a single regressor ($x$).

The common deterministic trend term ($d_t$) and individual-specific errors for the $x$-equation are zero-mean independent AR(1) processes defined as

$$d_t = 0.5 d_{t-1} + v_{dt} \qquad v_{dt} \sim N(0, 0.75) \qquad t = -48, \ldots, 1, \ldots, T \qquad d_{-49} = 0$$

$$v_{it} = \rho_{vi} v_{i,t-1} + v_{it} \qquad v_{it} \sim N(0, (1 - \rho^2_{vi})) \qquad t = -48, \ldots, 1, \ldots, T \qquad v_{i,-49} = 0$$

where $\rho_{vi} \sim U[0.05, 0.95]$. The three common factors are nonstationary processes

$$f_{jt} = f_{j,t-1} + v_{ft} \qquad j = 1, 2, 3 \qquad v_{ft} \sim N(0, 1) \qquad t = -49, \ldots, 1, \ldots, T \qquad f_{j,-50} = 0 \tag{7}$$

The authors generate innovations to $y$ as a mix of heterogeneous AR(1) and MA(1) errors

$$\varepsilon_{it} = \rho_{i\varepsilon} \varepsilon_{i,t-1} + \sigma_i \sqrt{1 - \rho^2_{i\varepsilon}} \omega_{it} \qquad i = 1, \ldots, N_1 \qquad t = -48, \ldots, 0, \ldots, T$$

$$\varepsilon_{it} = \frac{\sigma_i}{\sqrt{1 + \theta^2_{i\varepsilon}}} (\omega_{it} + \theta_{i\varepsilon} \omega_{i,t-1}) \qquad i = N_1 + 1, \ldots, N \qquad t = -48, \ldots, 0, \ldots, T$$

where $N_1$ is the nearest integer to $N/2$ and $\omega_{it} \sim N(0, 1)$, $\sigma^2_i \sim U[0.5, 1.5]$, $\rho_{i\varepsilon} \sim U[0.05, 0.95]$, and $\theta_{i\varepsilon} \sim U[0, 1]$. $\rho_{vi}$, $\rho_{i\varepsilon}$, $\theta_{i\varepsilon}$ and $\sigma_i$ do not change across replications. Initial values are set to zero and the first 50 observations are discarded for all of the above.

Regarding parameter values, $\alpha_i \sim N(0, 1)$ and $a_{i1}$, $a_{i2} \sim \mathrm{iid}N(0.5, 0.5)$ do not change across replications. We limit ourselves to *'Experiment 1'* in Kapetanios et al. (2011), where $\beta_i = \beta + \eta_i$ with $\beta = 1$ and $\eta_i \sim N(0, 0.04)$. For the factor loadings the authors consider

$$\lambda^x_{i1} \sim N(0.5, 0.5) \qquad \text{and} \qquad \lambda^x_{i3} \sim N(0.5, 0.5) \tag{8}$$

$$\text{with either} \quad \mathcal{A}: \quad \lambda^y_{i1} \sim N(1, 0.2) \qquad \text{and} \qquad \lambda^y_{i2\mathcal{A}} \sim N(1, 0.2) \tag{9}$$

$$\text{or} \quad \mathcal{B}: \quad \lambda^y_{i1} \sim N(1, 0.2) \qquad \text{and} \qquad \lambda^y_{i2\mathcal{B}} \sim N(0, 1) \tag{10}$$

Since we are interested in consistent estimation of the mean parameter estimate ($\mathbb{E}[\beta_i]$) and therefore did not find considerable differences in the patterns of the results in setup $\mathcal{A}$ and $\mathcal{B}$ we only present the former to save space.[1]

[1] In setup $\mathcal{B}$ the mean $\mathbb{E}[\beta_i]$ can be estimated consistently but not the individual $\beta_i$ — see Kapetanios, Pesaran, and

With reference to our own empirical model we can state that the points of departure (e.g. the complex structure of innovations in $y$) are not substantial by any measure and were introduced by the authors to highlight the robustness of their results to a range of alternative sources of heterogeneity.

We investigate combinations of $T$ and $N$ for $T, N = \{20, 30, 50, 100\}$, but with 1,000 instead of the 2,000 replications in Kapetanios et al. (2011) for each case. Our results in Table B-1 in the Appendix replicate those in Table 1 of Kapetanios et al. (2011). In addition to the mean, median, empirical standard errors and mean estimated standard errors we also report the average bias and the root mean squared error (RMSE), in line with the presentation in Kapetanios et al. (2011).[2] We also introduce 'infeasible' estimators, namely for fixed effects and MG — these represent estimators where the unobserved common factors in $y$ are included in the estimation equation to provide a benchmark.

The POLS and FE estimators without year dummies (marked †) indicate serious bias which increases in $T$ but is stable as $N$ increases. In all cases the bias in the one-way FE estimator (marked †) is larger. The standard MG estimator (with linear trend) similarly performs quite poorly, in general no better (or worse) than the FE estimator. In contrast the CCEP and FD-OLS (with $T-1$ year dummies) for the pooled case and the augmented MG-estimators display no bias. In data dimensions investigated the FD-OLS estimator has RMSE closest to the infeasible estimators.

The significant bias in the POLS and FE estimator however is almost entirely absent once these are augmented with $(T-1)$ year dummies (again marked ‡). RMSE are still slightly elevated for the latter two estimators, but on the whole the year dummies in the POLS and FE estimators can accommodate the cross-section dependence (as well as the other data properties) introduced in this setup quite well.

Yamagata (2009, p.6).

[2]The bias is computed as $M^{-1}\sum_{m=1}^{M}\hat{\beta}_m - 1$, the average deviation across replications (here $M = 1,000$) of the estimate from the true mean parameter $\beta = 1$. The RMSE is computed as $\{M^{-1}\sum_{m=1}^{M}(\hat{\beta}_m - 1)^2\}^{1/2}$, the average squared deviation across replications of the estimate from the true mean parameter. In case of both statistics we multiplied the results by 100.

# Table B-1: Kapetanios, Pesaran and Yamagata (2011)

**Monte Carlo Results — replicating Kapetanios, Pesaran and Yamagata (2011)**

1,000 replications; year dummies in the POLS or FE estimation equations: † — no, ‡ — yes; AMG-estimators are constructed from FD-OLS year dummy coefficients

| $T = 20$ | $N = 20$ | | | | | | $N = 30$ | | | | | | $N = 50$ | | | | | | $N = 100$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 |
| *Pooled Estimators* | | | | | | | | | | | | | | | | | | | | | | | | |
| POLS† | 1.028 | 1.021 | 0.197 | 0.046 | 2.78 | 19.85 | 1.038 | 1.026 | 0.163 | 0.037 | 3.80 | 16.69 | 1.050 | 1.038 | 0.144 | 0.029 | 5.01 | 15.26 | 1.047 | 1.032 | 0.115 | 0.020 | 4.69 | 12.42 |
| POLS‡ | 0.989 | 0.992 | 0.181 | 0.040 | -1.09 | 18.15 | 0.986 | 0.992 | 0.142 | 0.033 | -1.45 | 14.27 | 0.996 | 0.999 | 0.119 | 0.026 | -0.37 | 11.85 | 0.995 | 0.992 | 0.081 | 0.018 | -0.47 | 8.13 |
| FE† | 1.224 | 1.201 | 0.296 | 0.062 | 22.37 | 37.07 | 1.213 | 1.194 | 0.272 | 0.048 | 21.28 | 34.52 | 1.231 | 1.218 | 0.280 | 0.039 | 23.11 | 36.31 | 1.228 | 1.213 | 0.265 | 0.027 | 22.84 | 35.00 |
| FE‡ | 0.996 | 0.994 | 0.107 | 0.041 | -0.41 | 10.72 | 0.999 | 0.995 | 0.085 | 0.031 | -0.14 | 8.54 | 1.000 | 0.999 | 0.070 | 0.026 | -0.02 | 7.04 | 1.002 | 1.003 | 0.046 | 0.018 | 0.21 | 4.56 |
| CCEP | 0.998 | 1.001 | 0.089 | 0.044 | -0.17 | 8.89 | 0.999 | 0.995 | 0.073 | 0.034 | -0.11 | 7.32 | 1.001 | 1.000 | 0.061 | 0.030 | 0.13 | 6.10 | 1.002 | 1.001 | 0.041 | 0.020 | 0.21 | 4.05 |
| FD-OLS | 0.998 | 0.998 | 0.074 | 0.042 | -0.21 | 7.41 | 0.999 | 1.000 | 0.058 | 0.031 | -0.11 | 5.77 | 1.001 | 1.002 | 0.050 | 0.028 | 0.06 | 4.96 | 1.001 | 1.001 | 0.033 | 0.019 | 0.13 | 3.29 |
| FE (inf) | 1.002 | 1.001 | 0.068 | 0.034 | 0.16 | 6.81 | 1.000 | 0.999 | 0.053 | 0.025 | -0.04 | 5.30 | 0.999 | 0.999 | 0.045 | 0.023 | -0.13 | 4.48 | 1.001 | 1.002 | 0.030 | 0.015 | 0.09 | 3.03 |
| *MG-type Estimators* | | | | | | | | | | | | | | | | | | | | | | | | |
| CMG | 0.998 | 0.997 | 0.088 | 0.084 | -0.25 | 8.75 | 1.000 | 0.997 | 0.074 | 0.070 | -0.02 | 7.42 | 1.002 | 1.001 | 0.062 | 0.059 | 0.16 | 6.17 | 1.001 | 1.001 | 0.041 | 0.041 | 0.10 | 4.10 |
| AMG(i) | 0.997 | 0.999 | 0.080 | 0.075 | -0.31 | 8.00 | 0.996 | 0.997 | 0.065 | 0.062 | -0.37 | 6.51 | 1.001 | 1.003 | 0.057 | 0.053 | 0.05 | 5.71 | 1.000 | 1.001 | 0.037 | 0.036 | -0.01 | 3.69 |
| AMG(ii) | 0.997 | 0.997 | 0.078 | 0.075 | -0.26 | 7.79 | 0.998 | 0.998 | 0.066 | 0.063 | -0.19 | 6.55 | 1.002 | 1.002 | 0.057 | 0.053 | 0.18 | 5.74 | 1.001 | 1.001 | 0.037 | 0.036 | 0.06 | 3.71 |
| MG | 1.217 | 1.184 | 0.286 | 0.163 | 21.74 | 35.91 | 1.209 | 1.187 | 0.261 | 0.133 | 20.88 | 33.45 | 1.230 | 1.208 | 0.270 | 0.113 | 22.99 | 35.45 | 1.230 | 1.211 | 0.251 | 0.077 | 23.00 | 34.05 |
| MG (inf) | 1.003 | 1.004 | 0.063 | 0.063 | 0.25 | 6.33 | 0.999 | 0.999 | 0.052 | 0.052 | -0.14 | 5.22 | 0.999 | 0.999 | 0.047 | 0.045 | -0.09 | 4.71 | 0.999 | 0.999 | 0.030 | 0.030 | -0.08 | 3.01 |

| $T = 30$ | $N = 20$ | | | | | | $N = 30$ | | | | | | $N = 50$ | | | | | | $N = 100$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 |
| *Pooled Estimators* | | | | | | | | | | | | | | | | | | | | | | | | |
| POLS† | 1.064 | 1.050 | 0.196 | 0.038 | 6.43 | 20.62 | 1.066 | 1.049 | 0.172 | 0.030 | 6.61 | 18.41 | 1.054 | 1.039 | 0.144 | 0.023 | 5.45 | 15.40 | 1.061 | 1.042 | 0.124 | 0.016 | 6.10 | 13.82 |
| POLS‡ | 1.015 | 1.020 | 0.174 | 0.032 | 1.51 | 17.41 | 1.006 | 1.000 | 0.140 | 0.026 | 0.59 | 13.96 | 0.994 | 0.997 | 0.108 | 0.020 | -0.60 | 10.82 | 1.001 | 1.002 | 0.074 | 0.014 | 0.09 | 7.37 |
| FE† | 1.253 | 1.240 | 0.318 | 0.051 | 25.34 | 40.65 | 1.240 | 1.216 | 0.287 | 0.040 | 23.96 | 37.40 | 1.241 | 1.224 | 0.285 | 0.031 | 24.14 | 37.37 | 1.243 | 1.226 | 0.283 | 0.022 | 24.26 | 37.29 |
| FE‡ | 1.002 | 1.001 | 0.113 | 0.032 | 0.16 | 11.24 | 1.006 | 1.005 | 0.087 | 0.025 | 0.57 | 8.68 | 0.999 | 1.003 | 0.069 | 0.020 | -0.10 | 6.87 | 1.002 | 1.000 | 0.050 | 0.014 | 0.16 | 4.98 |
| CCEP | 0.998 | 1.000 | 0.093 | 0.036 | -0.17 | 9.31 | 1.001 | 1.001 | 0.070 | 0.027 | 0.07 | 6.96 | 1.001 | 1.004 | 0.056 | 0.022 | 0.10 | 5.63 | 1.001 | 1.002 | 0.041 | 0.015 | 0.08 | 4.12 |
| FD-OLS | 1.001 | 0.999 | 0.075 | 0.038 | 0.13 | 7.49 | 1.003 | 1.000 | 0.055 | 0.026 | 0.27 | 5.50 | 0.998 | 0.999 | 0.042 | 0.021 | -0.23 | 4.21 | 1.002 | 1.002 | 0.032 | 0.015 | 0.19 | 3.17 |
| FE (inf) | 1.001 | 0.998 | 0.066 | 0.027 | 0.11 | 6.56 | 1.002 | 1.003 | 0.053 | 0.020 | 0.16 | 5.28 | 0.998 | 0.997 | 0.041 | 0.016 | -0.22 | 4.11 | 1.001 | 1.002 | 0.029 | 0.011 | 0.11 | 2.92 |
| *MG-type Estimators* | | | | | | | | | | | | | | | | | | | | | | | | |
| CMG | 0.997 | 0.997 | 0.088 | 0.083 | -0.33 | 8.82 | 1.000 | 0.999 | 0.067 | 0.065 | 0.04 | 6.73 | 1.001 | 1.002 | 0.053 | 0.052 | 0.12 | 5.31 | 1.003 | 1.004 | 0.039 | 0.038 | 0.25 | 3.94 |
| AMG(i) | 0.998 | 1.001 | 0.084 | 0.078 | -0.22 | 8.44 | 1.003 | 1.004 | 0.063 | 0.059 | 0.34 | 6.33 | 0.999 | 1.000 | 0.048 | 0.048 | -0.07 | 4.84 | 1.002 | 1.004 | 0.036 | 0.034 | 0.24 | 3.61 |
| AMG(ii) | 0.999 | 0.998 | 0.085 | 0.080 | -0.14 | 8.53 | 1.002 | 1.002 | 0.062 | 0.061 | 0.20 | 6.16 | 0.999 | 1.000 | 0.050 | 0.049 | -0.09 | 4.97 | 1.002 | 1.002 | 0.036 | 0.035 | 0.22 | 3.60 |
| MG | 1.247 | 1.223 | 0.320 | 0.183 | 24.65 | 40.36 | 1.231 | 1.204 | 0.275 | 0.137 | 23.12 | 35.95 | 1.241 | 1.223 | 0.270 | 0.111 | 24.12 | 36.17 | 1.243 | 1.219 | 0.263 | 0.079 | 24.27 | 35.77 |
| MG (inf) | 0.998 | 0.997 | 0.060 | 0.060 | -0.17 | 6.01 | 1.001 | 1.000 | 0.046 | 0.046 | 0.08 | 4.62 | 0.999 | 0.999 | 0.036 | 0.037 | -0.14 | 3.60 | 1.002 | 1.002 | 0.026 | 0.026 | 0.15 | 2.58 |

Continued on the following page.

## Kapetanios, Pesaran and Yamagata (2009) — continued

| $T = 50$ | $N = 20$ | | | | | | $N = 30$ | | | | | | $N = 50$ | | | | | | $N = 100$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 |
| *Pooled Estimators* | | | | | | | | | | | | | | | | | | | | | | | | |
| POLS† | 1.083 | 1.058 | 0.207 | 0.029 | 8.31 | 22.25 | 1.083 | 1.063 | 0.183 | 0.024 | 8.30 | 20.10 | 1.083 | 1.061 | 0.165 | 0.018 | 8.31 | 18.48 | 1.078 | 1.052 | 0.147 | 0.013 | 7.84 | 16.69 |
| POLS‡ | 0.998 | 0.995 | 0.167 | 0.024 | -0.25 | 16.70 | 1.000 | 1.003 | 0.129 | 0.020 | 0.02 | 12.87 | 1.000 | 0.998 | 0.098 | 0.015 | -0.04 | 9.79 | 0.997 | 1.000 | 0.071 | 0.011 | -0.36 | 7.10 |
| FE† | 1.263 | 1.239 | 0.334 | 0.039 | 26.27 | 42.48 | 1.259 | 1.240 | 0.315 | 0.031 | 25.85 | 40.71 | 1.268 | 1.257 | 0.315 | 0.025 | 26.84 | 41.38 | 1.268 | 1.253 | 0.306 | 0.017 | 26.79 | 40.67 |
| FE‡ | 0.997 | 0.998 | 0.114 | 0.024 | -0.28 | 11.43 | 0.999 | 0.998 | 0.092 | 0.019 | -0.14 | 9.22 | 0.999 | 1.001 | 0.070 | 0.015 | -0.07 | 6.96 | 1.001 | 0.999 | 0.051 | 0.011 | 0.06 | 5.08 |
| CCEP | 1.006 | 1.005 | 0.092 | 0.025 | 0.55 | 9.25 | 1.000 | 1.001 | 0.074 | 0.019 | 0.02 | 7.38 | 1.002 | 1.005 | 0.061 | 0.016 | 0.24 | 6.05 | 1.001 | 1.001 | 0.042 | 0.011 | 0.08 | 4.24 |
| FD-OLS | 1.001 | 0.998 | 0.067 | 0.027 | 0.13 | 6.70 | 1.000 | 0.998 | 0.053 | 0.020 | -0.01 | 5.33 | 1.002 | 1.004 | 0.042 | 0.017 | 0.22 | 4.17 | 1.001 | 1.002 | 0.029 | 0.012 | 0.08 | 2.93 |
| FE (inf) | 0.999 | 0.998 | 0.060 | 0.017 | -0.07 | 6.02 | 0.998 | 1.000 | 0.050 | 0.013 | -0.17 | 4.95 | 1.001 | 1.002 | 0.041 | 0.011 | 0.08 | 4.08 | 1.001 | 1.001 | 0.029 | 0.008 | 0.10 | 2.90 |
| *MG-type Estimators* | | | | | | | | | | | | | | | | | | | | | | | | |
| CMG | 1.005 | 1.008 | 0.087 | 0.083 | 0.48 | 8.71 | 1.000 | 1.003 | 0.070 | 0.068 | -0.03 | 7.02 | 1.002 | 1.003 | 0.057 | 0.055 | 0.23 | 5.68 | 1.000 | 1.000 | 0.040 | 0.038 | -0.02 | 3.95 |
| AMG(i) | 1.003 | 0.998 | 0.077 | 0.073 | 0.27 | 7.70 | 1.002 | 1.003 | 0.063 | 0.062 | 0.19 | 6.27 | 1.004 | 1.006 | 0.053 | 0.051 | 0.37 | 5.30 | 1.001 | 1.002 | 0.036 | 0.035 | 0.08 | 3.58 |
| AMG(ii) | 1.005 | 1.002 | 0.077 | 0.075 | 0.47 | 7.75 | 1.003 | 1.004 | 0.064 | 0.063 | 0.25 | 6.42 | 1.003 | 1.004 | 0.053 | 0.052 | 0.29 | 5.31 | 1.001 | 1.001 | 0.037 | 0.036 | 0.06 | 3.73 |
| MG | 1.263 | 1.241 | 0.336 | 0.180 | 26.29 | 42.65 | 1.266 | 1.236 | 0.316 | 0.148 | 26.58 | 41.24 | 1.277 | 1.246 | 0.304 | 0.123 | 27.73 | 41.11 | 1.277 | 1.254 | 0.294 | 0.083 | 27.65 | 40.33 |
| MG (inf) | 1.000 | 1.003 | 0.051 | 0.050 | 0.01 | 5.06 | 1.000 | 1.000 | 0.042 | 0.042 | 0.04 | 4.15 | 1.002 | 1.002 | 0.035 | 0.033 | 0.18 | 3.46 | 1.000 | 1.001 | 0.024 | 0.023 | 0.04 | 2.41 |

| $T = 100$ | $N = 20$ | | | | | | $N = 30$ | | | | | | $N = 50$ | | | | | | $N = 100$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 | mean | median | emp. ste.* | mean ste.* | Bias x 100 | RMSE x 100 |
| *Pooled Estimators* | | | | | | | | | | | | | | | | | | | | | | | | |
| POLS† | 1.128 | 1.106 | 0.221 | 0.022 | 12.77 | 25.54 | 1.124 | 1.100 | 0.202 | 0.018 | 12.41 | 23.68 | 1.116 | 1.091 | 0.182 | 0.014 | 11.61 | 21.62 | 1.118 | 1.089 | 0.171 | 0.010 | 11.80 | 20.78 |
| POLS‡ | 1.007 | 1.004 | 0.158 | 0.018 | 0.72 | 15.84 | 1.008 | 1.003 | 0.131 | 0.014 | 0.81 | 13.12 | 0.999 | 0.999 | 0.097 | 0.011 | -0.11 | 9.73 | 1.001 | 1.003 | 0.070 | 0.008 | 0.07 | 7.02 |
| FE† | 1.318 | 1.289 | 0.346 | 0.028 | 31.78 | 46.97 | 1.322 | 1.312 | 0.337 | 0.023 | 32.19 | 46.61 | 1.319 | 1.312 | 0.324 | 0.018 | 31.89 | 45.47 | 1.322 | 1.311 | 0.320 | 0.012 | 32.23 | 45.40 |
| FE‡ | 1.001 | 1.000 | 0.121 | 0.017 | 0.05 | 12.11 | 1.002 | 1.002 | 0.098 | 0.014 | 0.24 | 9.81 | 0.998 | 0.997 | 0.076 | 0.010 | -0.21 | 7.63 | 1.000 | 1.001 | 0.053 | 0.007 | -0.01 | 5.29 |
| CCEP | 1.001 | 0.997 | 0.103 | 0.016 | 0.10 | 10.27 | 1.007 | 1.007 | 0.088 | 0.014 | 0.69 | 8.79 | 1.003 | 1.004 | 0.065 | 0.010 | 0.28 | 6.50 | 1.004 | 1.004 | 0.047 | 0.008 | 0.36 | 4.72 |
| FD-OLS | 1.002 | 1.002 | 0.065 | 0.019 | 0.22 | 6.46 | 1.002 | 1.002 | 0.053 | 0.016 | 0.16 | 5.33 | 1.000 | 1.003 | 0.039 | 0.012 | -0.05 | 3.93 | 1.001 | 1.001 | 0.028 | 0.008 | 0.12 | 2.82 |
| FE (inf) | 1.002 | 1.001 | 0.064 | 0.010 | 0.18 | 6.41 | 1.000 | 1.000 | 0.057 | 0.008 | 0.01 | 5.68 | 1.000 | 1.001 | 0.042 | 0.006 | 0.04 | 4.21 | 1.000 | 1.000 | 0.029 | 0.004 | 0.04 | 2.91 |
| *MG-type Estimators* | | | | | | | | | | | | | | | | | | | | | | | | |
| CMG | 1.003 | 1.001 | 0.099 | 0.090 | 0.27 | 9.88 | 1.007 | 1.006 | 0.081 | 0.076 | 0.71 | 8.15 | 1.004 | 1.003 | 0.062 | 0.059 | 0.36 | 6.21 | 1.003 | 1.001 | 0.043 | 0.043 | 0.25 | 4.34 |
| AMG(i) | 1.001 | 1.001 | 0.081 | 0.079 | 0.12 | 8.04 | 1.003 | 1.002 | 0.067 | 0.069 | 0.25 | 6.73 | 1.001 | 1.002 | 0.053 | 0.052 | 0.05 | 5.32 | 1.001 | 1.002 | 0.037 | 0.038 | 0.09 | 3.72 |
| AMG(ii) | 1.003 | 1.000 | 0.083 | 0.080 | 0.34 | 8.25 | 1.007 | 1.007 | 0.073 | 0.070 | 0.72 | 7.32 | 1.002 | 1.004 | 0.054 | 0.054 | 0.22 | 5.39 | 1.002 | 1.003 | 0.039 | 0.039 | 0.18 | 3.93 |
| MG | 1.334 | 1.298 | 0.366 | 0.207 | 33.41 | 49.55 | 1.351 | 1.327 | 0.361 | 0.181 | 35.10 | 50.37 | 1.338 | 1.310 | 0.327 | 0.137 | 33.84 | 47.05 | 1.343 | 1.326 | 0.312 | 0.099 | 34.33 | 46.35 |
| MG (inf) | 1.003 | 1.002 | 0.049 | 0.047 | 0.25 | 4.90 | 1.002 | 1.002 | 0.042 | 0.039 | 0.16 | 4.16 | 1.002 | 1.001 | 0.031 | 0.030 | 0.15 | 3.08 | 1.000 | 1.001 | 0.022 | 0.021 | 0.03 | 2.18 |

**Notes:** See Table A-1 and main text for details. FE (inf) and MG (inf) are 'infeasible estimators' where the true unobserved common factors are included in the regression. ‡ (†) We do (not) include $T - 1$ year dummies.

# C Bond and Eberhardt (2013)

We define our dependent variable and regressor as

$$y_{it} = \beta_i x_{it} + u_{it} \qquad u_{it} = \alpha_i + \lambda^y_{i1} f_{1t} + \lambda^y_{i2} f_{2t} + \varepsilon_{it} \tag{11}$$

$$x_{it} = a_i + \lambda^x_{i1} f_{1t} + \lambda^x_{i3} f_{3t} + \epsilon_{it} \qquad \epsilon_{it} = \rho\epsilon_{i,t-1} + e_{it} \tag{12}$$

The serially-correlated $x$-variable is in practice constructed using a dynamic equation

$$x_{it} = (1-\rho)a_i + \lambda^x_{i1} f_{1t} - \rho\lambda^x_{i1} f_{1,t-1} + \lambda^x_{i3} f_{3t} - \rho\lambda^x_{i3} f_{3,t-1} + \rho x_{i,t-1} + e_{it}$$

which we begin with $x_{i,-49} = a_i$ and then accumulate for $t = -48, \ldots, 0, 1, \ldots, T$, discarding the first 50 time-series observations for all $i$. The common AR-coefficient is $\rho = .25$.

The unobserved common factors are nonstationary processes with individual drifts so as to ensure upward evolution over time, as observed in many macro data series.

$$f_{jt} = \mu_j + f_{j,t-1} + \upsilon_{fjt} \qquad t = -48, \ldots, 0, 1, \ldots, T \qquad f_{j,-49} = 0 \tag{13}$$

$$\upsilon_{fjt} \sim N\left(0, \sigma^2_{fj}\right) \qquad \sigma^2_{fj} = .00125 \qquad \mu_j = \{0.015, 0.012, 0.01\} \qquad j = 1, 2, 3$$

The error terms for the $y$ and $x$ equations are defined as

$$e_{it} \sim iid\, N(0, \sigma^2_{e,i}) \qquad \text{where } \sigma^2_{e,i} \sim U[.001, .003]$$

$$\varepsilon_{it} \sim iid\, N(0, \sigma^2_{\varepsilon}) \qquad \sigma^2_{\varepsilon} = .00125$$

The slope coefficient on $x$ is set to $\beta_i = 1 + e^\beta_i$ where $e^\beta_i \sim U[-.25, +.25]$. The factor loadings are uniformly distributed, with $\lambda^x_{i1}$ and $\lambda^y_{i1}$ iid $U[0, 1]$ respectively, and $\lambda^x_{i3}$ and $\lambda^y_{i2}$ iid $U[.25, 1.25]$ respectively.

We consider the following cases

(i) baseline (as above).
(ii) baseline with additional group-specific linear trends.
(iii) feedbacks: an idiosyncratic shock to $y$ feeds back into $x$ with one period lag.
(iv) two 'clubs' of countries with the same $\beta$ coefficient.

The group-specific linear trends in Case (ii) are distributed $U[-.02, +.03]$, s.t. that the mean annual growth rate across the panel is non-zero. For the feedback case, the lagged error $\varepsilon_{i,t-1}$ from the $y$-equation in (11) is included in the $x$-equation in (12) with coefficient .25 (in practice we enter this term in the same way as the other terms in the dynamic equation as described above). Finally, for the 'two clubs' case 20% of panel groups have $\beta = 2$, while 80% have $\beta = .75$, s.t. the mean $\beta$ across all groups is still unity.

Results for our benchmark specification — Case (i) — indicate that 2FE has bias of .0324 with empirical standard error of .0876, compared to .0271 for the infeasible FE estimator. Similarly for the MG estimator. In all cases this bias is increasing in $T$ and decreasing in $N$. For the CCE and AMG estimators, all of which are unbiased, the AMG(ii) commonly is most efficient.

Once we add the idiosyncratic trend terms — Case (ii) — the bias in the standard pooled estimators does not change by any significant margin. 2FE now has a bias of .0277, but a very substantial empirical standard error of .1973 (more than double that of the benchmark case), compared with .0280 for the infeasible FE estimator. This imprecision increases with $T$. In contrast the unbiased CCE and AMG estimators are still efficient.

By construction, the feedback setup — Case (iii) — leads to bias in the FD-OLS, which carries over to the AMG estimators: due to differencing the $\varepsilon_{i,t-1}$ are contained in both the errors and the regressors of the FD-OLS estimation equation, whereas this is not the case in the other (levels-based) estimators which account for common factors. We therefore also present the results for an IV-version of the FD-OLS estimator, where we use growth rates at time $(t-1)$ as instruments for the endogenous growth rates at time $t$ (FD-IV), and AMG estimators which are based on the year dummies from the instrumented first stage regression (AMG-IV). The pooled OLS, 2FE and MG results are virtually unchanged from the baseline results: 2FE has a bias of .0299 with empirical standard error of .0865 compared with .0271 for the infeasible FE estimator. The augmented estimators all display small finite sample bias, albeit very modest in case of the CCE estimators, while the new AMG estimates based on the FD-IV results are unbiased. The latter is unbiased, but inefficient compared with the new AMG estimators.

In the setup where $\beta$ is heterogeneous but only takes two values for different 'clubs' of countries — Case (iv) — the results show considerable bias for the POLS estimator, while other estimators remain relatively unchanged: the 2FE estimator has a bias of .0224 and an empirical standard error of .1375 compared with .0357 for the infeasible FE. The small finite sample bias for the AMG(ii) implementation is wiped out in the instrumented version AMG(ii)-IV.

All of these results confirm the performance of the AMG estimators while highlighting more substantial bias in the naïve estimators (POLS, 2FE, MG).

# Table C-1: Bond and Eberhardt (2013) — (i) Baseline setup

**Monte Carlo Results — Baseline Setup**

1,000 replications; POLS, FE and FD-OLS all have $T-1$ year dummies; AMG-estimators are constructed from FD-OLS year dummy coefficients

| $T=20$ | $N=20$ | | | | $N=30$ | | | | $N=50$ | | | | $N=100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0481 | 1.0618 | 0.3660 | 0.0793 | 1.0448 | 1.0364 | 0.2875 | 0.0618 | 0.9689 | 0.9628 | 0.2142 | 0.0508 | 0.9896 | 0.9845 | 0.1384 | 0.0328 |
| FE | 1.0543 | 1.0483 | 0.1205 | 0.0499 | 1.0188 | 1.0188 | 0.0934 | 0.0402 | 1.0211 | 1.0201 | 0.0703 | 0.0312 | 1.0093 | 1.0086 | 0.0479 | 0.0218 |
| CCEP | 1.0014 | 0.9994 | 0.0584 | 0.0444 | 0.9999 | 1.0018 | 0.0491 | 0.0365 | 1.0006 | 1.0011 | 0.0370 | 0.0282 | 1.0014 | 0.9998 | 0.0268 | 0.0200 |
| FD-OLS | 1.0057 | 1.0054 | 0.0648 | 0.0466 | 1.0016 | 1.0008 | 0.0534 | 0.0377 | 1.0029 | 1.0027 | 0.0396 | 0.0291 | 1.0013 | 1.0005 | 0.0292 | 0.0204 |
| FE (inf) | 1.0019 | 1.0028 | 0.0474 | 0.0344 | 1.0003 | 0.9991 | 0.0403 | 0.0281 | 1.0008 | 1.0015 | 0.0309 | 0.0219 | 1.0009 | 1.0001 | 0.0221 | 0.0154 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0013 | 1.0008 | 0.0598 | 0.0586 | 0.9983 | 1.0003 | 0.0498 | 0.0483 | 1.0004 | 1.0007 | 0.0382 | 0.0376 | 1.0016 | 1.0008 | 0.0277 | 0.0269 |
| AMG(i) | 1.0059 | 1.0050 | 0.0598 | 0.0530 | 1.0015 | 1.0021 | 0.0500 | 0.0439 | 1.0040 | 1.0044 | 0.0373 | 0.0344 | 1.0021 | 1.0005 | 0.0271 | 0.0246 |
| AMG(ii) | 1.0046 | 1.0028 | 0.0590 | 0.0499 | 1.0013 | 1.0022 | 0.0492 | 0.0421 | 1.0031 | 1.0041 | 0.0376 | 0.0328 | 1.0023 | 1.0011 | 0.0270 | 0.0233 |
| MG | 1.1076 | 1.1013 | 0.1651 | 0.0656 | 1.1261 | 1.1160 | 0.1725 | 0.0543 | 1.1128 | 1.1002 | 0.1582 | 0.0421 | 1.1205 | 1.1114 | 0.1656 | 0.0299 |
| MG (inf) | 1.0007 | 1.0000 | 0.0488 | 0.0493 | 0.9992 | 0.9981 | 0.0408 | 0.0405 | 1.0003 | 1.0014 | 0.0317 | 0.0314 | 1.0007 | 0.9996 | 0.0224 | 0.0222 |

| $T=30$ | $N=20$ | | | | $N=30$ | | | | $N=50$ | | | | $N=100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0517 | 1.0593 | 0.3582 | 0.0649 | 1.0370 | 1.0269 | 0.2895 | 0.0507 | 0.9754 | 0.9815 | 0.2139 | 0.0413 | 0.9908 | 0.9940 | 0.1406 | 0.0268 |
| FE | 1.0735 | 1.0703 | 0.1536 | 0.0431 | 1.0258 | 1.0257 | 0.1178 | 0.0346 | 1.0324 | 1.0312 | 0.0876 | 0.0269 | 1.0111 | 1.0069 | 0.0602 | 0.0188 |
| CCEP | 1.0018 | 1.0049 | 0.0514 | 0.0350 | 1.0012 | 1.0007 | 0.0438 | 0.0287 | 0.9995 | 0.9975 | 0.0333 | 0.0222 | 1.0007 | 1.0006 | 0.0241 | 0.0157 |
| FD-OLS | 1.0035 | 1.0052 | 0.0552 | 0.0381 | 1.0037 | 1.0045 | 0.0454 | 0.0308 | 1.0021 | 1.0015 | 0.0342 | 0.0237 | 1.0009 | 1.0004 | 0.0248 | 0.0167 |
| FE (inf) | 1.0012 | 1.0035 | 0.0438 | 0.0255 | 1.0014 | 1.0023 | 0.0347 | 0.0207 | 1.0000 | 0.9996 | 0.0271 | 0.0161 | 1.0002 | 1.0003 | 0.0197 | 0.0113 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0007 | 1.0017 | 0.0517 | 0.0497 | 1.0009 | 1.0014 | 0.0436 | 0.0420 | 0.9992 | 0.9975 | 0.0338 | 0.0327 | 1.0003 | 1.0002 | 0.0241 | 0.0237 |
| AMG(i) | 1.0064 | 1.0081 | 0.0523 | 0.0488 | 1.0041 | 1.0036 | 0.0435 | 0.0405 | 1.0026 | 1.0008 | 0.0323 | 0.0319 | 1.0024 | 1.0024 | 0.0237 | 0.0229 |
| AMG(ii) | 1.0035 | 1.0036 | 0.0517 | 0.0461 | 1.0043 | 1.0048 | 0.0429 | 0.0386 | 1.0018 | 1.0004 | 0.0326 | 0.0304 | 1.0024 | 1.0023 | 0.0231 | 0.0217 |
| MG | 1.1284 | 1.1263 | 0.1827 | 0.0604 | 1.1520 | 1.1369 | 0.1864 | 0.0502 | 1.1259 | 1.1143 | 0.1825 | 0.0388 | 1.1378 | 1.1356 | 0.1839 | 0.0278 |
| MG (inf) | 1.0012 | 1.0038 | 0.0431 | 0.0419 | 1.0016 | 1.0019 | 0.0336 | 0.0344 | 0.9999 | 0.9989 | 0.0267 | 0.0267 | 1.0002 | 1.0000 | 0.0194 | 0.0190 |

Continued on the following page.

Bond and Eberhardt (2013) — (i) Baseline setup (continued)

| $T = 50$ | $N = 20$ | | | | $N = 30$ | | | | $N = 50$ | | | | $N = 100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0502 | 1.0698 | 0.3640 | 0.0504 | 1.0342 | 1.0343 | 0.2919 | 0.0388 | 0.9857 | 0.9825 | 0.2057 | 0.0318 | 0.9893 | 0.9971 | 0.1392 | 0.0209 |
| FE | 1.1156 | 1.1189 | 0.2044 | 0.0357 | 1.0381 | 1.0356 | 0.1529 | 0.0285 | 1.0451 | 1.0468 | 0.1163 | 0.0221 | 1.0165 | 1.0140 | 0.0823 | 0.0155 |
| CCEP | 1.0024 | 1.0023 | 0.0480 | 0.0264 | 0.9993 | 0.9988 | 0.0405 | 0.0218 | 0.9997 | 1.0001 | 0.0317 | 0.0168 | 0.9996 | 1.0003 | 0.0217 | 0.0119 |
| FD-OLS | 1.0055 | 1.0031 | 0.0493 | 0.0295 | 1.0006 | 1.0008 | 0.0387 | 0.0239 | 1.0018 | 1.0022 | 0.0312 | 0.0184 | 1.0003 | 1.0004 | 0.0217 | 0.0129 |
| FE (inf) | 1.0009 | 1.0000 | 0.0393 | 0.0172 | 0.9995 | 0.9997 | 0.0324 | 0.0141 | 1.0000 | 1.0001 | 0.0257 | 0.0109 | 0.9997 | 0.9995 | 0.0177 | 0.0077 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0026 | 0.9999 | 0.0475 | 0.0459 | 0.9982 | 0.9993 | 0.0405 | 0.0387 | 0.9994 | 0.9997 | 0.0310 | 0.0300 | 1.0001 | 0.9999 | 0.0213 | 0.0217 |
| AMG(i) | 1.0075 | 1.0064 | 0.0474 | 0.0479 | 1.0024 | 1.0027 | 0.0385 | 0.0398 | 1.0040 | 1.0035 | 0.0301 | 0.0312 | 1.0024 | 1.0023 | 0.0211 | 0.0224 |
| AMG(ii) | 1.0048 | 1.0036 | 0.0464 | 0.0444 | 1.0016 | 1.0020 | 0.0375 | 0.0372 | 1.0024 | 1.0022 | 0.0301 | 0.0290 | 1.0018 | 1.0020 | 0.0207 | 0.0209 |
| MG | 1.1700 | 1.1564 | 0.2160 | 0.0595 | 1.1761 | 1.1669 | 0.2123 | 0.0499 | 1.1613 | 1.1496 | 0.2088 | 0.0384 | 1.1641 | 1.1584 | 0.2148 | 0.0275 |
| MG (inf) | 1.0006 | 1.0017 | 0.0368 | 0.0370 | 0.9996 | 1.0001 | 0.0314 | 0.0300 | 0.9998 | 0.9996 | 0.0241 | 0.0236 | 0.9996 | 1.0005 | 0.0170 | 0.0166 |

| $T = 100$ | $N = 20$ | | | | $N = 30$ | | | | $N = 50$ | | | | $N = 100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0973 | 1.1043 | 0.3540 | 0.0349 | 1.0422 | 1.0282 | 0.2762 | 0.0273 | 0.9990 | 0.9964 | 0.2148 | 0.0221 | 0.9993 | 1.0001 | 0.1434 | 0.0145 |
| FE | 1.1469 | 1.1565 | 0.2527 | 0.0266 | 1.0446 | 1.0479 | 0.1911 | 0.0212 | 1.0557 | 1.0553 | 0.1433 | 0.0166 | 1.0233 | 1.0196 | 0.1042 | 0.0115 |
| CCEP | 1.0068 | 1.0045 | 0.0535 | 0.0185 | 1.0017 | 1.0011 | 0.0428 | 0.0153 | 0.9999 | 1.0001 | 0.0343 | 0.0119 | 0.9984 | 0.9987 | 0.0260 | 0.0084 |
| FD-OLS | 1.0063 | 1.0051 | 0.0427 | 0.0208 | 1.0034 | 1.0033 | 0.0346 | 0.0169 | 1.0021 | 1.0023 | 0.0266 | 0.0130 | 1.0002 | 1.0007 | 0.0195 | 0.0091 |
| FE (inf) | 1.0019 | 1.0012 | 0.0375 | 0.0101 | 1.0018 | 1.0019 | 0.0302 | 0.0082 | 0.9997 | 0.9996 | 0.0226 | 0.0063 | 0.9994 | 0.9991 | 0.0171 | 0.0045 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0044 | 1.0024 | 0.0509 | 0.0478 | 0.9998 | 0.9992 | 0.0415 | 0.0408 | 0.9987 | 0.9986 | 0.0328 | 0.0323 | 0.9996 | 0.9992 | 0.0249 | 0.0229 |
| AMG(i) | 1.0089 | 1.0075 | 0.0461 | 0.0503 | 1.0052 | 1.0055 | 0.0363 | 0.0420 | 1.0054 | 1.0042 | 0.0291 | 0.0336 | 1.0032 | 1.0038 | 0.0212 | 0.0238 |
| AMG(ii) | 1.0056 | 1.0039 | 0.0436 | 0.0459 | 1.0049 | 1.0046 | 0.0358 | 0.0387 | 1.0026 | 1.0027 | 0.0280 | 0.0308 | 1.0022 | 1.0031 | 0.0209 | 0.0219 |
| MG | 1.2078 | 1.1970 | 0.2549 | 0.0617 | 1.2084 | 1.2021 | 0.2516 | 0.0519 | 1.1932 | 1.1815 | 0.2678 | 0.0412 | 1.1944 | 1.1858 | 0.2601 | 0.0295 |
| MG (inf) | 1.0010 | 0.9995 | 0.0349 | 0.0337 | 1.0014 | 1.0020 | 0.0279 | 0.0277 | 0.9993 | 0.9992 | 0.0209 | 0.0216 | 0.9997 | 0.9996 | 0.0155 | 0.0152 |

## Table C-2: Bond and Eberhardt (2013) — (ii) Additional country trend

**Monte Carlo Results — Baseline Setup with Idiosyncratic Trends**

1,000 replications; POLS, FE and FD-OLS all have $T-1$ year dummies; AMG-estimators are constructed from FD-OLS year dummy coefficients

| $T=20$ | $N=20$ | | | | $N=30$ | | | | $N=50$ | | | | $N=100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0517 | 1.0587 | 0.4729 | 0.1068 | 1.0321 | 1.0318 | 0.3800 | 0.0839 | 0.9679 | 0.9616 | 0.2921 | 0.0675 | 0.9914 | 0.9951 | 0.1949 | 0.0441 |
| FE | 1.0403 | 1.0364 | 0.2249 | 0.0905 | 1.0201 | 1.0226 | 0.1840 | 0.0732 | 1.0210 | 1.0192 | 0.1429 | 0.0563 | 1.0113 | 1.0123 | 0.0998 | 0.0396 |
| CCEP | 0.9986 | 0.9999 | 0.0726 | 0.0526 | 0.9995 | 0.9990 | 0.0595 | 0.0435 | 1.0025 | 1.0022 | 0.0445 | 0.0333 | 1.0015 | 1.0006 | 0.0307 | 0.0236 |
| FD-OLS | 1.0050 | 1.0067 | 0.0670 | 0.0497 | 1.0015 | 0.9995 | 0.0536 | 0.0401 | 1.0027 | 1.0006 | 0.0393 | 0.0309 | 1.0008 | 1.0000 | 0.0287 | 0.0217 |
| FE (inf) | 1.0023 | 1.0036 | 0.0520 | 0.0384 | 0.9998 | 0.9991 | 0.0427 | 0.0313 | 1.0012 | 1.0017 | 0.0322 | 0.0243 | 1.0008 | 1.0004 | 0.0234 | 0.0172 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 0.9990 | 0.9994 | 0.0741 | 0.0692 | 0.9981 | 0.9968 | 0.0622 | 0.0582 | 1.0022 | 1.0018 | 0.0456 | 0.0441 | 1.0017 | 1.0015 | 0.0320 | 0.0317 |
| AMG(i) | 1.0050 | 1.0065 | 0.0947 | 0.0537 | 1.0035 | 1.0054 | 0.0745 | 0.0445 | 1.0054 | 1.0049 | 0.0603 | 0.0347 | 1.0041 | 1.0033 | 0.0458 | 0.0250 |
| AMG(ii) | 1.0161 | 1.0074 | 0.1054 | 0.0718 | 1.0155 | 1.0143 | 0.0819 | 0.0586 | 1.0152 | 1.0115 | 0.0672 | 0.0446 | 1.0120 | 1.0109 | 0.0505 | 0.0315 |
| MG | 1.1092 | 1.1037 | 0.1686 | 0.0656 | 1.1254 | 1.1144 | 0.1742 | 0.0544 | 1.1129 | 1.0965 | 0.1579 | 0.0423 | 1.1203 | 1.1148 | 0.1650 | 0.0300 |
| MG (inf) | 1.0032 | 1.0017 | 0.0545 | 0.0537 | 1.0016 | 1.0021 | 0.0451 | 0.0436 | 1.0029 | 1.0027 | 0.0357 | 0.0338 | 1.0029 | 1.0028 | 0.0255 | 0.0241 |

| $T=30$ | $N=20$ | | | | $N=30$ | | | | $N=50$ | | | | $N=100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0654 | 1.0722 | 0.4969 | 0.0893 | 1.0241 | 1.0298 | 0.3888 | 0.0708 | 0.9731 | 0.9688 | 0.3102 | 0.0567 | 0.9948 | 1.0017 | 0.2054 | 0.0371 |
| FE | 1.0718 | 1.0761 | 0.3278 | 0.0888 | 1.0109 | 1.0138 | 0.2497 | 0.0717 | 1.0277 | 1.0283 | 0.1973 | 0.0552 | 1.0108 | 1.0159 | 0.1400 | 0.0389 |
| CCEP | 1.0028 | 1.0021 | 0.0612 | 0.0431 | 1.0015 | 0.9991 | 0.0553 | 0.0355 | 0.9991 | 1.0003 | 0.0395 | 0.0275 | 1.0003 | 1.0018 | 0.0286 | 0.0194 |
| FD-OLS | 1.0036 | 1.0038 | 0.0556 | 0.0402 | 1.0028 | 1.0024 | 0.0473 | 0.0325 | 1.0025 | 1.0031 | 0.0351 | 0.0250 | 1.0009 | 1.0017 | 0.0243 | 0.0176 |
| FE (inf) | 1.0009 | 1.0019 | 0.0446 | 0.0282 | 1.0011 | 1.0001 | 0.0372 | 0.0230 | 0.9998 | 0.9995 | 0.0280 | 0.0179 | 1.0004 | 1.0002 | 0.0191 | 0.0126 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0019 | 1.0017 | 0.0618 | 0.0603 | 1.0007 | 0.9984 | 0.0554 | 0.0508 | 0.9997 | 0.9997 | 0.0404 | 0.0400 | 1.0002 | 1.0008 | 0.0295 | 0.0284 |
| AMG(i) | 1.0041 | 1.0044 | 0.0839 | 0.0495 | 1.0058 | 1.0089 | 0.0697 | 0.0405 | 1.0049 | 1.0047 | 0.0506 | 0.0322 | 1.0019 | 1.0014 | 0.0378 | 0.0229 |
| AMG(ii) | 1.0100 | 1.0071 | 0.0894 | 0.0665 | 1.0130 | 1.0144 | 0.0752 | 0.0555 | 1.0090 | 1.0080 | 0.0558 | 0.0432 | 1.0061 | 1.0053 | 0.0412 | 0.0300 |
| MG | 1.1262 | 1.1248 | 0.1824 | 0.0603 | 1.1506 | 1.1427 | 0.1853 | 0.0502 | 1.1269 | 1.1185 | 0.1848 | 0.0390 | 1.1379 | 1.1361 | 0.1826 | 0.0277 |
| MG (inf) | 1.0013 | 1.0005 | 0.0452 | 0.0441 | 1.0028 | 1.0025 | 0.0375 | 0.0361 | 1.0017 | 1.0019 | 0.0286 | 0.0281 | 1.0012 | 1.0011 | 0.0198 | 0.0200 |

Continued on the following page.

## Bond and Eberhardt (2013) — (ii) Additional country trend (continued)

| $T = 50$ | $N = 20$ | | | | $N = 30$ | | | | $N = 50$ | | | | $N = 100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0407 | 1.0480 | 0.5318 | 0.0724 | 1.0288 | 1.0308 | 0.4090 | 0.0572 | 0.9913 | 0.9831 | 0.3194 | 0.0462 | 0.9868 | 0.9830 | 0.2078 | 0.0304 |
| FE | 1.1113 | 1.1193 | 0.4462 | 0.0821 | 1.0354 | 1.0517 | 0.3627 | 0.0658 | 1.0486 | 1.0570 | 0.2810 | 0.0512 | 1.0137 | 1.0202 | 0.2003 | 0.0361 |
| CCEP | 1.0053 | 1.0051 | 0.0640 | 0.0356 | 0.9999 | 0.9987 | 0.0511 | 0.0290 | 0.9999 | 1.0007 | 0.0409 | 0.0223 | 0.9991 | 0.9984 | 0.0288 | 0.0159 |
| FD-OLS | 1.0058 | 1.0038 | 0.0502 | 0.0309 | 1.0006 | 1.0013 | 0.0395 | 0.0250 | 1.0009 | 1.0012 | 0.0318 | 0.0192 | 1.0007 | 1.0005 | 0.0221 | 0.0135 |
| FE (inf) | 1.0015 | 1.0004 | 0.0406 | 0.0192 | 0.9999 | 1.0003 | 0.0330 | 0.0157 | 0.9988 | 0.9998 | 0.0255 | 0.0122 | 1.0001 | 1.0002 | 0.0181 | 0.0086 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0055 | 1.0051 | 0.0628 | 0.0586 | 0.9989 | 0.9983 | 0.0506 | 0.0482 | 0.9997 | 1.0004 | 0.0398 | 0.0375 | 0.9993 | 0.9992 | 0.0285 | 0.0270 |
| AMG(i) | 1.0040 | 1.0080 | 0.0767 | 0.0483 | 0.9991 | 0.9996 | 0.0597 | 0.0395 | 1.0011 | 1.0005 | 0.0461 | 0.0311 | 1.0027 | 1.0021 | 0.0339 | 0.0224 |
| AMG(ii) | 1.0061 | 1.0068 | 0.0829 | 0.0694 | 1.0023 | 1.0013 | 0.0655 | 0.0561 | 1.0027 | 1.0034 | 0.0495 | 0.0437 | 1.0038 | 1.0041 | 0.0360 | 0.0308 |
| MG | 1.1724 | 1.1591 | 0.2178 | 0.0600 | 1.1755 | 1.1653 | 0.2131 | 0.0496 | 1.1606 | 1.1530 | 0.2088 | 0.0383 | 1.1651 | 1.1605 | 0.2149 | 0.0276 |
| MG (inf) | 1.0013 | 0.9999 | 0.0400 | 0.0383 | 1.0002 | 1.0008 | 0.0314 | 0.0311 | 1.0000 | 0.9997 | 0.0245 | 0.0243 | 1.0010 | 1.0011 | 0.0177 | 0.0171 |

| $T = 100$ | $N = 20$ | | | | $N = 30$ | | | | $N = 50$ | | | | $N = 100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.1143 | 1.1221 | 0.5645 | 0.0569 | 1.0373 | 1.0306 | 0.4429 | 0.0454 | 0.9945 | 0.9797 | 0.3600 | 0.0359 | 1.0010 | 1.0050 | 0.2425 | 0.0238 |
| FE | 1.1824 | 1.1952 | 0.6226 | 0.0652 | 1.0394 | 1.0153 | 0.4984 | 0.0537 | 1.0535 | 1.0629 | 0.3844 | 0.0409 | 1.0211 | 1.0263 | 0.2716 | 0.0289 |
| CCEP | 1.0051 | 1.0048 | 0.0673 | 0.0280 | 0.9999 | 0.9996 | 0.0586 | 0.0231 | 1.0017 | 1.0009 | 0.0457 | 0.0179 | 0.9992 | 1.0002 | 0.0314 | 0.0126 |
| FD-OLS | 1.0063 | 1.0070 | 0.0429 | 0.0217 | 1.0018 | 1.0014 | 0.0337 | 0.0176 | 1.0032 | 1.0024 | 0.0270 | 0.0135 | 1.0020 | 1.0019 | 0.0188 | 0.0095 |
| FE (inf) | 1.0013 | 1.0009 | 0.0364 | 0.0114 | 0.9997 | 1.0004 | 0.0301 | 0.0093 | 1.0002 | 0.9994 | 0.0241 | 0.0072 | 1.0012 | 1.0010 | 0.0166 | 0.0051 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0038 | 1.0017 | 0.0639 | 0.0619 | 0.9976 | 0.9975 | 0.0524 | 0.0530 | 0.9998 | 0.9999 | 0.0429 | 0.0417 | 1.0005 | 1.0016 | 0.0294 | 0.0295 |
| AMG(i) | 1.0013 | 1.0019 | 0.0683 | 0.0508 | 1.0043 | 1.0062 | 0.0516 | 0.0421 | 1.0043 | 1.0049 | 0.0425 | 0.0336 | 1.0049 | 1.0056 | 0.0284 | 0.0238 |
| AMG(ii) | 1.0003 | 0.9993 | 0.0732 | 0.0733 | 1.0040 | 1.0050 | 0.0542 | 0.0602 | 1.0037 | 1.0016 | 0.0448 | 0.0479 | 1.0042 | 1.0050 | 0.0311 | 0.0337 |
| MG | 1.2072 | 1.1991 | 0.2528 | 0.0621 | 1.2091 | 1.2019 | 0.2514 | 0.0521 | 1.1948 | 1.1830 | 0.2692 | 0.0413 | 1.1966 | 1.1871 | 0.2593 | 0.0295 |
| MG (inf) | 1.0012 | 1.0021 | 0.0343 | 0.0345 | 1.0002 | 0.9999 | 0.0279 | 0.0280 | 1.0006 | 1.0004 | 0.0221 | 0.0218 | 1.0017 | 1.0017 | 0.0156 | 0.0154 |

# Table C-3: Bond and Eberhardt (2013) — (iii) Feedback setup

**Monte Carlo Results — Setup with Feedbacks from $y$ to $x$**

1,000 replications; POLS, FE and FD-OLS all have $T-1$ year dummies; AMG-estimators are constructed from † FD-OLS or ‡ FD-IV year dummy coefficients

| $T=20$ | $N=20$ | | | | $N=30$ | | | | $N=50$ | | | | $N=100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0481 | 1.0618 | 0.3660 | 0.0793 | 1.0448 | 1.0374 | 0.2874 | 0.0618 | 0.9688 | 0.9629 | 0.2141 | 0.0508 | 0.9896 | 0.9845 | 0.1384 | 0.0328 |
| FE | 1.0485 | 1.0427 | 0.1183 | 0.0493 | 1.0140 | 1.0117 | 0.0923 | 0.0397 | 1.0163 | 1.0133 | 0.0691 | 0.0309 | 1.0048 | 1.0036 | 0.0473 | 0.0216 |
| CCEP | 0.9823 | 0.9814 | 0.0578 | 0.0436 | 0.9805 | 0.9833 | 0.0492 | 0.0358 | 0.9812 | 0.9822 | 0.0361 | 0.0277 | 0.9823 | 0.9806 | 0.0265 | 0.0196 |
| FD-OLS | 0.9181 | 0.9195 | 0.0631 | 0.0467 | 0.9142 | 0.9127 | 0.0530 | 0.0377 | 0.9154 | 0.9146 | 0.0391 | 0.0291 | 0.9142 | 0.9140 | 0.0287 | 0.0204 |
| FD-IV | 0.9951 | 0.9876 | 0.1662 | 0.0474 | 0.9963 | 0.9936 | 0.1282 | 0.0381 | 1.0027 | 1.0033 | 0.1036 | 0.0293 | 0.9978 | 0.9981 | 0.0706 | 0.0205 |
| FE (inf) | 0.9892 | 0.9902 | 0.0472 | 0.0340 | 0.9875 | 0.9867 | 0.0406 | 0.0278 | 0.9880 | 0.9881 | 0.0304 | 0.0216 | 0.9883 | 0.9879 | 0.0224 | 0.0152 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 0.9772 | 0.9758 | 0.0589 | 0.0576 | 0.9740 | 0.9764 | 0.0495 | 0.0473 | 0.9762 | 0.9761 | 0.0370 | 0.0368 | 0.9772 | 0.9765 | 0.0271 | 0.0264 |
| AMG(i)† | 0.9585 | 0.9597 | 0.0596 | 0.0526 | 0.9540 | 0.9541 | 0.0508 | 0.0435 | 0.9580 | 0.9576 | 0.0378 | 0.0340 | 0.9569 | 0.9562 | 0.0288 | 0.0244 |
| AMG(i)‡ | 0.9922 | 0.9890 | 0.0877 | 0.0532 | 0.9913 | 0.9931 | 0.0704 | 0.0438 | 0.9939 | 0.9926 | 0.0571 | 0.0343 | 0.9914 | 0.9894 | 0.0432 | 0.0245 |
| AMG(ii)† | 0.9528 | 0.9534 | 0.0573 | 0.0500 | 0.9508 | 0.9514 | 0.0494 | 0.0419 | 0.9537 | 0.9528 | 0.0375 | 0.0327 | 0.9539 | 0.9535 | 0.0286 | 0.0234 |
| AMG(ii)‡ | 1.0055 | 0.9958 | 0.1005 | 0.0507 | 1.0030 | 0.9990 | 0.0773 | 0.0422 | 1.0037 | 0.9981 | 0.0663 | 0.0328 | 0.9991 | 0.9974 | 0.0490 | 0.0233 |
| MG | 1.0918 | 1.0852 | 0.1627 | 0.0648 | 1.1105 | 1.1012 | 0.1692 | 0.0535 | 1.0970 | 1.0828 | 0.1554 | 0.0415 | 1.1048 | 1.0956 | 0.1625 | 0.0295 |
| MG (inf) | 0.9829 | 0.9815 | 0.0483 | 0.0490 | 0.9814 | 0.9819 | 0.0410 | 0.0400 | 0.9826 | 0.9834 | 0.0311 | 0.0311 | 0.9831 | 0.9823 | 0.0225 | 0.0220 |

| $T=30$ | $N=20$ | | | | $N=30$ | | | | $N=50$ | | | | $N=100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0518 | 1.0588 | 0.3581 | 0.0648 | 1.0370 | 1.0271 | 0.2894 | 0.0507 | 0.9754 | 0.9818 | 0.2138 | 0.0413 | 0.9908 | 0.9938 | 0.1406 | 0.0268 |
| FE | 1.0697 | 1.0647 | 0.1513 | 0.0428 | 1.0232 | 1.0231 | 0.1163 | 0.0343 | 1.0299 | 1.0285 | 0.0865 | 0.0267 | 1.0088 | 1.0055 | 0.0596 | 0.0186 |
| CCEP | 0.9888 | 0.9915 | 0.0507 | 0.0343 | 0.9883 | 0.9892 | 0.0432 | 0.0282 | 0.9867 | 0.9851 | 0.0330 | 0.0219 | 0.9880 | 0.9882 | 0.0238 | 0.0155 |
| FD-OLS | 0.9162 | 0.9177 | 0.0547 | 0.0377 | 0.9162 | 0.9165 | 0.0447 | 0.0305 | 0.9149 | 0.9136 | 0.0341 | 0.0235 | 0.9139 | 0.9138 | 0.0243 | 0.0165 |
| FD-IV | 0.9948 | 0.9924 | 0.1312 | 0.0381 | 1.0009 | 1.0006 | 0.1052 | 0.0308 | 1.0004 | 0.9993 | 0.0813 | 0.0237 | 0.9973 | 0.9989 | 0.0569 | 0.0166 |
| FE (inf) | 0.9934 | 0.9963 | 0.0436 | 0.0252 | 0.9938 | 0.9943 | 0.0345 | 0.0205 | 0.9924 | 0.9923 | 0.0271 | 0.0159 | 0.9926 | 0.9926 | 0.0198 | 0.0112 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 0.9847 | 0.9873 | 0.0510 | 0.0490 | 0.9845 | 0.9855 | 0.0431 | 0.0413 | 0.9828 | 0.9819 | 0.0333 | 0.0322 | 0.9841 | 0.9843 | 0.0238 | 0.0233 |
| AMG(i)† | 0.9581 | 0.9580 | 0.0529 | 0.0485 | 0.9563 | 0.9569 | 0.0442 | 0.0401 | 0.9552 | 0.9541 | 0.0340 | 0.0316 | 0.9560 | 0.9558 | 0.0258 | 0.0227 |
| AMG(i)‡ | 0.9979 | 0.9985 | 0.0801 | 0.0486 | 0.9978 | 0.9968 | 0.0653 | 0.0403 | 0.9959 | 0.9953 | 0.0486 | 0.0317 | 0.9949 | 0.9954 | 0.0375 | 0.0227 |
| AMG(ii)† | 0.9516 | 0.9520 | 0.0513 | 0.0460 | 0.9528 | 0.9535 | 0.0429 | 0.0385 | 0.9511 | 0.9503 | 0.0338 | 0.0303 | 0.9527 | 0.9532 | 0.0255 | 0.0217 |
| AMG(ii)‡ | 1.0033 | 1.0008 | 0.0874 | 0.0464 | 1.0061 | 1.0004 | 0.0722 | 0.0386 | 1.0015 | 0.9995 | 0.0542 | 0.0303 | 0.9997 | 0.9991 | 0.0415 | 0.0216 |
| MG | 1.1179 | 1.1159 | 0.1801 | 0.0596 | 1.1413 | 1.1239 | 0.1839 | 0.0496 | 1.1157 | 1.1043 | 0.1799 | 0.0384 | 1.1274 | 1.1261 | 0.1810 | 0.0274 |
| MG (inf) | 0.9901 | 0.9913 | 0.0430 | 0.0416 | 0.9906 | 0.9907 | 0.0336 | 0.0341 | 0.9888 | 0.9884 | 0.0265 | 0.0265 | 0.9892 | 0.9891 | 0.0195 | 0.0189 |

Continued on the following page.

## Bond and Eberhardt (2013) — (iii) Feedback setup (continued)

| $T = 50$ | $N = 20$ | | | | $N = 30$ | | | | $N = 50$ | | | | $N = 100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0501 | 1.0700 | 0.3639 | 0.0503 | 1.0342 | 1.0344 | 0.2919 | 0.0388 | 0.9857 | 0.9823 | 0.2056 | 0.0318 | 0.9893 | 0.9969 | 0.1391 | 0.0209 |
| FE | 1.1136 | 1.1164 | 0.2024 | 0.0355 | 1.0369 | 1.0349 | 0.1515 | 0.0284 | 1.0439 | 1.0458 | 0.1153 | 0.0220 | 1.0156 | 1.0125 | 0.0816 | 0.0154 |
| CCEP | 0.9947 | 0.9935 | 0.0474 | 0.0260 | 0.9917 | 0.9914 | 0.0400 | 0.0214 | 0.9922 | 0.9925 | 0.0314 | 0.0166 | 0.9921 | 0.9924 | 0.0214 | 0.0117 |
| FD-OLS | 0.9179 | 0.9165 | 0.0489 | 0.0290 | 0.9131 | 0.9125 | 0.0385 | 0.0235 | 0.9145 | 0.9143 | 0.0307 | 0.0181 | 0.9132 | 0.9137 | 0.0212 | 0.0127 |
| FD-IV | 0.9973 | 0.9963 | 0.1028 | 0.0293 | 0.9944 | 0.9924 | 0.0836 | 0.0236 | 0.9977 | 1.0005 | 0.0659 | 0.0182 | 0.9972 | 0.9971 | 0.0439 | 0.0128 |
| FE (inf) | 0.9970 | 0.9969 | 0.0392 | 0.0171 | 0.9957 | 0.9960 | 0.0323 | 0.0139 | 0.9962 | 0.9960 | 0.0257 | 0.0108 | 0.9960 | 0.9959 | 0.0177 | 0.0076 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 0.9927 | 0.9899 | 0.0470 | 0.0453 | 0.9886 | 0.9881 | 0.0399 | 0.0381 | 0.9897 | 0.9895 | 0.0306 | 0.0296 | 0.9903 | 0.9901 | 0.0209 | 0.0214 |
| AMG(i)† | 0.9543 | 0.9541 | 0.0491 | 0.0477 | 0.9503 | 0.9509 | 0.0395 | 0.0395 | 0.9528 | 0.9516 | 0.0318 | 0.0310 | 0.9515 | 0.9512 | 0.0238 | 0.0222 |
| AMG(i)‡ | 1.0001 | 1.0000 | 0.0711 | 0.0477 | 0.9960 | 0.9977 | 0.0564 | 0.0395 | 0.9987 | 0.9990 | 0.0444 | 0.0310 | 0.9978 | 0.9977 | 0.0303 | 0.0222 |
| AMG(ii)† | 0.9485 | 0.9470 | 0.0469 | 0.0443 | 0.9461 | 0.9459 | 0.0380 | 0.0371 | 0.9477 | 0.9485 | 0.0310 | 0.0290 | 0.9475 | 0.9477 | 0.0236 | 0.0209 |
| AMG(ii)‡ | 1.0021 | 0.9992 | 0.0774 | 0.0446 | 0.9993 | 0.9978 | 0.0612 | 0.0371 | 1.0007 | 0.9999 | 0.0486 | 0.0290 | 0.9994 | 0.9992 | 0.0327 | 0.0208 |
| MG | 1.1634 | 1.1486 | 0.2130 | 0.0588 | 1.1694 | 1.1597 | 0.2094 | 0.0493 | 1.1548 | 1.1428 | 0.2061 | 0.0380 | 1.1577 | 1.1515 | 0.2118 | 0.0272 |
| MG (inf) | 0.9946 | 0.9958 | 0.0368 | 0.0369 | 0.9938 | 0.9943 | 0.0312 | 0.0299 | 0.9939 | 0.9940 | 0.0242 | 0.0235 | 0.9937 | 0.9943 | 0.0170 | 0.0166 |

| $T = 100$ | $N = 20$ | | | | $N = 30$ | | | | $N = 50$ | | | | $N = 100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0973 | 1.1041 | 0.3540 | 0.0349 | 1.0423 | 1.0277 | 0.2761 | 0.0273 | 0.9990 | 0.9964 | 0.2148 | 0.0221 | 0.9993 | 1.0000 | 0.1434 | 0.0145 |
| FE | 1.1463 | 1.1546 | 0.2518 | 0.0266 | 1.0443 | 1.0476 | 0.1904 | 0.0211 | 1.0554 | 1.0557 | 0.1428 | 0.0165 | 1.0231 | 1.0194 | 0.1039 | 0.0115 |
| CCEP | 1.0031 | 1.0007 | 0.0526 | 0.0182 | 0.9981 | 0.9978 | 0.0423 | 0.0150 | 0.9964 | 0.9967 | 0.0338 | 0.0117 | 0.9949 | 0.9952 | 0.0256 | 0.0083 |
| FD-OLS | 0.9189 | 0.9181 | 0.0429 | 0.0204 | 0.9162 | 0.9165 | 0.0346 | 0.0165 | 0.9147 | 0.9146 | 0.0264 | 0.0127 | 0.9132 | 0.9139 | 0.0194 | 0.0089 |
| FD-IV | 0.9966 | 0.9926 | 0.0807 | 0.0205 | 1.0010 | 1.0005 | 0.0601 | 0.0166 | 0.9988 | 0.9977 | 0.0473 | 0.0128 | 0.9989 | 0.9982 | 0.0327 | 0.0090 |
| FE (inf) | 1.0005 | 0.9998 | 0.0375 | 0.0101 | 1.0004 | 1.0009 | 0.0302 | 0.0082 | 0.9983 | 0.9985 | 0.0226 | 0.0063 | 0.9981 | 0.9976 | 0.0171 | 0.0045 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 0.9997 | 0.9978 | 0.0501 | 0.0470 | 0.9952 | 0.9947 | 0.0410 | 0.0401 | 0.9940 | 0.9947 | 0.0323 | 0.0317 | 0.9948 | 0.9944 | 0.0244 | 0.0225 |
| AMG(i)† | 0.9478 | 0.9458 | 0.0473 | 0.0503 | 0.9447 | 0.9460 | 0.0384 | 0.0418 | 0.9448 | 0.9443 | 0.0315 | 0.0334 | 0.9432 | 0.9429 | 0.0248 | 0.0237 |
| AMG(i)‡ | 1.0011 | 0.9987 | 0.0667 | 0.0501 | 1.0030 | 1.0027 | 0.0497 | 0.0418 | 1.0021 | 1.0019 | 0.0397 | 0.0334 | 1.0011 | 1.0013 | 0.0282 | 0.0237 |
| AMG(ii)† | 0.9422 | 0.9410 | 0.0447 | 0.0461 | 0.9415 | 0.9413 | 0.0374 | 0.0389 | 0.9388 | 0.9395 | 0.0295 | 0.0310 | 0.9392 | 0.9402 | 0.0239 | 0.0220 |
| AMG(ii)‡ | 1.0001 | 0.9962 | 0.0689 | 0.0460 | 1.0038 | 1.0026 | 0.0519 | 0.0386 | 1.0007 | 1.0008 | 0.0409 | 0.0307 | 1.0008 | 1.0009 | 0.0294 | 0.0218 |
| MG | 1.2041 | 1.1925 | 0.2523 | 0.0612 | 1.2048 | 1.1968 | 0.2491 | 0.0514 | 1.1897 | 1.1785 | 0.2651 | 0.0408 | 1.1909 | 1.1814 | 0.2575 | 0.0292 |
| MG (inf) | 0.9986 | 0.9970 | 0.0348 | 0.0337 | 0.9990 | 0.9997 | 0.0279 | 0.0277 | 0.9969 | 0.9966 | 0.0209 | 0.0215 | 0.9974 | 0.9971 | 0.0155 | 0.0152 |

**Notes:** ‡ These use the year dummy coefficients from FD-IV estimator, rather than the FD-OLS estimator.

## Table C-4: Bond and Eberhardt (2013) — (iii)$^\star$ Feedback and country trend

**Monte Carlo Results — Setup with Feedbacks from $y$ to $x$**

1,000 replications; POLS, FE and FD-OLS all have $T-1$ year dummies; AMG-estimators are constructed from † FD-OLS or ‡ FD-IV year dummy coefficients

| $T=20$ | $N=20$ | | | | $N=30$ | | | | $N=50$ | | | | $N=100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0517 | 1.0595 | 0.4728 | 0.1068 | 1.0321 | 1.0324 | 0.3799 | 0.0839 | 0.9678 | 0.9614 | 0.2920 | 0.0675 | 0.9914 | 0.9953 | 0.1949 | 0.0441 |
| FE | 1.0345 | 1.0289 | 0.2202 | 0.0895 | 1.0157 | 1.0187 | 0.1807 | 0.0724 | 1.0162 | 1.0150 | 0.1402 | 0.0557 | 1.0068 | 1.0107 | 0.0979 | 0.0392 |
| CCEP | 0.9793 | 0.9802 | 0.0714 | 0.0517 | 0.9804 | 0.9789 | 0.0590 | 0.0427 | 0.9827 | 0.9819 | 0.0434 | 0.0327 | 0.9824 | 0.9807 | 0.0303 | 0.0232 |
| FD-OLS | 0.9173 | 0.9163 | 0.0656 | 0.0484 | 0.9142 | 0.9141 | 0.0529 | 0.0391 | 0.9153 | 0.9138 | 0.0385 | 0.0301 | 0.9137 | 0.9130 | 0.0283 | 0.0212 |
| FD-IV | 0.9968 | 0.9981 | 0.1686 | 0.0490 | 0.9954 | 0.9893 | 0.1293 | 0.0395 | 1.0007 | 0.9996 | 0.1034 | 0.0304 | 0.9973 | 0.9964 | 0.0723 | 0.0213 |
| FE (inf) | 0.9834 | 0.9840 | 0.0518 | 0.0379 | 0.9808 | 0.9806 | 0.0427 | 0.0309 | 0.9824 | 0.9828 | 0.0317 | 0.0240 | 0.9821 | 0.9820 | 0.0236 | 0.0169 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 0.9745 | 0.9730 | 0.0726 | 0.0678 | 0.9738 | 0.9747 | 0.0612 | 0.0569 | 0.9776 | 0.9775 | 0.0445 | 0.0432 | 0.9772 | 0.9777 | 0.0313 | 0.0311 |
| AMG(i) IV | 0.9934 | 0.9922 | 0.0910 | 0.0532 | 0.9912 | 0.9929 | 0.0721 | 0.0440 | 0.9931 | 0.9922 | 0.0585 | 0.0343 | 0.9914 | 0.9908 | 0.0445 | 0.0247 |
| AMG(ii) IV | 1.0047 | 0.9966 | 0.1030 | 0.0707 | 1.0035 | 1.0011 | 0.0800 | 0.0577 | 1.0034 | 0.9996 | 0.0657 | 0.0440 | 0.9998 | 0.9976 | 0.0494 | 0.0311 |
| MG | 1.0933 | 1.0899 | 0.1658 | 0.0648 | 1.1099 | 1.0978 | 0.1711 | 0.0537 | 1.0972 | 1.0782 | 0.1552 | 0.0417 | 1.1045 | 1.0977 | 0.1618 | 0.0296 |
| MG (inf) | 0.9789 | 0.9769 | 0.0540 | 0.0530 | 0.9773 | 0.9798 | 0.0451 | 0.0431 | 0.9788 | 0.9793 | 0.0351 | 0.0334 | 0.9788 | 0.9790 | 0.0254 | 0.0238 |

| $T=30$ | $N=20$ | | | | $N=30$ | | | | $N=50$ | | | | $N=100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0654 | 1.0724 | 0.4969 | 0.0893 | 1.0241 | 1.0300 | 0.3887 | 0.0708 | 0.9731 | 0.9684 | 0.3101 | 0.0567 | 0.9948 | 1.0020 | 0.2053 | 0.0371 |
| FE | 1.0680 | 1.0746 | 0.3230 | 0.0880 | 1.0082 | 1.0124 | 0.2460 | 0.0711 | 1.0253 | 1.0278 | 0.1943 | 0.0548 | 1.0083 | 1.0121 | 0.1379 | 0.0386 |
| CCEP | 0.9898 | 0.9902 | 0.0605 | 0.0424 | 0.9885 | 0.9878 | 0.0544 | 0.0349 | 0.9861 | 0.9873 | 0.0387 | 0.0270 | 0.9874 | 0.9887 | 0.0282 | 0.0190 |
| FD-OLS | 0.9162 | 0.9168 | 0.0547 | 0.0391 | 0.9153 | 0.9142 | 0.0467 | 0.0316 | 0.9153 | 0.9152 | 0.0347 | 0.0244 | 0.9139 | 0.9145 | 0.0238 | 0.0171 |
| FD-IV | 0.9965 | 0.9975 | 0.1331 | 0.0395 | 1.0022 | 1.0028 | 0.1072 | 0.0319 | 1.0024 | 1.0029 | 0.0820 | 0.0245 | 0.9968 | 0.9961 | 0.0554 | 0.0172 |
| FE (inf) | 0.9893 | 0.9897 | 0.0443 | 0.0278 | 0.9895 | 0.9893 | 0.0371 | 0.0227 | 0.9882 | 0.9879 | 0.0280 | 0.0177 | 0.9889 | 0.9886 | 0.0193 | 0.0125 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 0.9858 | 0.9848 | 0.0609 | 0.0592 | 0.9842 | 0.9840 | 0.0545 | 0.0498 | 0.9833 | 0.9836 | 0.0392 | 0.0393 | 0.9837 | 0.9841 | 0.0289 | 0.0279 |
| AMG(i) IV | 0.9978 | 0.9971 | 0.0805 | 0.0490 | 0.9983 | 1.0023 | 0.0663 | 0.0401 | 0.9976 | 0.9973 | 0.0487 | 0.0319 | 0.9945 | 0.9932 | 0.0363 | 0.0227 |
| AMG(ii) IV | 1.0041 | 1.0003 | 0.0864 | 0.0658 | 1.0054 | 1.0046 | 0.0725 | 0.0547 | 1.0019 | 1.0013 | 0.0538 | 0.0427 | 0.9988 | 0.9981 | 0.0401 | 0.0296 |
| MG | 1.1158 | 1.1139 | 0.1797 | 0.0596 | 1.1399 | 1.1316 | 0.1827 | 0.0496 | 1.1167 | 1.1089 | 0.1821 | 0.0386 | 1.1274 | 1.1245 | 0.1797 | 0.0273 |
| MG (inf) | 0.9861 | 0.9857 | 0.0448 | 0.0438 | 0.9873 | 0.9869 | 0.0374 | 0.0358 | 0.9862 | 0.9867 | 0.0285 | 0.0279 | 0.9859 | 0.9860 | 0.0199 | 0.0198 |

Continued on the following page.

Bond and Eberhardt (2013) — (iii)* Feedback and country trend (continued)

| $T = 50$ | $N = 20$ | | | | $N = 30$ | | | | $N = 50$ | | | | $N = 100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.0406 | 1.0486 | 0.5317 | 0.0724 | 1.0288 | 1.0311 | 0.4089 | 0.0571 | 0.9913 | 0.9834 | 0.3193 | 0.0462 | 0.9868 | 0.9831 | 0.2077 | 0.0304 |
| FE | 1.1093 | 1.1158 | 0.4420 | 0.0817 | 1.0341 | 1.0501 | 0.3591 | 0.0655 | 1.0474 | 1.0540 | 0.2786 | 0.0509 | 1.0127 | 1.0212 | 0.1984 | 0.0359 |
| CCEP | 0.9978 | 0.9964 | 0.0630 | 0.0350 | 0.9921 | 0.9903 | 0.0500 | 0.0285 | 0.9923 | 0.9927 | 0.0403 | 0.0220 | 0.9916 | 0.9906 | 0.0282 | 0.0156 |
| FD-OLS | 0.9183 | 0.9183 | 0.0501 | 0.0301 | 0.9132 | 0.9144 | 0.0392 | 0.0243 | 0.9136 | 0.9137 | 0.0312 | 0.0187 | 0.9136 | 0.9131 | 0.0219 | 0.0132 |
| FD-IV | 0.9979 | 0.9997 | 0.1048 | 0.0303 | 0.9946 | 0.9948 | 0.0858 | 0.0245 | 0.9963 | 0.9984 | 0.0655 | 0.0188 | 0.9988 | 0.9997 | 0.0455 | 0.0132 |
| FE (inf) | 0.9954 | 0.9944 | 0.0408 | 0.0191 | 0.9939 | 0.9943 | 0.0330 | 0.0155 | 0.9928 | 0.9936 | 0.0255 | 0.0121 | 0.9942 | 0.9945 | 0.0181 | 0.0085 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 0.9959 | 0.9963 | 0.0618 | 0.0575 | 0.9892 | 0.9875 | 0.0493 | 0.0473 | 0.9899 | 0.9908 | 0.0391 | 0.0369 | 0.9894 | 0.9889 | 0.0277 | 0.0265 |
| AMG(i) IV | 1.0009 | 1.0022 | 0.0738 | 0.0479 | 0.9957 | 0.9944 | 0.0572 | 0.0392 | 0.9975 | 0.9975 | 0.0443 | 0.0308 | 0.9987 | 0.9976 | 0.0328 | 0.0222 |
| AMG(ii) IV | 1.0030 | 1.0020 | 0.0801 | 0.0686 | 0.9989 | 0.9983 | 0.0632 | 0.0555 | 0.9992 | 0.9993 | 0.0481 | 0.0433 | 1.0000 | 1.0002 | 0.0349 | 0.0304 |
| MG | 1.1657 | 1.1519 | 0.2148 | 0.0594 | 1.1688 | 1.1590 | 0.2103 | 0.0490 | 1.1542 | 1.1451 | 0.2061 | 0.0379 | 1.1587 | 1.1530 | 0.2120 | 0.0272 |
| MG (inf) | 0.9928 | 0.9914 | 0.0400 | 0.0381 | 0.9919 | 0.9927 | 0.0314 | 0.0310 | 0.9916 | 0.9917 | 0.0245 | 0.0242 | 0.9926 | 0.9926 | 0.0177 | 0.0171 |

| $T = 100$ | $N = 20$ | | | | $N = 30$ | | | | $N = 50$ | | | | $N = 100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.1143 | 1.1221 | 0.5644 | 0.0569 | 1.0373 | 1.0301 | 0.4428 | 0.0454 | 0.9945 | 0.9799 | 0.3599 | 0.0359 | 1.0010 | 1.0052 | 0.2425 | 0.0238 |
| FE | 1.1816 | 1.1930 | 0.6203 | 0.0651 | 1.0390 | 1.0171 | 0.4965 | 0.0536 | 1.0534 | 1.0632 | 0.3832 | 0.0409 | 1.0209 | 1.0255 | 0.2706 | 0.0288 |
| CCEP | 1.0014 | 1.0008 | 0.0657 | 0.0275 | 0.9962 | 0.9957 | 0.0575 | 0.0227 | 0.9982 | 0.9970 | 0.0447 | 0.0176 | 0.9957 | 0.9967 | 0.0307 | 0.0124 |
| FD-OLS | 0.9190 | 0.9189 | 0.0430 | 0.0211 | 0.9145 | 0.9140 | 0.0333 | 0.0171 | 0.9158 | 0.9151 | 0.0267 | 0.0132 | 0.9148 | 0.9150 | 0.0186 | 0.0093 |
| FD-IV | 0.9965 | 0.9988 | 0.0820 | 0.0213 | 1.0003 | 1.0026 | 0.0605 | 0.0172 | 1.0002 | 0.9994 | 0.0481 | 0.0133 | 1.0010 | 1.0020 | 0.0332 | 0.0093 |
| FE (inf) | 0.9990 | 0.9986 | 0.0363 | 0.0113 | 0.9975 | 0.9973 | 0.0300 | 0.0092 | 0.9980 | 0.9971 | 0.0240 | 0.0071 | 0.9990 | 0.9989 | 0.0165 | 0.0051 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 0.9990 | 0.9976 | 0.0624 | 0.0606 | 0.9928 | 0.9924 | 0.0516 | 0.0519 | 0.9951 | 0.9948 | 0.0420 | 0.0408 | 0.9958 | 0.9963 | 0.0286 | 0.0289 |
| AMG(i) IV | 1.0012 | 1.0012 | 0.0663 | 0.0504 | 1.0030 | 1.0044 | 0.0499 | 0.0418 | 1.0031 | 1.0023 | 0.0406 | 0.0334 | 1.0034 | 1.0041 | 0.0273 | 0.0237 |
| AMG(ii) IV | 1.0002 | 0.9984 | 0.0710 | 0.0727 | 1.0026 | 1.0026 | 0.0527 | 0.0596 | 1.0025 | 1.0009 | 0.0432 | 0.0475 | 1.0027 | 1.0023 | 0.0298 | 0.0334 |
| MG | 1.2035 | 1.1962 | 0.2503 | 0.0615 | 1.2054 | 1.1978 | 0.2490 | 0.0516 | 1.1914 | 1.1790 | 0.2665 | 0.0409 | 1.1931 | 1.1835 | 0.2567 | 0.0292 |
| MG (inf) | 0.9978 | 0.9987 | 0.0342 | 0.0344 | 0.9968 | 0.9970 | 0.0279 | 0.0280 | 0.9972 | 0.9966 | 0.0221 | 0.0218 | 0.9983 | 0.9983 | 0.0155 | 0.0154 |

**Notes:** ‡ These use the year dummy coefficients from FD-IV estimator, rather than the FD-OLS estimator.

# Table C-5: Bond and Eberhardt (2013) — (iv) Two 'clubs' for $\beta$

**Monte Carlo Results — Setup with 2 'clubs' of countries**

1,000 replications; POLS, FE and FD-OLS all have $T-1$ year dummies; AMG-estimators are constructed from † FD-OLS or ‡ FD-IV year dummy coefficients

| $T=20$ | $N=20$ | | | | $N=30$ | | | | $N=50$ | | | | $N=100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.8149 | 1.7937 | 0.5854 | 0.2526 | 0.7037 | 0.6908 | 0.4523 | 0.1948 | 0.5417 | 0.5377 | 0.3662 | 0.1566 | 0.6228 | 0.6079 | 0.2252 | 0.1022 |
| FE | 1.0311 | 1.0204 | 0.1755 | 0.0691 | 1.0079 | 1.0082 | 0.1450 | 0.0561 | 1.0157 | 1.0144 | 0.1095 | 0.0434 | 1.0079 | 1.0065 | 0.0756 | 0.0308 |
| CCEP | 0.9989 | 0.9977 | 0.0727 | 0.0512 | 0.9974 | 0.9968 | 0.0591 | 0.0421 | 1.0026 | 1.0016 | 0.0450 | 0.0326 | 1.0000 | 0.9995 | 0.0320 | 0.0231 |
| FD-OLS | 1.0023 | 1.0036 | 0.0778 | 0.0563 | 1.0006 | 1.0002 | 0.0650 | 0.0455 | 1.0017 | 1.0016 | 0.0481 | 0.0350 | 1.0005 | 0.9997 | 0.0355 | 0.0246 |
| FD-IV | 0.9953 | 0.9914 | 0.2019 | 0.0569 | 0.9975 | 0.9970 | 0.1587 | 0.0458 | 0.9993 | 0.9996 | 0.1241 | 0.0352 | 0.9971 | 0.9950 | 0.0864 | 0.0247 |
| FE (inf) | 1.0004 | 0.9981 | 0.0636 | 0.0431 | 0.9994 | 1.0006 | 0.0515 | 0.0353 | 1.0018 | 1.0010 | 0.0391 | 0.0274 | 1.0003 | 1.0004 | 0.0285 | 0.0193 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0013 | 1.0017 | 0.0525 | 0.1205 | 0.9980 | 0.9993 | 0.0419 | 0.0993 | 1.0007 | 1.0001 | 0.0329 | 0.0769 | 1.0012 | 1.0006 | 0.0239 | 0.0548 |
| AMG(i) | 1.0058 | 1.0104 | 0.1008 | 0.1195 | 1.0051 | 1.0036 | 0.0820 | 0.0980 | 1.0065 | 1.0048 | 0.0647 | 0.0763 | 1.0036 | 1.0037 | 0.0470 | 0.0541 |
| AMG(ii) | 1.0268 | 1.0199 | 0.1172 | 0.1193 | 1.0228 | 1.0140 | 0.0965 | 0.0980 | 1.0182 | 1.0093 | 0.0768 | 0.0755 | 1.0123 | 1.0105 | 0.0545 | 0.0535 |
| MG | 1.1070 | 1.1008 | 0.1631 | 0.1283 | 1.1257 | 1.1134 | 0.1705 | 0.1047 | 1.1130 | 1.1011 | 0.1571 | 0.0805 | 1.1202 | 1.1128 | 0.1650 | 0.0571 |
| MG (inf) | 1.0000 | 1.0013 | 0.0377 | 0.1205 | 0.9988 | 0.9993 | 0.0310 | 0.0978 | 1.0004 | 1.0012 | 0.0248 | 0.0753 | 1.0003 | 1.0002 | 0.0175 | 0.0530 |

| $T=30$ | $N=20$ | | | | $N=30$ | | | | $N=50$ | | | | $N=100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.7897 | 1.7979 | 0.6062 | 0.2051 | 0.7090 | 0.7064 | 0.4695 | 0.1579 | 0.5539 | 0.5537 | 0.3778 | 0.1267 | 0.6332 | 0.6166 | 0.2479 | 0.0830 |
| FE | 1.0400 | 1.0279 | 0.2265 | 0.0619 | 1.0098 | 1.0028 | 0.1799 | 0.0505 | 1.0224 | 1.0171 | 0.1375 | 0.0388 | 1.0114 | 1.0051 | 0.1015 | 0.0277 |
| CCEP | 1.0008 | 0.9985 | 0.0601 | 0.0405 | 0.9978 | 0.9978 | 0.0505 | 0.0332 | 1.0017 | 1.0000 | 0.0384 | 0.0257 | 1.0007 | 0.9991 | 0.0279 | 0.0182 |
| FD-OLS | 1.0008 | 0.9976 | 0.0654 | 0.0455 | 1.0020 | 1.0019 | 0.0541 | 0.0368 | 1.0023 | 1.0009 | 0.0401 | 0.0283 | 1.0015 | 1.0017 | 0.0297 | 0.0200 |
| FD-IV | 0.9908 | 0.9908 | 0.1610 | 0.0458 | 1.0044 | 1.0068 | 0.1324 | 0.0370 | 1.0011 | 0.9960 | 0.0968 | 0.0284 | 0.9977 | 0.9988 | 0.0692 | 0.0200 |
| FE (inf) | 1.0028 | 1.0004 | 0.0578 | 0.0329 | 0.9983 | 0.9979 | 0.0466 | 0.0266 | 0.9999 | 0.9994 | 0.0357 | 0.0207 | 1.0001 | 0.9993 | 0.0259 | 0.0147 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0002 | 0.9988 | 0.0406 | 0.1177 | 1.0005 | 1.0005 | 0.0354 | 0.0966 | 0.9996 | 0.9991 | 0.0260 | 0.0747 | 1.0002 | 0.9996 | 0.0194 | 0.0533 |
| AMG(i) | 1.0033 | 1.0035 | 0.0919 | 0.1185 | 1.0077 | 1.0087 | 0.0766 | 0.0967 | 1.0045 | 1.0018 | 0.0541 | 0.0750 | 1.0019 | 1.0048 | 0.0417 | 0.0533 |
| AMG(ii) | 1.0162 | 1.0082 | 0.1045 | 0.1183 | 1.0220 | 1.0155 | 0.0879 | 0.0966 | 1.0132 | 1.0108 | 0.0625 | 0.0746 | 1.0075 | 1.0075 | 0.0473 | 0.0528 |
| MG | 1.1273 | 1.1158 | 0.1797 | 0.1262 | 1.1518 | 1.1404 | 0.1830 | 0.1032 | 1.1260 | 1.1166 | 0.1827 | 0.0788 | 1.1377 | 1.1358 | 0.1834 | 0.0559 |
| MG (inf) | 1.0000 | 0.9990 | 0.0277 | 0.1181 | 1.0014 | 1.0015 | 0.0232 | 0.0954 | 1.0000 | 1.0003 | 0.0174 | 0.0734 | 1.0001 | 1.0002 | 0.0125 | 0.0518 |

Continued on the following page.

Bond and Eberhardt (2013) — (iv) Two 'clubs' for $\beta$ (continued)

| $T = 50$ | $N = 20$ | | | | $N = 30$ | | | | $N = 50$ | | | | $N = 100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.7581 | 1.7304 | 0.6804 | 0.1555 | 0.7469 | 0.7299 | 0.4968 | 0.1198 | 0.5878 | 0.5711 | 0.4052 | 0.0958 | 0.6544 | 0.6465 | 0.2592 | 0.0632 |
| FE | 1.0730 | 1.0577 | 0.3102 | 0.0530 | 1.0259 | 1.0188 | 0.2327 | 0.0436 | 1.0308 | 1.0245 | 0.1809 | 0.0331 | 1.0147 | 1.0109 | 0.1342 | 0.0239 |
| CCEP | 1.0003 | 1.0010 | 0.0541 | 0.0306 | 0.9962 | 0.9955 | 0.0432 | 0.0252 | 1.0012 | 1.0000 | 0.0343 | 0.0195 | 0.9997 | 0.9988 | 0.0240 | 0.0138 |
| FD-OLS | 1.0036 | 1.0026 | 0.0562 | 0.0350 | 1.0000 | 1.0002 | 0.0441 | 0.0283 | 1.0019 | 0.9999 | 0.0355 | 0.0218 | 0.9999 | 0.9990 | 0.0251 | 0.0154 |
| FD-IV | 0.9980 | 0.9944 | 0.1261 | 0.0352 | 0.9957 | 0.9896 | 0.1014 | 0.0284 | 0.9988 | 0.9993 | 0.0760 | 0.0218 | 0.9972 | 0.9983 | 0.0521 | 0.0154 |
| FE (inf) | 1.0017 | 1.0001 | 0.0539 | 0.0233 | 1.0001 | 0.9993 | 0.0432 | 0.0190 | 1.0013 | 1.0012 | 0.0345 | 0.0148 | 0.9990 | 0.9980 | 0.0244 | 0.0104 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0030 | 1.0020 | 0.0361 | 0.1160 | 0.9987 | 0.9984 | 0.0295 | 0.0955 | 0.9992 | 0.9991 | 0.0226 | 0.0739 | 1.0004 | 1.0007 | 0.0159 | 0.0525 |
| AMG(i) | 1.0061 | 1.0043 | 0.0834 | 0.1179 | 1.0010 | 0.9992 | 0.0669 | 0.0968 | 1.0040 | 1.0040 | 0.0491 | 0.0749 | 1.0017 | 1.0012 | 0.0339 | 0.0532 |
| AMG(ii) | 1.0142 | 1.0067 | 0.0936 | 0.1179 | 1.0080 | 1.0025 | 0.0761 | 0.0962 | 1.0072 | 1.0063 | 0.0547 | 0.0741 | 1.0038 | 1.0031 | 0.0374 | 0.0524 |
| MG | 1.1699 | 1.1553 | 0.2150 | 0.1256 | 1.1766 | 1.1668 | 0.2104 | 0.1031 | 1.1608 | 1.1480 | 0.2079 | 0.0785 | 1.1644 | 1.1598 | 0.2147 | 0.0560 |
| MG (inf) | 1.0005 | 0.9999 | 0.0196 | 0.1162 | 1.0001 | 0.9997 | 0.0152 | 0.0940 | 0.9993 | 0.9993 | 0.0118 | 0.0725 | 0.9999 | 0.9999 | 0.0084 | 0.0509 |

| $T = 100$ | $N = 20$ | | | | $N = 30$ | | | | $N = 50$ | | | | $N = 100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.6150 | 1.5904 | 0.7539 | 0.1035 | 0.8114 | 0.8097 | 0.5409 | 0.0804 | 0.6528 | 0.6305 | 0.4439 | 0.0634 | 0.7408 | 0.7289 | 0.2888 | 0.0424 |
| FE | 1.0786 | 1.0545 | 0.3821 | 0.0408 | 1.0371 | 1.0189 | 0.2999 | 0.0335 | 1.0348 | 1.0376 | 0.2320 | 0.0255 | 1.0310 | 1.0327 | 0.1667 | 0.0184 |
| CCEP | 1.0023 | 1.0023 | 0.0563 | 0.0214 | 0.9965 | 0.9964 | 0.0466 | 0.0177 | 1.0015 | 1.0013 | 0.0362 | 0.0137 | 0.9990 | 0.9990 | 0.0274 | 0.0097 |
| FD-OLS | 1.0018 | 1.0033 | 0.0453 | 0.0246 | 1.0022 | 1.0010 | 0.0372 | 0.0199 | 1.0023 | 1.0032 | 0.0282 | 0.0153 | 1.0017 | 1.0015 | 0.0217 | 0.0108 |
| FD-IV | 0.9934 | 0.9927 | 0.0907 | 0.0246 | 1.0008 | 1.0021 | 0.0716 | 0.0200 | 0.9996 | 1.0001 | 0.0554 | 0.0154 | 0.9994 | 1.0006 | 0.0377 | 0.0108 |
| FE (inf) | 1.0008 | 0.9949 | 0.0579 | 0.0149 | 1.0034 | 1.0034 | 0.0448 | 0.0122 | 1.0013 | 1.0015 | 0.0383 | 0.0094 | 1.0010 | 1.0002 | 0.0258 | 0.0067 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0046 | 1.0052 | 0.0379 | 0.1176 | 0.9989 | 0.9989 | 0.0312 | 0.0971 | 0.9994 | 0.9998 | 0.0253 | 0.0751 | 0.9996 | 1.0000 | 0.0195 | 0.0531 |
| AMG(i) | 1.0027 | 1.0011 | 0.0748 | 0.1197 | 1.0033 | 1.0018 | 0.0586 | 0.0982 | 1.0056 | 1.0069 | 0.0466 | 0.0762 | 1.0017 | 1.0030 | 0.0316 | 0.0539 |
| AMG(ii) | 1.0055 | 1.0013 | 0.0798 | 0.1191 | 1.0064 | 1.0053 | 0.0627 | 0.0972 | 1.0057 | 1.0053 | 0.0492 | 0.0750 | 1.0022 | 1.0030 | 0.0335 | 0.0529 |
| MG | 1.2074 | 1.1958 | 0.2524 | 0.1270 | 1.2075 | 1.1975 | 0.2499 | 0.1043 | 1.1937 | 1.1839 | 0.2683 | 0.0802 | 1.1945 | 1.1898 | 0.2602 | 0.0570 |
| MG (inf) | 1.0006 | 1.0001 | 0.0108 | 0.1152 | 1.0005 | 1.0002 | 0.0092 | 0.0933 | 0.9998 | 0.9999 | 0.0070 | 0.0717 | 0.9998 | 0.9999 | 0.0050 | 0.0505 |

**Notes:** ‡ These use the year dummy coefficients from FD-IV estimator, rather than the FD-OLS estimator.

# Table C-6: Bond and Eberhardt (2013) — (iv)* Two 'clubs', country trends

**Monte Carlo Results — Setup with 2 'clubs' of countries and country trends**

1,000 replications; POLS, FE and FD-OLS all have $T-1$ year dummies; AMG-estimators are constructed from † FD-OLS or ‡ FD-IV year dummy coefficients

| $T=20$ | $N=20$ | | | | $N=30$ | | | | $N=50$ | | | | $N=100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.8069 | 1.7834 | 0.6712 | 0.2612 | 0.7184 | 0.7198 | 0.5146 | 0.2032 | 0.5362 | 0.5287 | 0.4150 | 0.1630 | 0.6198 | 0.6131 | 0.2632 | 0.1064 |
| FE | 1.0184 | 1.0082 | 0.2557 | 0.1025 | 1.0130 | 1.0061 | 0.2168 | 0.0833 | 1.0175 | 1.0129 | 0.1683 | 0.0641 | 1.0075 | 1.0060 | 0.1161 | 0.0454 |
| CCEP | 0.9959 | 0.9960 | 0.0836 | 0.0586 | 0.9975 | 0.9952 | 0.0684 | 0.0484 | 1.0032 | 1.0032 | 0.0507 | 0.0371 | 1.0002 | 0.9998 | 0.0354 | 0.0263 |
| FD-OLS | 1.0016 | 1.0017 | 0.0793 | 0.0577 | 1.0013 | 1.0018 | 0.0654 | 0.0467 | 1.0017 | 1.0016 | 0.0478 | 0.0359 | 1.0001 | 0.9986 | 0.0357 | 0.0253 |
| FE (inf) | 1.0005 | 1.0008 | 0.0684 | 0.0455 | 1.0006 | 1.0016 | 0.0524 | 0.0371 | 1.0015 | 1.0000 | 0.0397 | 0.0288 | 0.9996 | 0.9999 | 0.0287 | 0.0203 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 0.9987 | 0.9984 | 0.0677 | 0.1267 | 0.9979 | 0.9964 | 0.0546 | 0.1048 | 1.0020 | 1.0030 | 0.0403 | 0.0806 | 1.0016 | 1.0009 | 0.0285 | 0.0574 |
| AMG(i) | 1.0078 | 1.0105 | 0.1029 | 0.1196 | 1.0038 | 1.0026 | 0.0828 | 0.0981 | 1.0058 | 1.0062 | 0.0644 | 0.0763 | 1.0045 | 1.0034 | 0.0477 | 0.0541 |
| AMG(ii) | 1.0274 | 1.0172 | 0.1174 | 0.1307 | 1.0215 | 1.0172 | 0.0918 | 0.1066 | 1.0181 | 1.0140 | 0.0714 | 0.0818 | 1.0141 | 1.0106 | 0.0522 | 0.0578 |
| MG | 1.1082 | 1.0993 | 0.1640 | 0.1284 | 1.1254 | 1.1132 | 0.1715 | 0.1048 | 1.1127 | 1.1001 | 0.1563 | 0.0806 | 1.1203 | 1.1120 | 0.1650 | 0.0571 |
| MG (inf) | 1.0006 | 0.9999 | 0.0428 | 0.1222 | 0.9993 | 0.9975 | 0.0341 | 0.0989 | 1.0004 | 1.0014 | 0.0271 | 0.0762 | 1.0010 | 1.0002 | 0.0192 | 0.0536 |

| $T=30$ | $N=20$ | | | | $N=30$ | | | | $N=50$ | | | | $N=100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.8009 | 1.7707 | 0.6974 | 0.2129 | 0.7297 | 0.7311 | 0.5478 | 0.1663 | 0.5506 | 0.5589 | 0.4528 | 0.1325 | 0.6312 | 0.6313 | 0.2837 | 0.0868 |
| FE | 1.0403 | 1.0383 | 0.3698 | 0.0994 | 1.0013 | 1.0133 | 0.2795 | 0.0811 | 1.0202 | 1.0222 | 0.2275 | 0.0622 | 1.0077 | 1.0076 | 0.1592 | 0.0441 |
| CCEP | 1.0013 | 0.9991 | 0.0694 | 0.0478 | 0.9994 | 0.9990 | 0.0593 | 0.0393 | 1.0009 | 1.0014 | 0.0445 | 0.0305 | 1.0006 | 1.0011 | 0.0321 | 0.0215 |
| FD-OLS | 1.0003 | 0.9970 | 0.0653 | 0.0467 | 1.0019 | 0.9999 | 0.0544 | 0.0378 | 1.0029 | 1.0021 | 0.0405 | 0.0291 | 1.0012 | 1.0015 | 0.0299 | 0.0205 |
| FE (inf) | 1.0022 | 0.9988 | 0.0535 | 0.0346 | 1.0016 | 1.0001 | 0.0465 | 0.0282 | 1.0016 | 0.9998 | 0.0364 | 0.0219 | 1.0001 | 0.9992 | 0.0240 | 0.0155 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0021 | 1.0010 | 0.0548 | 0.1223 | 1.0008 | 0.9994 | 0.0485 | 0.1010 | 0.9997 | 1.0010 | 0.0347 | 0.0784 | 1.0001 | 1.0006 | 0.0261 | 0.0558 |
| AMG(i) | 1.0032 | 1.0033 | 0.0946 | 0.1185 | 1.0070 | 1.0094 | 0.0774 | 0.0967 | 1.0053 | 1.0049 | 0.0539 | 0.0750 | 1.0019 | 1.0033 | 0.0415 | 0.0533 |
| AMG(ii) | 1.0160 | 1.0082 | 0.1035 | 0.1286 | 1.0197 | 1.0152 | 0.0859 | 0.1054 | 1.0127 | 1.0104 | 0.0614 | 0.0816 | 1.0077 | 1.0063 | 0.0453 | 0.0571 |
| MG | 1.1258 | 1.1189 | 0.1801 | 0.1261 | 1.1508 | 1.1381 | 0.1833 | 0.1032 | 1.1267 | 1.1196 | 0.1833 | 0.0789 | 1.1378 | 1.1365 | 0.1830 | 0.0559 |
| MG (inf) | 0.9999 | 0.9994 | 0.0305 | 0.1189 | 1.0015 | 1.0018 | 0.0251 | 0.0960 | 0.9999 | 0.9995 | 0.0190 | 0.0739 | 0.9999 | 0.9997 | 0.0134 | 0.0521 |

Continued on the following page.

Bond and Eberhardt (2013) — (iv)* Two ‘clubs’, country trends (continued)

| $T = 50$ | $N = 20$ | | | | $N = 30$ | | | | $N = 50$ | | | | $N = 100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.7315 | 1.7307 | 0.7819 | 0.1637 | 0.7518 | 0.7384 | 0.5836 | 0.1268 | 0.5759 | 0.5795 | 0.4862 | 0.1018 | 0.6663 | 0.6606 | 0.3030 | 0.0668 |
| FE | 1.0674 | 1.0687 | 0.4922 | 0.0913 | 1.0249 | 1.0182 | 0.4090 | 0.0738 | 1.0331 | 1.0291 | 0.3222 | 0.0570 | 1.0165 | 1.0226 | 0.2254 | 0.0405 |
| CCEP | 1.0035 | 1.0035 | 0.0665 | 0.0389 | 0.9969 | 0.9977 | 0.0543 | 0.0317 | 1.0016 | 1.0004 | 0.0429 | 0.0244 | 0.9985 | 0.9988 | 0.0295 | 0.0174 |
| FD-OLS | 1.0028 | 1.0028 | 0.0562 | 0.0359 | 0.9998 | 1.0001 | 0.0437 | 0.0291 | 1.0016 | 1.0001 | 0.0357 | 0.0224 | 1.0002 | 0.9991 | 0.0253 | 0.0158 |
| FE (inf) | 0.9999 | 0.9972 | 0.0508 | 0.0246 | 0.9994 | 0.9966 | 0.0410 | 0.0201 | 0.9996 | 1.0004 | 0.0316 | 0.0156 | 0.9999 | 0.9996 | 0.0215 | 0.0110 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0062 | 1.0057 | 0.0521 | 0.1219 | 0.9992 | 0.9994 | 0.0438 | 0.1000 | 1.0001 | 1.0005 | 0.0347 | 0.0774 | 0.9991 | 0.9996 | 0.0239 | 0.0552 |
| AMG(i) | 1.0069 | 1.0053 | 0.0843 | 0.1180 | 1.0008 | 1.0002 | 0.0677 | 0.0967 | 1.0039 | 1.0027 | 0.0501 | 0.0749 | 1.0014 | 0.9997 | 0.0352 | 0.0533 |
| AMG(ii) | 1.0144 | 1.0070 | 0.0917 | 0.1311 | 1.0076 | 1.0042 | 0.0753 | 0.1059 | 1.0069 | 1.0043 | 0.0551 | 0.0819 | 1.0032 | 1.0030 | 0.0379 | 0.0577 |
| MG | 1.1723 | 1.1552 | 0.2146 | 0.1259 | 1.1758 | 1.1663 | 0.2115 | 0.1030 | 1.1608 | 1.1531 | 0.2079 | 0.0784 | 1.1650 | 1.1580 | 0.2149 | 0.0560 |
| MG (inf) | 1.0007 | 1.0010 | 0.0213 | 0.1166 | 0.9999 | 0.9998 | 0.0169 | 0.0944 | 0.9994 | 0.9992 | 0.0130 | 0.0727 | 1.0001 | 1.0000 | 0.0093 | 0.0511 |

| $T = 100$ | $N = 20$ | | | | $N = 30$ | | | | $N = 50$ | | | | $N = 100$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pooled Estimators* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| POLS | 1.6429 | 1.6258 | 0.8825 | 0.1122 | 0.7961 | 0.7808 | 0.6623 | 0.0884 | 0.6299 | 0.6197 | 0.5156 | 0.0694 | 0.7340 | 0.7407 | 0.3508 | 0.0464 |
| FE | 1.1202 | 1.1320 | 0.6789 | 0.0721 | 1.0369 | 1.0160 | 0.5495 | 0.0598 | 1.0245 | 1.0204 | 0.4288 | 0.0453 | 1.0213 | 1.0196 | 0.2998 | 0.0324 |
| CCEP | 1.0014 | 1.0012 | 0.0726 | 0.0301 | 0.9962 | 0.9964 | 0.0598 | 0.0248 | 1.0030 | 1.0012 | 0.0480 | 0.0192 | 0.9985 | 0.9992 | 0.0334 | 0.0135 |
| FD-OLS | 1.0023 | 1.0026 | 0.0452 | 0.0252 | 1.0023 | 1.0011 | 0.0382 | 0.0205 | 1.0017 | 1.0019 | 0.0287 | 0.0157 | 1.0012 | 1.0009 | 0.0212 | 0.0111 |
| FE (inf) | 0.9999 | 0.9975 | 0.0529 | 0.0157 | 1.0018 | 1.0019 | 0.0435 | 0.0128 | 0.9995 | 0.9990 | 0.0327 | 0.0099 | 1.0000 | 0.9993 | 0.0232 | 0.0070 |
| *MG-type Estimator* | | | | | | | | | | | | | | | | |
| | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* | mean | median | emp. ste* | mean ste* |
| CMG | 1.0042 | 1.0038 | 0.0575 | 0.1246 | 0.9981 | 0.9981 | 0.0448 | 0.1036 | 0.9994 | 0.9987 | 0.0381 | 0.0801 | 0.9988 | 0.9995 | 0.0266 | 0.0564 |
| AMG(i) | 1.0028 | 1.0048 | 0.0760 | 0.1197 | 1.0052 | 1.0044 | 0.0605 | 0.0982 | 1.0066 | 1.0079 | 0.0471 | 0.0762 | 1.0032 | 1.0046 | 0.0319 | 0.0539 |
| AMG(ii) | 1.0052 | 1.0022 | 0.0818 | 0.1335 | 1.0074 | 1.0060 | 0.0646 | 0.1092 | 1.0070 | 1.0059 | 0.0506 | 0.0845 | 1.0035 | 1.0042 | 0.0345 | 0.0593 |
| MG | 1.2070 | 1.1939 | 0.2515 | 0.1270 | 1.2097 | 1.1979 | 0.2501 | 0.1043 | 1.1944 | 1.1818 | 0.2689 | 0.0802 | 1.1950 | 1.1825 | 0.2590 | 0.0571 |
| MG (inf) | 1.0007 | 1.0006 | 0.0121 | 0.1152 | 1.0004 | 1.0001 | 0.0101 | 0.0934 | 0.9999 | 0.9998 | 0.0075 | 0.0718 | 0.9998 | 0.9997 | 0.0056 | 0.0505 |

**Notes:** ‡ These use the year dummy coefficients from FD-IV estimator, rather than the FD-OLS estimator.

# D Robustness checks for Bond and Eberhardt (2013)

In order to address concerns over heterogeneity bias introduced in the first stage of the AMG we also constructed an alternative AMG estimator where the first stage is changed to the following

$$\text{AMG — Stage (i)} \qquad \Delta y_{it} = \boldsymbol{b}_i' \Delta \boldsymbol{x}_{it} D_i + \sum_{t=2}^{T} c_t \Delta D_t + e_{it} \qquad (14)$$
$$\Rightarrow \hat{\boldsymbol{c}}_t \equiv \hat{\mu}_t^{\bullet}$$

This allows for a heterogeneous $\beta$ in the first stage and a consistent estimation of $\hat{\mu}_t^{\bullet}$. This estimator is applied in the latest simulations presented from Table D-1 onwards.

The motivation for these robustness checks is the concern that the performance of the AMG would deteriorate (vis-à-vis the CMG) once we increase the variance in the slope coefficient $\beta$ and/or in the factor loadings $\lambda_i$ across panel members. It may also be the case that uniform distribution for these parameters would not allow for the type of dispersion that would lead to the collapse of the AMG and we therefore include normally distributed factor loadings and slope coefficients in the following setup: $\beta_i \sim N(1, 1)$. A number of different cases are investigated for this new setup:

(a) **Large variation in slopes**: $\beta_i \sim N(1, 1)$. Factor loadings in $y$ are $\lambda_{i1}^y \sim N(0.5, 0.2)$ and $\lambda_{i1}^y \sim N(0.75, 0.2)$, in $x$ $\lambda_{i1}^x \sim N(0.5, 0.5)$ and $\lambda_{i3}^x \sim N(0.75, 0.5)$. Factors nonstationary with a drift $\{1.5\%, 1.2\%, 1\}$ for $f_1t$, $f_2t$, $f_3t$ respectively, overlap between $x$ and $y$ equation in the form of factor #1. Error and deterministic terms as in Kapetanios et al. (2011).

(b) **In addition large variation in all factor loadings**: Factor loadings in $y$ are $\lambda_{i1}^y \sim N(0.5, 1)$ and $\lambda_{i1}^y \sim N(0.75, 1)$, in $x$ $\lambda_{i1}^x \sim N(0.5, 2)$ and $\lambda_{i3}^x \sim N(0.75, 2)$.

(c) **Large variation in slopes and factor loadings in $\boldsymbol{x}$**, low factor loadings variation in $y$. Factor loadings in $y$ are $\lambda_{i1}^y \sim N(0.5, 0.1)$ and $\lambda_{i2}^y \sim N(0.75, 0.1)$, in $x$ $\lambda_{i1}^x \sim N(0.5, 2)$ and $\lambda_{i3}^x \sim N(0.75, 2)$.

(d) **Large variation in slopes and factor loadings in $\boldsymbol{y}$**, low factor loadings variation in $x$. Factor loadings in $y$ are $\lambda_{i1}^y \sim N(0.5, 2)$ and $\lambda_{i2}^y \sim N(0.75, 2)$, in $x$ $\lambda_{i1}^x \sim N(0.5, 0.1)$ and $\lambda_{i3}^x \sim N(0.75, 0.1)$.

(e) **Extreme variation in slopes and large variation in factor loadings in $\boldsymbol{x}$ and $\boldsymbol{y}$**. $\beta_i \sim N(1, 4)$. Factor loadings in $y$ are $\lambda_{i1}^y \sim N(0.5, 1)$ and $\lambda_{i2}^y \sim N(0.75, 1)$, in $x$ $\lambda_{i1}^x \sim N(0.5, 2)$ and $\lambda_{i3}^x \sim N(0.75, 2)$.

(f) **Large variation in the factor loadings on $f_{1t}$ in both $\boldsymbol{x}$ and $\boldsymbol{y}$** (i.e. in the factor that causes the endogeneity). Factor loadings in $y$ are $\lambda_{i1}^y \sim N(0.5, 2)$ and $\lambda_{i2}^y \sim N(0.75, 0.1)$, in $x$ $\lambda_{i1}^x \sim N(0.5, 2)$ and $\lambda_{i3}^x \sim N(0.75, 0.1)$.

Table D-1: Bond and Eberhardt (2013) — Robustness Check (a) Baseline

| $T = 20$ | $N = 20$ | | | | | | | $N = 30$ | | | | | | | $N = 50$ | | | | | | | $N = 100$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
| POLS | 0.965 | 0.947 | 1.527 | 0.333 | 4.582 | 4.251 | 150.203 | 1.012 | 0.998 | 1.199 | 0.259 | 4.620 | 0.459 | 119.026 | 1.002 | 1.040 | 0.963 | 0.208 | 4.624 | 0.054 | 95.309 | 1.003 | 1.002 | 0.632 | 0.141 | 4.496 | 0.175 | 62.804 |
| 2FE | 1.028 | 1.038 | 0.381 | 0.077 | 4.937 | 2.113 | 30.708 | 1.017 | 1.019 | 0.313 | 0.064 | 4.865 | 0.948 | 25.956 | 1.018 | 1.000 | 0.238 | 0.049 | 4.817 | 1.694 | 19.497 | 1.006 | 1.010 | 0.168 | 0.035 | 4.785 | 0.466 | 13.845 |
| CCE | 1.009 | 1.010 | 0.260 | 0.066 | 3.948 | 0.177 | 13.594 | 1.011 | 1.017 | 0.213 | 0.054 | 3.917 | 0.342 | 11.637 | 1.004 | 0.999 | 0.160 | 0.042 | 3.777 | 0.297 | 8.643 | 0.999 | 0.999 | 0.117 | 0.030 | 3.892 | 0.299 | 6.100 |
| FD | 1.002 | 1.016 | 0.255 | 0.070 | 3.648 | 0.527 | 13.190 | 1.014 | 1.020 | 0.211 | 0.057 | 3.700 | 0.591 | 11.488 | 1.004 | 0.998 | 0.159 | 0.044 | 3.627 | 0.271 | 8.245 | 1.001 | 0.998 | 0.116 | 0.031 | 3.743 | 0.044 | 6.046 |
| FE(inf) | 1.006 | 1.014 | 0.267 | 0.060 | 4.451 | 0.081 | 15.588 | 1.009 | 1.010 | 0.222 | 0.050 | 4.474 | 0.153 | 13.443 | 1.003 | 0.995 | 0.172 | 0.039 | 4.439 | 0.203 | 10.479 | 1.001 | 1.002 | 0.123 | 0.028 | 4.459 | 0.087 | 7.355 |
| CMG | 1.008 | 1.011 | 0.228 | 0.219 | 1.043 | 0.115 | 5.952 | 1.010 | 1.012 | 0.187 | 0.182 | 1.024 | 0.259 | 4.758 | 1.001 | 1.001 | 0.138 | 0.143 | 0.966 | 0.054 | 3.618 | 1.001 | 1.001 | 0.103 | 0.102 | 1.012 | 0.090 | 2.739 |
| AMG(i) | 1.012 | 1.020 | 0.230 | 0.228 | 1.005 | 0.447 | 5.523 | 1.012 | 1.012 | 0.187 | 0.187 | 1.001 | 0.476 | 4.463 | 1.003 | 1.001 | 0.138 | 0.145 | 0.957 | 0.185 | 3.548 | 1.002 | 1.000 | 0.103 | 0.102 | 1.004 | 0.091 | 2.594 |
| AMG(ii) | 1.011 | 1.020 | 0.229 | 0.227 | 1.006 | 0.359 | 5.304 | 1.011 | 1.011 | 0.186 | 0.187 | 0.997 | 0.345 | 4.287 | 1.003 | 1.003 | 0.139 | 0.144 | 0.962 | 0.160 | 3.339 | 1.002 | 1.000 | 0.102 | 0.102 | 1.001 | 0.031 | 2.412 |
| MG | 1.080 | 1.083 | 0.253 | 0.233 | 1.089 | 7.252 | 14.102 | 1.095 | 1.098 | 0.222 | 0.191 | 1.159 | 8.764 | 15.019 | 1.075 | 1.069 | 0.170 | 0.148 | 1.153 | 7.336 | 12.835 | 1.082 | 1.079 | 0.147 | 0.105 | 1.406 | 8.098 | 13.647 |
| MG(inf) | 1.006 | 1.014 | 0.224 | 0.226 | 0.993 | 0.079 | 3.595 | 1.008 | 1.007 | 0.183 | 0.184 | 0.992 | 0.027 | 3.150 | 1.001 | 0.995 | 0.137 | 0.142 | 0.960 | 0.060 | 2.339 | 1.002 | 1.002 | 0.101 | 0.101 | 1.003 | 0.002 | 1.718 |

| $T = 30$ | $N = 20$ | | | | | | | $N = 30$ | | | | | | | $N = 50$ | | | | | | | $N = 100$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
| POLS | 1.052 | 1.055 | 1.530 | 0.262 | 5.836 | 4.830 | 151.629 | 1.070 | 1.073 | 1.143 | 0.203 | 5.632 | 6.546 | 113.487 | 1.005 | 1.006 | 0.920 | 0.163 | 5.631 | 0.582 | 90.688 | 1.007 | 1.014 | 0.639 | 0.110 | 5.800 | 0.708 | 63.332 |
| 2FE | 1.015 | 1.022 | 0.415 | 0.065 | 6.363 | 1.163 | 34.716 | 1.030 | 1.030 | 0.336 | 0.053 | 6.312 | 2.555 | 28.738 | 1.022 | 1.024 | 0.260 | 0.041 | 6.303 | 2.256 | 22.259 | 1.005 | 1.002 | 0.191 | 0.029 | 6.482 | 0.526 | 16.154 |
| CCE | 1.011 | 1.015 | 0.263 | 0.052 | 5.093 | 0.792 | 13.562 | 1.011 | 1.008 | 0.205 | 0.042 | 4.829 | 0.696 | 10.902 | 1.004 | 1.004 | 0.159 | 0.033 | 4.789 | 0.400 | 8.598 | 0.998 | 0.998 | 0.117 | 0.024 | 4.905 | 0.194 | 6.209 |
| FD | 1.007 | 1.012 | 0.259 | 0.057 | 4.529 | 0.393 | 12.240 | 1.013 | 1.020 | 0.200 | 0.046 | 4.308 | 0.910 | 10.466 | 1.007 | 1.006 | 0.156 | 0.036 | 4.349 | 0.753 | 7.719 | 0.999 | 1.001 | 0.113 | 0.025 | 4.450 | 0.107 | 5.714 |
| FE(inf) | 1.006 | 1.017 | 0.274 | 0.047 | 5.840 | 0.248 | 16.899 | 1.016 | 1.020 | 0.223 | 0.038 | 5.789 | 1.150 | 14.086 | 1.007 | 1.009 | 0.167 | 0.030 | 5.572 | 0.706 | 10.572 | 0.998 | 0.998 | 0.128 | 0.021 | 5.956 | 0.199 | 7.955 |
| CMG | 1.005 | 1.004 | 0.233 | 0.218 | 1.071 | 0.163 | 5.563 | 1.005 | 1.003 | 0.182 | 0.181 | 1.007 | 0.087 | 4.361 | 1.000 | 1.000 | 0.139 | 0.142 | 0.980 | 0.015 | 3.435 | 1.000 | 0.999 | 0.103 | 0.102 | 1.009 | 0.043 | 2.393 |
| AMG(i) | 1.010 | 1.007 | 0.234 | 0.228 | 1.026 | 0.655 | 5.404 | 1.009 | 1.003 | 0.181 | 0.186 | 0.973 | 0.440 | 4.016 | 1.001 | 1.001 | 0.138 | 0.144 | 0.960 | 0.180 | 3.345 | 1.000 | 1.000 | 0.103 | 0.102 | 1.006 | 0.004 | 2.293 |
| AMG(ii) | 1.009 | 1.008 | 0.234 | 0.228 | 1.027 | 0.603 | 4.973 | 1.008 | 1.005 | 0.180 | 0.186 | 0.972 | 0.351 | 3.808 | 1.001 | 1.000 | 0.138 | 0.144 | 0.963 | 0.102 | 3.078 | 1.000 | 0.999 | 0.102 | 0.102 | 1.001 | 0.015 | 2.172 |
| MG | 1.091 | 1.087 | 0.269 | 0.233 | 1.155 | 8.756 | 15.845 | 1.107 | 1.104 | 0.219 | 0.191 | 1.145 | 10.276 | 16.295 | 1.079 | 1.077 | 0.176 | 0.148 | 1.195 | 7.911 | 14.616 | 1.089 | 1.085 | 0.152 | 0.105 | 1.451 | 8.847 | 14.847 |
| MG(inf) | 1.005 | 1.001 | 0.230 | 0.224 | 1.024 | 0.128 | 2.876 | 1.005 | 1.007 | 0.177 | 0.183 | 0.969 | 0.084 | 2.272 | 1.000 | 0.999 | 0.136 | 0.141 | 0.966 | 0.006 | 1.766 | 1.000 | 0.999 | 0.100 | 0.100 | 0.995 | 0.040 | 1.221 |

| $T = 50$ | $N = 20$ | | | | | | | $N = 30$ | | | | | | | $N = 50$ | | | | | | | $N = 100$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
| POLS | 1.044 | 1.059 | 1.387 | 0.184 | 7.522 | 3.345 | 137.271 | 1.011 | 0.978 | 1.073 | 0.144 | 7.433 | 1.222 | 105.874 | 0.985 | 1.000 | 0.856 | 0.116 | 7.404 | 1.263 | 84.131 | 1.007 | 1.032 | 0.577 | 0.079 | 7.322 | 1.082 | 57.084 |
| 2FE | 1.044 | 1.040 | 0.442 | 0.051 | 8.587 | 3.264 | 37.679 | 1.020 | 1.009 | 0.368 | 0.042 | 8.731 | 2.139 | 31.032 | 1.008 | 1.001 | 0.280 | 0.033 | 8.561 | 1.018 | 24.017 | 1.006 | 0.997 | 0.196 | 0.023 | 8.418 | 0.962 | 17.075 |
| CCE | 1.017 | 1.018 | 0.263 | 0.038 | 6.869 | 0.581 | 14.913 | 1.011 | 1.003 | 0.219 | 0.032 | 6.870 | 1.262 | 12.207 | 0.999 | 0.998 | 0.165 | 0.025 | 6.630 | 0.076 | 9.121 | 0.998 | 0.998 | 0.126 | 0.018 | 7.029 | 0.159 | 6.950 |
| FD | 1.018 | 1.016 | 0.250 | 0.044 | 5.698 | 0.687 | 11.309 | 1.003 | 1.004 | 0.204 | 0.036 | 5.679 | 0.375 | 8.946 | 1.001 | 1.005 | 0.154 | 0.028 | 5.566 | 0.339 | 7.009 | 0.999 | 0.997 | 0.115 | 0.020 | 5.852 | 0.291 | 5.092 |
| FE(inf) | 1.017 | 1.020 | 0.285 | 0.034 | 8.408 | 0.598 | 17.711 | 1.003 | 1.004 | 0.233 | 0.028 | 8.237 | 0.383 | 14.365 | 1.001 | 0.991 | 0.179 | 0.022 | 8.091 | 0.312 | 11.720 | 0.998 | 0.997 | 0.132 | 0.016 | 8.375 | 0.133 | 8.280 |
| CMG | 1.014 | 1.024 | 0.224 | 0.216 | 1.036 | 0.273 | 5.791 | 1.000 | 1.001 | 0.186 | 0.181 | 1.029 | 0.127 | 4.411 | 0.997 | 0.998 | 0.143 | 0.142 | 1.009 | 0.128 | 3.433 | 0.996 | 0.994 | 0.104 | 0.102 | 1.023 | 0.077 | 2.568 |
| AMG(i) | 1.017 | 1.023 | 0.225 | 0.226 | 0.993 | 0.613 | 5.150 | 1.002 | 1.006 | 0.186 | 0.186 | 1.000 | 0.337 | 4.279 | 1.003 | 1.000 | 0.142 | 0.144 | 0.988 | 0.457 | 3.174 | 0.996 | 0.995 | 0.104 | 0.102 | 1.013 | 0.006 | 2.318 |
| AMG(ii) | 1.017 | 1.025 | 0.223 | 0.225 | 0.990 | 0.567 | 4.653 | 1.000 | 1.005 | 0.185 | 0.185 | 1.002 | 0.151 | 3.734 | 1.001 | 1.002 | 0.142 | 0.143 | 0.992 | 0.284 | 2.870 | 0.997 | 0.998 | 0.104 | 0.102 | 1.016 | 0.017 | 2.175 |
| MG | 1.119 | 1.122 | 0.260 | 0.233 | 1.114 | 10.812 | 18.317 | 1.110 | 1.108 | 0.232 | 0.192 | 1.209 | 11.170 | 17.887 | 1.098 | 1.104 | 0.190 | 0.148 | 1.282 | 10.014 | 16.658 | 1.098 | 1.096 | 0.165 | 0.106 | 1.566 | 10.175 | 16.681 |
| MG(inf) | 1.011 | 1.023 | 0.218 | 0.221 | 0.986 | 0.011 | 1.927 | 0.998 | 0.998 | 0.181 | 0.182 | 0.998 | 0.035 | 1.563 | 0.998 | 0.999 | 0.139 | 0.141 | 0.990 | 0.004 | 1.196 | 0.996 | 0.998 | 0.102 | 0.100 | 1.021 | 0.019 | 0.832 |

| $T = 100$ | $N = 20$ | | | | | | | $N = 30$ | | | | | | | $N = 50$ | | | | | | | $N = 100$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
| POLS | 1.045 | 1.013 | 1.154 | 0.109 | 10.634 | 4.350 | 113.159 | 1.070 | 1.078 | 0.912 | 0.086 | 10.596 | 6.557 | 89.269 | 1.012 | 1.007 | 0.733 | 0.069 | 10.692 | 0.938 | 70.807 | 1.018 | 1.027 | 0.483 | 0.047 | 10.322 | 1.387 | 47.628 |
| 2FE | 1.037 | 1.035 | 0.482 | 0.036 | 13.275 | 3.495 | 42.727 | 1.038 | 1.044 | 0.393 | 0.030 | 12.883 | 3.419 | 34.610 | 1.021 | 1.027 | 0.311 | 0.023 | 13.295 | 1.873 | 26.776 | 1.013 | 1.013 | 0.212 | 0.017 | 12.733 | 0.822 | 19.170 |
| CCE | 1.004 | 1.001 | 0.284 | 0.027 | 10.710 | 0.271 | 18.569 | 1.013 | 1.014 | 0.230 | 0.022 | 10.460 | 0.900 | 15.163 | 1.006 | 1.002 | 0.188 | 0.017 | 10.964 | 0.354 | 12.335 | 1.002 | 1.000 | 0.135 | 0.012 | 11.096 | 0.261 | 8.237 |
| FD | 1.005 | 1.003 | 0.246 | 0.031 | 7.907 | 0.314 | 10.768 | 1.009 | 1.006 | 0.198 | 0.026 | 7.758 | 0.489 | 8.970 | 1.005 | 0.998 | 0.160 | 0.020 | 8.143 | 0.296 | 6.691 | 1.005 | 1.003 | 0.113 | 0.014 | 8.136 | 0.013 | 4.795 |
| FE(inf) | 1.003 | 1.004 | 0.292 | 0.023 | 12.825 | 0.121 | 19.909 | 1.008 | 1.015 | 0.243 | 0.019 | 12.759 | 0.367 | 17.327 | 0.997 | 0.996 | 0.197 | 0.015 | 13.237 | 0.558 | 13.545 | 1.005 | 1.004 | 0.138 | 0.011 | 12.969 | 0.066 | 9.574 |
| CMG | 1.004 | 1.012 | 0.233 | 0.220 | 1.060 | 0.273 | 7.106 | 1.004 | 1.000 | 0.180 | 0.184 | 0.981 | 0.040 | 5.522 | 1.004 | 1.007 | 0.152 | 0.145 | 1.052 | 0.196 | 4.637 | 1.004 | 1.006 | 0.109 | 0.103 | 1.059 | 0.006 | 3.016 |
| AMG(i) | 1.008 | 1.010 | 0.229 | 0.229 | 1.002 | 0.650 | 5.742 | 1.006 | 1.005 | 0.179 | 0.188 | 0.953 | 0.250 | 4.362 | 1.008 | 1.010 | 0.150 | 0.146 | 1.030 | 0.551 | 3.779 | 1.005 | 1.006 | 0.107 | 0.103 | 1.038 | 0.078 | 2.695 |
| AMG(ii) | 1.006 | 1.014 | 0.229 | 0.227 | 1.007 | 0.478 | 5.184 | 1.005 | 1.004 | 0.179 | 0.186 | 0.960 | 0.145 | 4.011 | 1.006 | 1.004 | 0.149 | 0.145 | 1.026 | 0.343 | 3.446 | 1.005 | 1.006 | 0.106 | 0.102 | 1.040 | 0.027 | 2.398 |
| MG | 1.127 | 1.124 | 0.277 | 0.238 | 1.166 | 12.551 | 21.030 | 1.129 | 1.129 | 0.237 | 0.195 | 1.213 | 12.526 | 20.456 | 1.116 | 1.111 | 0.216 | 0.152 | 1.424 | 11.342 | 19.608 | 1.120 | 1.118 | 0.180 | 0.107 | 1.675 | 11.535 | 18.935 |
| MG(inf) | 1.002 | 1.003 | 0.221 | 0.221 | 1.002 | 0.006 | 1.191 | 1.004 | 1.010 | 0.176 | 0.181 | 0.969 | 0.030 | 0.971 | 1.002 | 0.998 | 0.142 | 0.141 | 1.011 | 0.005 | 0.745 | 1.004 | 1.007 | 0.104 | 0.099 | 1.047 | 0.025 | 0.518 |

**Notes**: DGP slope $\beta_i \sim N(1,1)$, persistence in $x$ variable $\rho = 0.25$, factor loadings in $y$ are $\lambda^y_{i1} \sim N(0.5, 0.2)$ and $\lambda^y_{i2} \sim N(0.75, 0.2)$, in $x$ $\lambda^x_{i1} \sim N(0.5, 0.5)$ and $\lambda^x_{i3} \sim N(0.75, 0.5)$. Factors nonstationary with a drift $\{1.5\%, 1.2\%, 1\}$ for $f_1t$, $f_2t$, $f_3t$ respectively, overlap between $x$ and $y$ equation in the form of factor #1. Error and deterministic terms as in Kapetanios et al. (2011). 1,000 replications; year dummies in the POLS or FE estimation equations; heterogeneous $\beta_i$ in all models.

# Table D-2: Bond and Eberhardt (2013) — Robustness Check (b) high variation in factor loadings

| $T=20$ | $N=20$ | | | | | | | $N=30$ | | | | | | | $N=50$ | | | | | | | $N=100$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
| POLS | 0.965 | 0.947 | 1.527 | 0.333 | 4.582 | 4.251 | 150.203 | 1.012 | 0.998 | 1.199 | 0.259 | 4.620 | 0.459 | 119.026 | 1.002 | 1.040 | 0.963 | 0.208 | 4.624 | 0.054 | 95.309 | 1.003 | 1.002 | 0.632 | 0.141 | 4.496 | 0.175 | 62.804 |
| 2FE | 1.028 | 1.038 | 0.381 | 0.077 | 4.937 | 2.113 | 30.708 | 1.017 | 1.019 | 0.313 | 0.064 | 4.865 | 0.948 | 25.956 | 1.018 | 1.000 | 0.238 | 0.049 | 4.817 | 1.694 | 19.497 | 1.006 | 1.010 | 0.168 | 0.035 | 4.785 | 0.466 | 13.845 |
| CCE | 1.009 | 1.010 | 0.260 | 0.066 | 3.948 | 0.177 | 13.594 | 1.011 | 1.017 | 0.213 | 0.054 | 3.917 | 0.342 | 11.637 | 1.004 | 0.999 | 0.160 | 0.042 | 3.777 | 0.297 | 8.643 | 0.999 | 0.999 | 0.117 | 0.030 | 3.892 | 0.299 | 6.100 |
| FD | 1.002 | 1.016 | 0.255 | 0.070 | 3.648 | 0.527 | 13.190 | 1.014 | 1.020 | 0.211 | 0.057 | 3.700 | 0.591 | 11.488 | 1.004 | 0.998 | 0.159 | 0.044 | 3.627 | 0.271 | 8.245 | 1.001 | 0.998 | 0.116 | 0.031 | 3.743 | 0.044 | 6.046 |
| FE(inf) | 1.006 | 1.014 | 0.267 | 0.060 | 4.451 | 0.081 | 15.588 | 1.009 | 1.010 | 0.222 | 0.050 | 4.474 | 0.153 | 13.443 | 1.003 | 0.995 | 0.172 | 0.039 | 4.439 | 0.203 | 10.479 | 1.001 | 1.002 | 0.123 | 0.028 | 4.459 | 0.087 | 7.355 |
| CMG | 1.008 | 1.011 | 0.228 | 0.219 | 1.043 | 0.115 | 5.952 | 1.010 | 1.012 | 0.187 | 0.182 | 1.024 | 0.259 | 4.758 | 1.001 | 1.001 | 0.138 | 0.143 | 0.966 | 0.054 | 3.618 | 1.001 | 1.001 | 0.103 | 0.102 | 1.012 | 0.090 | 2.739 |
| AMG(i) | 1.012 | 1.020 | 0.230 | 0.228 | 1.005 | 0.447 | 5.523 | 1.012 | 1.012 | 0.187 | 0.187 | 1.001 | 0.476 | 4.463 | 1.003 | 1.001 | 0.138 | 0.145 | 0.957 | 0.185 | 3.548 | 1.002 | 1.000 | 0.103 | 0.102 | 1.004 | 0.091 | 2.594 |
| AMG(ii) | 1.011 | 1.020 | 0.229 | 0.227 | 1.006 | 0.359 | 5.304 | 1.011 | 1.011 | 0.186 | 0.187 | 0.997 | 0.345 | 4.287 | 1.003 | 1.003 | 0.139 | 0.144 | 0.962 | 0.160 | 3.339 | 1.002 | 1.000 | 0.102 | 0.102 | 1.001 | 0.031 | 2.412 |
| MG | 1.080 | 1.083 | 0.253 | 0.233 | 1.089 | 7.252 | 14.102 | 1.095 | 1.098 | 0.222 | 0.191 | 1.159 | 8.764 | 15.019 | 1.075 | 1.069 | 0.170 | 0.148 | 1.153 | 7.336 | 12.835 | 1.082 | 1.079 | 0.147 | 0.105 | 1.406 | 8.098 | 13.647 |
| MG(inf) | 1.006 | 1.014 | 0.224 | 0.226 | 0.993 | 0.079 | 3.595 | 1.008 | 1.007 | 0.183 | 0.184 | 0.992 | 0.027 | 3.150 | 1.001 | 0.995 | 0.137 | 0.142 | 0.960 | 0.060 | 2.339 | 1.002 | 1.002 | 0.101 | 0.101 | 1.003 | 0.002 | 1.718 |
| $T=30$ | $N=20$ | | | | | | | $N=30$ | | | | | | | $N=50$ | | | | | | | $N=100$ | | | | | | |
| | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
| POLS | 1.028 | 1.006 | 0.975 | 0.157 | 6.215 | 2.503 | 94.669 | 1.058 | 1.022 | 0.706 | 0.122 | 5.793 | 5.392 | 68.922 | 1.026 | 1.040 | 0.579 | 0.098 | 5.940 | 2.676 | 56.127 | 1.009 | 1.020 | 0.411 | 0.067 | 6.134 | 0.865 | 39.912 |
| 2FE | 1.018 | 1.023 | 0.405 | 0.056 | 7.181 | 1.418 | 32.994 | 1.028 | 1.021 | 0.330 | 0.046 | 7.154 | 2.339 | 27.644 | 1.027 | 1.025 | 0.253 | 0.036 | 7.064 | 2.773 | 21.543 | 1.005 | 1.005 | 0.184 | 0.026 | 7.181 | 0.515 | 15.307 |
| CCE | 1.014 | 1.021 | 0.313 | 0.052 | 6.007 | 1.020 | 21.704 | 1.021 | 1.026 | 0.247 | 0.042 | 5.826 | 1.707 | 17.743 | 1.009 | 1.015 | 0.191 | 0.033 | 5.730 | 0.929 | 13.720 | 0.999 | 1.007 | 0.140 | 0.024 | 5.885 | 0.132 | 10.065 |
| FD | 1.010 | 1.017 | 0.286 | 0.054 | 5.282 | 0.689 | 17.190 | 1.020 | 1.025 | 0.223 | 0.044 | 5.078 | 1.632 | 14.558 | 1.014 | 1.014 | 0.173 | 0.034 | 5.076 | 1.474 | 10.943 | 1.001 | 1.002 | 0.126 | 0.024 | 5.214 | 0.044 | 8.015 |
| FE(inf) | 1.006 | 1.016 | 0.312 | 0.044 | 7.079 | 0.303 | 22.951 | 1.022 | 1.023 | 0.256 | 0.036 | 7.060 | 1.814 | 19.418 | 1.012 | 1.011 | 0.195 | 0.028 | 6.866 | 1.202 | 14.821 | 0.997 | 1.001 | 0.148 | 0.020 | 7.238 | 0.356 | 10.887 |
| CMG | 1.003 | 1.002 | 0.248 | 0.233 | 1.063 | 0.075 | 10.173 | 1.007 | 1.000 | 0.194 | 0.192 | 1.009 | 0.239 | 7.878 | 1.000 | 1.004 | 0.148 | 0.151 | 0.981 | 0.014 | 6.455 | 1.000 | 0.995 | 0.110 | 0.108 | 1.011 | 0.035 | 4.299 |
| AMG(i) | 1.016 | 1.010 | 0.248 | 0.240 | 1.033 | 1.246 | 9.356 | 1.012 | 1.011 | 0.193 | 0.195 | 0.991 | 0.832 | 7.241 | 1.003 | 1.004 | 0.146 | 0.151 | 0.962 | 0.375 | 5.927 | 1.000 | 1.001 | 0.110 | 0.108 | 1.019 | 0.040 | 4.123 |
| AMG(ii) | 1.015 | 1.007 | 0.246 | 0.239 | 1.029 | 1.127 | 8.810 | 1.009 | 1.009 | 0.190 | 0.194 | 0.978 | 0.486 | 7.027 | 1.003 | 1.005 | 0.145 | 0.150 | 0.967 | 0.292 | 5.633 | 1.000 | 1.002 | 0.108 | 0.107 | 1.005 | 0.029 | 3.881 |
| MG | 1.051 | 1.039 | 0.262 | 0.243 | 1.074 | 4.811 | 12.571 | 1.058 | 1.047 | 0.204 | 0.200 | 1.023 | 5.395 | 11.244 | 1.036 | 1.037 | 0.154 | 0.154 | 0.998 | 3.663 | 9.189 | 1.040 | 1.036 | 0.121 | 0.110 | 1.102 | 4.024 | 8.023 |
| MG(inf) | 1.004 | 0.998 | 0.229 | 0.224 | 1.025 | 0.067 | 2.498 | 1.005 | 1.003 | 0.177 | 0.183 | 0.969 | 0.054 | 2.012 | 1.000 | 1.000 | 0.136 | 0.141 | 0.966 | 0.017 | 1.583 | 1.000 | 0.999 | 0.100 | 0.100 | 0.995 | 0.053 | 1.091 |
| $T=50$ | $N=20$ | | | | | | | $N=30$ | | | | | | | $N=50$ | | | | | | | $N=100$ | | | | | | |
| | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
| POLS | 1.048 | 1.031 | 0.844 | 0.108 | 7.792 | 3.727 | 81.736 | 1.014 | 1.008 | 0.665 | 0.085 | 7.828 | 1.559 | 63.844 | 1.004 | 0.998 | 0.529 | 0.068 | 7.818 | 0.549 | 50.687 | 1.014 | 1.011 | 0.357 | 0.047 | 7.608 | 1.751 | 34.628 |
| 2FE | 1.048 | 1.050 | 0.419 | 0.044 | 9.626 | 3.691 | 34.728 | 1.024 | 1.003 | 0.344 | 0.036 | 9.697 | 2.561 | 28.279 | 1.011 | 1.005 | 0.262 | 0.028 | 9.407 | 1.292 | 21.945 | 1.004 | 0.997 | 0.184 | 0.020 | 9.303 | 0.768 | 15.582 |
| CCE | 1.022 | 1.019 | 0.321 | 0.039 | 8.311 | 1.062 | 23.773 | 1.021 | 1.008 | 0.268 | 0.032 | 8.386 | 2.184 | 19.183 | 0.999 | 0.998 | 0.202 | 0.025 | 8.071 | 0.117 | 14.838 | 0.998 | 0.996 | 0.153 | 0.018 | 8.528 | 0.166 | 11.210 |
| FD | 1.026 | 1.024 | 0.278 | 0.042 | 6.672 | 1.542 | 16.359 | 1.011 | 1.004 | 0.229 | 0.034 | 6.717 | 1.191 | 13.259 | 1.006 | 1.003 | 0.172 | 0.026 | 6.537 | 0.785 | 10.400 | 1.001 | 1.003 | 0.127 | 0.019 | 6.803 | 0.453 | 7.575 |
| FE(inf) | 1.024 | 1.020 | 0.323 | 0.032 | 10.115 | 1.267 | 23.242 | 1.008 | 1.005 | 0.271 | 0.027 | 10.102 | 0.922 | 19.670 | 1.005 | 0.999 | 0.207 | 0.021 | 9.834 | 0.675 | 15.800 | 0.999 | 1.004 | 0.152 | 0.015 | 10.023 | 0.286 | 11.139 |
| CMG | 1.017 | 1.023 | 0.245 | 0.236 | 1.039 | 0.568 | 11.533 | 1.003 | 1.001 | 0.203 | 0.196 | 1.035 | 0.379 | 8.623 | 0.996 | 1.002 | 0.155 | 0.154 | 1.007 | 0.173 | 6.988 | 0.995 | 0.998 | 0.113 | 0.111 | 1.019 | 0.125 | 5.116 |
| AMG(i) | 1.021 | 1.023 | 0.238 | 0.240 | 0.993 | 0.970 | 9.875 | 1.006 | 1.006 | 0.198 | 0.197 | 1.006 | 0.730 | 8.121 | 1.004 | 1.003 | 0.150 | 0.153 | 0.979 | 0.591 | 6.125 | 0.995 | 0.994 | 0.110 | 0.109 | 1.013 | 0.123 | 4.432 |
| AMG(ii) | 1.018 | 1.025 | 0.235 | 0.238 | 0.987 | 0.731 | 9.260 | 1.001 | 1.002 | 0.197 | 0.195 | 1.008 | 0.247 | 7.375 | 1.001 | 1.000 | 0.150 | 0.151 | 0.993 | 0.296 | 5.752 | 0.996 | 0.994 | 0.109 | 0.107 | 1.018 | 0.021 | 4.188 |
| MG | 1.065 | 1.071 | 0.250 | 0.245 | 1.021 | 5.395 | 14.092 | 1.051 | 1.054 | 0.214 | 0.203 | 1.052 | 5.208 | 12.029 | 1.041 | 1.040 | 0.162 | 0.156 | 1.035 | 4.273 | 9.765 | 1.039 | 1.041 | 0.123 | 0.112 | 1.102 | 4.283 | 8.404 |
| MG(inf) | 1.011 | 1.020 | 0.218 | 0.221 | 0.987 | 0.025 | 1.724 | 0.999 | 0.998 | 0.181 | 0.182 | 0.998 | 0.009 | 1.402 | 0.998 | 1.000 | 0.139 | 0.140 | 0.991 | 0.012 | 1.074 | 0.996 | 0.999 | 0.102 | 0.100 | 1.022 | 0.003 | 0.724 |
| $T=100$ | $N=20$ | | | | | | | $N=30$ | | | | | | | $N=50$ | | | | | | | $N=100$ | | | | | | |
| | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
| POLS | 1.040 | 1.029 | 0.710 | 0.062 | 11.462 | 3.844 | 67.328 | 1.057 | 1.063 | 0.570 | 0.050 | 11.460 | 5.329 | 53.803 | 1.022 | 1.033 | 0.458 | 0.039 | 11.678 | 1.957 | 42.631 | 1.018 | 1.016 | 0.305 | 0.027 | 11.177 | 1.334 | 29.306 |
| 2FE | 1.039 | 1.030 | 0.428 | 0.030 | 14.193 | 3.723 | 36.674 | 1.035 | 1.036 | 0.352 | 0.025 | 13.944 | 3.102 | 30.077 | 1.024 | 1.018 | 0.284 | 0.019 | 14.571 | 2.156 | 23.863 | 1.014 | 1.015 | 0.194 | 0.014 | 13.966 | 0.923 | 16.952 |
| CCE | 1.006 | 1.000 | 0.341 | 0.027 | 12.590 | 0.470 | 26.801 | 1.015 | 1.015 | 0.280 | 0.022 | 12.523 | 1.102 | 22.379 | 1.005 | 1.001 | 0.229 | 0.017 | 13.111 | 0.326 | 18.067 | 1.002 | 1.001 | 0.165 | 0.012 | 13.438 | 0.282 | 12.382 |
| FD | 1.012 | 1.008 | 0.276 | 0.029 | 9.406 | 1.011 | 16.669 | 1.017 | 1.015 | 0.222 | 0.024 | 9.186 | 1.310 | 13.824 | 1.007 | 0.999 | 0.179 | 0.019 | 9.575 | 0.493 | 10.456 | 1.005 | 1.006 | 0.127 | 0.013 | 9.646 | 0.089 | 7.586 |
| FE(inf) | 1.011 | 1.002 | 0.335 | 0.022 | 15.540 | 0.923 | 25.783 | 1.014 | 1.019 | 0.281 | 0.018 | 15.382 | 1.033 | 22.498 | 0.991 | 0.992 | 0.223 | 0.014 | 15.572 | 1.107 | 17.345 | 1.005 | 0.999 | 0.158 | 0.010 | 15.428 | 0.017 | 12.339 |
| CMG | 1.004 | 1.004 | 0.265 | 0.249 | 1.062 | 0.205 | 13.998 | 1.003 | 0.998 | 0.203 | 0.207 | 0.980 | 0.137 | 11.253 | 1.007 | 1.005 | 0.171 | 0.164 | 1.044 | 0.495 | 9.066 | 1.003 | 1.007 | 0.122 | 0.116 | 1.053 | 0.112 | 6.140 |
| AMG(i) | 1.017 | 1.022 | 0.253 | 0.246 | 1.025 | 1.576 | 11.528 | 1.009 | 1.008 | 0.191 | 0.202 | 0.948 | 0.505 | 8.741 | 1.011 | 1.013 | 0.164 | 0.158 | 1.038 | 0.854 | 7.448 | 1.004 | 1.006 | 0.116 | 0.111 | 1.042 | 0.039 | 5.101 |
| AMG(ii) | 1.010 | 1.015 | 0.249 | 0.243 | 1.026 | 0.843 | 10.848 | 1.008 | 1.004 | 0.190 | 0.200 | 0.952 | 0.374 | 8.295 | 1.006 | 1.009 | 0.159 | 0.156 | 1.023 | 0.390 | 7.006 | 1.005 | 1.007 | 0.114 | 0.110 | 1.042 | 0.019 | 4.688 |
| MG | 1.067 | 1.064 | 0.266 | 0.254 | 1.048 | 6.562 | 16.037 | 1.058 | 1.057 | 0.205 | 0.208 | 0.985 | 5.371 | 12.945 | 1.051 | 1.051 | 0.178 | 0.162 | 1.095 | 4.850 | 11.143 | 1.050 | 1.053 | 0.128 | 0.115 | 1.118 | 4.590 | 9.137 |
| MG(inf) | 1.001 | 1.005 | 0.222 | 0.221 | 1.004 | 0.012 | 1.069 | 1.004 | 1.010 | 0.175 | 0.181 | 0.968 | 0.019 | 0.851 | 1.002 | 0.998 | 0.142 | 0.141 | 1.012 | 0.008 | 0.643 | 1.004 | 1.005 | 0.104 | 0.099 | 1.048 | 0.014 | 0.456 |

**Notes**: DGP slope $\beta_i \sim N(1,1)$, persistence in $x$ variable $\rho = 0.25$, factor loadings in $y$ are $\lambda_{i1}^y \sim N(0.5,1)$ and $\lambda_{i2}^y \sim N(0.75,1)$, in $x$ $\lambda_{i1}^x \sim N(0.5,2)$ and $\lambda_{i3}^x \sim N(0.75,2)$. Factors nonstationary with a drift $\{1.5\%, 1.2\%, 1\}$ for $f_1t$, $f_2t$, $f_3t$ respectively, overlap between $x$ and $y$ equation in the form of factor #1. Error and deterministic terms as in Kapetanios et al. (2011). 1,000 replications; year dummies in the POLS or FE estimation equations; heterogeneous $\beta_i$ in all models.

Table D-3: Bond and Eberhardt (2013) — Robustness check (c) high variation in factor loadings in $x$

| $T = 20$ | $N = 20$ | | | | | | | $N = 30$ | | | | | | | $N = 50$ | | | | | | | $N = 100$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
| POLS | 0.985 | 0.986 | 0.984 | 0.200 | 4.930 | 2.230 | 95.067 | 1.003 | 0.971 | 0.737 | 0.156 | 4.737 | 0.456 | 72.165 | 1.012 | 1.015 | 0.600 | 0.124 | 4.832 | 1.027 | 58.321 | 1.008 | 1.000 | 0.396 | 0.085 | 4.643 | 0.614 | 38.768 |
| 2FE | 1.018 | 1.027 | 0.358 | 0.057 | 6.309 | 1.079 | 27.741 | 1.011 | 1.010 | 0.295 | 0.048 | 6.185 | 0.366 | 23.701 | 1.012 | 1.001 | 0.225 | 0.037 | 6.098 | 1.039 | 17.875 | 1.005 | 1.012 | 0.160 | 0.026 | 6.066 | 0.359 | 12.737 |
| CCE | 1.011 | 1.001 | 0.286 | 0.059 | 4.867 | 0.396 | 18.047 | 1.015 | 1.019 | 0.234 | 0.049 | 4.797 | 0.707 | 15.666 | 1.008 | 1.007 | 0.182 | 0.038 | 4.742 | 0.704 | 12.014 | 1.001 | 0.990 | 0.133 | 0.027 | 4.854 | 0.083 | 8.618 |
| FD | 1.006 | 0.995 | 0.275 | 0.060 | 4.593 | 0.148 | 16.628 | 1.013 | 1.017 | 0.228 | 0.049 | 4.626 | 0.524 | 14.221 | 1.006 | 1.002 | 0.172 | 0.038 | 4.551 | 0.451 | 10.494 | 1.002 | 1.000 | 0.125 | 0.027 | 4.657 | 0.039 | 7.656 |
| FE(inf) | 1.008 | 1.019 | 0.305 | 0.056 | 5.421 | 0.057 | 21.529 | 1.013 | 1.025 | 0.251 | 0.047 | 5.373 | 0.548 | 17.892 | 1.006 | 0.999 | 0.196 | 0.037 | 5.351 | 0.424 | 14.229 | 1.002 | 1.001 | 0.139 | 0.026 | 5.338 | 0.037 | 9.942 |
| CMG | 1.008 | 1.013 | 0.225 | 0.218 | 1.035 | 0.102 | 4.701 | 1.011 | 1.009 | 0.184 | 0.181 | 1.020 | 0.282 | 3.840 | 1.001 | 1.000 | 0.137 | 0.141 | 0.970 | 0.033 | 3.034 | 1.001 | 1.003 | 0.102 | 0.101 | 1.013 | 0.071 | 2.170 |
| AMG(i) | 1.009 | 1.010 | 0.225 | 0.226 | 0.999 | 0.152 | 3.885 | 1.012 | 1.011 | 0.184 | 0.185 | 0.995 | 0.381 | 3.192 | 1.003 | 1.001 | 0.137 | 0.142 | 0.961 | 0.174 | 2.466 | 1.002 | 1.000 | 0.101 | 0.101 | 1.003 | 0.061 | 1.754 |
| AMG(ii) | 1.008 | 1.012 | 0.225 | 0.225 | 0.997 | 0.104 | 3.734 | 1.009 | 1.008 | 0.183 | 0.184 | 0.994 | 0.167 | 3.089 | 1.002 | 1.002 | 0.136 | 0.142 | 0.959 | 0.032 | 2.341 | 1.002 | 1.004 | 0.101 | 0.101 | 1.005 | 0.048 | 1.633 |
| MG | 1.040 | 1.042 | 0.235 | 0.229 | 1.025 | 3.281 | 8.013 | 1.052 | 1.051 | 0.195 | 0.189 | 1.035 | 4.385 | 8.167 | 1.036 | 1.033 | 0.147 | 0.146 | 1.013 | 3.458 | 6.766 | 1.041 | 1.042 | 0.115 | 0.103 | 1.111 | 3.925 | 6.854 |
| MG(inf) | 1.006 | 1.013 | 0.223 | 0.225 | 0.993 | 0.078 | 3.304 | 1.008 | 1.009 | 0.182 | 0.184 | 0.992 | 0.058 | 2.863 | 1.001 | 0.997 | 0.137 | 0.142 | 0.961 | 0.038 | 2.086 | 1.002 | 1.002 | 0.101 | 0.101 | 1.006 | 0.022 | 1.539 |

| $T = 30$ | $N = 20$ | | | | | | | $N = 30$ | | | | | | | $N = 50$ | | | | | | | $N = 100$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
| POLS | 1.016 | 1.007 | 0.954 | 0.154 | 6.189 | 1.225 | 92.680 | 1.047 | 1.042 | 0.695 | 0.119 | 5.814 | 4.295 | 67.856 | 1.012 | 1.021 | 0.568 | 0.096 | 5.939 | 1.248 | 54.889 | 1.006 | 1.011 | 0.403 | 0.066 | 6.120 | 0.563 | 39.005 |
| 2FE | 1.003 | 1.007 | 0.372 | 0.046 | 8.004 | 0.040 | 29.223 | 1.016 | 1.012 | 0.304 | 0.038 | 7.964 | 1.136 | 24.851 | 1.014 | 1.015 | 0.236 | 0.030 | 7.894 | 1.420 | 19.375 | 1.003 | 1.004 | 0.172 | 0.022 | 7.957 | 0.278 | 13.730 |
| CCE | 1.013 | 1.023 | 0.296 | 0.045 | 6.515 | 0.917 | 19.127 | 1.021 | 1.026 | 0.235 | 0.038 | 6.248 | 1.652 | 16.173 | 1.008 | 1.009 | 0.183 | 0.030 | 6.165 | 0.816 | 12.501 | 0.998 | 1.001 | 0.134 | 0.021 | 6.252 | 0.180 | 9.159 |
| FD | 1.006 | 1.014 | 0.279 | 0.049 | 5.674 | 0.245 | 16.040 | 1.016 | 1.024 | 0.218 | 0.040 | 5.453 | 1.191 | 13.883 | 1.011 | 1.011 | 0.170 | 0.031 | 5.487 | 1.095 | 10.347 | 1.000 | 1.003 | 0.123 | 0.022 | 5.602 | 0.042 | 7.564 |
| FE(inf) | 1.006 | 1.016 | 0.312 | 0.044 | 7.079 | 0.303 | 22.951 | 1.022 | 1.023 | 0.256 | 0.036 | 7.060 | 1.814 | 19.418 | 1.012 | 1.011 | 0.195 | 0.028 | 6.866 | 1.202 | 14.821 | 0.997 | 1.001 | 0.148 | 0.020 | 7.238 | 0.356 | 10.887 |
| CMG | 1.003 | 1.001 | 0.232 | 0.216 | 1.073 | 0.047 | 4.536 | 1.006 | 1.003 | 0.179 | 0.179 | 1.000 | 0.140 | 3.570 | 1.000 | 1.001 | 0.137 | 0.140 | 0.977 | 0.001 | 2.719 | 1.000 | 0.999 | 0.101 | 0.101 | 1.008 | 0.028 | 1.838 |
| AMG(i) | 1.007 | 1.006 | 0.232 | 0.225 | 1.029 | 0.382 | 3.591 | 1.007 | 1.005 | 0.178 | 0.183 | 0.972 | 0.263 | 2.780 | 1.001 | 1.004 | 0.137 | 0.142 | 0.962 | 0.124 | 2.248 | 1.000 | 0.999 | 0.102 | 0.101 | 1.007 | 0.018 | 1.551 |
| AMG(ii) | 1.007 | 1.005 | 0.231 | 0.225 | 1.028 | 0.356 | 3.370 | 1.006 | 1.002 | 0.178 | 0.183 | 0.969 | 0.144 | 2.675 | 1.001 | 1.002 | 0.137 | 0.142 | 0.963 | 0.088 | 2.122 | 1.000 | 0.997 | 0.101 | 0.101 | 1.000 | 0.007 | 1.461 |
| MG | 1.042 | 1.036 | 0.246 | 0.229 | 1.071 | 3.873 | 8.528 | 1.053 | 1.046 | 0.190 | 0.188 | 1.008 | 4.895 | 8.604 | 1.035 | 1.034 | 0.145 | 0.145 | 0.999 | 3.490 | 7.188 | 1.040 | 1.040 | 0.113 | 0.103 | 1.099 | 4.011 | 6.981 |
| MG(inf) | 1.004 | 0.998 | 0.229 | 0.224 | 1.025 | 0.067 | 2.498 | 1.005 | 1.003 | 0.177 | 0.183 | 0.969 | 0.054 | 2.012 | 1.000 | 1.000 | 0.136 | 0.141 | 0.966 | 0.017 | 1.583 | 1.000 | 0.999 | 0.100 | 0.100 | 0.995 | 0.053 | 1.091 |

| $T = 50$ | $N = 20$ | | | | | | | $N = 30$ | | | | | | | $N = 50$ | | | | | | | $N = 100$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
| POLS | 1.033 | 1.039 | 0.826 | 0.106 | 7.817 | 2.250 | 79.981 | 1.002 | 0.993 | 0.650 | 0.083 | 7.823 | 0.366 | 62.205 | 0.990 | 0.985 | 0.522 | 0.066 | 7.908 | 0.828 | 49.842 | 1.011 | 1.016 | 0.352 | 0.046 | 7.687 | 1.416 | 34.117 |
| 2FE | 1.032 | 1.029 | 0.379 | 0.036 | 10.645 | 2.056 | 30.162 | 1.012 | 0.997 | 0.319 | 0.029 | 10.821 | 1.285 | 25.172 | 0.998 | 0.994 | 0.245 | 0.023 | 10.600 | 0.022 | 19.698 | 1.002 | 1.004 | 0.173 | 0.017 | 10.339 | 0.559 | 14.176 |
| CCE | 1.016 | 1.017 | 0.300 | 0.033 | 9.077 | 0.476 | 20.732 | 1.019 | 1.003 | 0.256 | 0.028 | 9.179 | 1.979 | 17.500 | 0.999 | 0.996 | 0.193 | 0.022 | 8.795 | 0.105 | 13.421 | 0.998 | 0.998 | 0.147 | 0.016 | 9.301 | 0.197 | 10.325 |
| FD | 1.022 | 1.018 | 0.270 | 0.038 | 7.180 | 1.056 | 15.363 | 1.007 | 1.007 | 0.225 | 0.031 | 7.274 | 0.820 | 12.618 | 1.001 | 1.001 | 0.170 | 0.024 | 7.114 | 0.346 | 9.923 | 1.000 | 1.002 | 0.125 | 0.017 | 7.344 | 0.399 | 7.200 |
| FE(inf) | 1.024 | 1.020 | 0.323 | 0.032 | 10.115 | 1.267 | 23.242 | 1.008 | 1.005 | 0.271 | 0.027 | 10.102 | 0.922 | 19.670 | 1.005 | 0.999 | 0.207 | 0.021 | 9.834 | 0.675 | 15.800 | 0.999 | 1.004 | 0.152 | 0.015 | 10.023 | 0.286 | 11.139 |
| CMG | 1.013 | 1.021 | 0.221 | 0.215 | 1.029 | 0.187 | 4.651 | 1.001 | 0.998 | 0.184 | 0.179 | 1.029 | 0.175 | 3.296 | 0.997 | 1.000 | 0.141 | 0.140 | 1.008 | 0.073 | 2.582 | 0.996 | 0.998 | 0.103 | 0.100 | 1.024 | 0.028 | 1.867 |
| AMG(i) | 1.014 | 1.024 | 0.220 | 0.222 | 0.990 | 0.309 | 3.408 | 1.001 | 1.003 | 0.183 | 0.183 | 0.999 | 0.227 | 2.779 | 1.000 | 0.999 | 0.140 | 0.142 | 0.986 | 0.199 | 2.101 | 0.996 | 0.998 | 0.102 | 0.101 | 1.017 | 0.032 | 1.490 |
| AMG(ii) | 1.013 | 1.024 | 0.219 | 0.222 | 0.988 | 0.214 | 3.160 | 0.999 | 1.000 | 0.183 | 0.183 | 1.001 | 0.053 | 2.486 | 0.999 | 0.999 | 0.140 | 0.141 | 0.991 | 0.086 | 1.959 | 0.996 | 0.999 | 0.102 | 0.101 | 1.018 | 0.001 | 1.404 |
| MG | 1.058 | 1.067 | 0.231 | 0.228 | 1.015 | 4.709 | 9.850 | 1.046 | 1.053 | 0.198 | 0.189 | 1.047 | 4.694 | 8.799 | 1.039 | 1.039 | 0.152 | 0.146 | 1.044 | 4.053 | 7.648 | 1.040 | 1.039 | 0.116 | 0.104 | 1.120 | 4.315 | 7.278 |
| MG(inf) | 1.011 | 1.020 | 0.218 | 0.221 | 0.987 | 0.025 | 1.724 | 0.999 | 0.998 | 0.181 | 0.182 | 0.998 | 0.009 | 1.402 | 0.998 | 1.000 | 0.139 | 0.140 | 0.991 | 0.012 | 1.074 | 0.996 | 0.999 | 0.102 | 0.100 | 1.022 | 0.003 | 0.724 |

| $T = 100$ | $N = 20$ | | | | | | | $N = 30$ | | | | | | | $N = 50$ | | | | | | | $N = 100$ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
| POLS | 1.024 | 1.003 | 0.686 | 0.060 | 11.491 | 2.280 | 64.718 | 1.044 | 1.050 | 0.550 | 0.048 | 11.482 | 4.026 | 51.675 | 1.006 | 1.021 | 0.444 | 0.038 | 11.728 | 0.407 | 41.127 | 1.014 | 1.015 | 0.297 | 0.026 | 11.262 | 0.945 | 28.383 |
| 2FE | 1.022 | 1.020 | 0.394 | 0.025 | 15.882 | 2.009 | 32.396 | 1.020 | 1.019 | 0.328 | 0.021 | 15.528 | 1.632 | 27.197 | 1.009 | 1.010 | 0.260 | 0.016 | 15.998 | 0.695 | 21.269 | 1.011 | 1.014 | 0.180 | 0.012 | 15.345 | 0.656 | 15.247 |
| CCE | 1.007 | 0.999 | 0.320 | 0.023 | 14.210 | 0.497 | 24.276 | 1.016 | 1.005 | 0.265 | 0.019 | 13.972 | 1.250 | 20.127 | 1.003 | 1.006 | 0.212 | 0.015 | 14.238 | 0.131 | 16.126 | 1.001 | 1.001 | 0.157 | 0.011 | 14.735 | 0.311 | 11.298 |
| FD | 1.007 | 1.005 | 0.272 | 0.027 | 10.225 | 0.549 | 15.831 | 1.013 | 1.008 | 0.220 | 0.022 | 9.997 | 0.922 | 13.270 | 1.002 | 0.999 | 0.175 | 0.017 | 10.293 | 0.020 | 9.975 | 1.005 | 1.005 | 0.125 | 0.012 | 10.402 | 0.038 | 7.192 |
| FE(inf) | 1.011 | 1.002 | 0.335 | 0.022 | 15.540 | 0.923 | 25.783 | 1.014 | 1.019 | 0.281 | 0.018 | 15.382 | 1.033 | 22.498 | 0.991 | 0.992 | 0.223 | 0.014 | 15.572 | 1.107 | 17.345 | 1.005 | 0.999 | 0.158 | 0.010 | 15.428 | 0.017 | 12.339 |
| CCEMG | 1.002 | 1.005 | 0.229 | 0.217 | 1.054 | 0.076 | 5.315 | 1.004 | 1.005 | 0.179 | 0.181 | 0.990 | 0.034 | 4.066 | 1.004 | 1.006 | 0.146 | 0.142 | 1.032 | 0.209 | 3.218 | 1.004 | 1.006 | 0.107 | 0.100 | 1.062 | 0.050 | 2.108 |
| AMG(i) | 1.006 | 1.005 | 0.226 | 0.224 | 1.011 | 0.475 | 3.722 | 1.006 | 1.006 | 0.176 | 0.183 | 0.961 | 0.161 | 2.839 | 1.005 | 1.005 | 0.146 | 0.143 | 1.022 | 0.269 | 2.422 | 1.004 | 1.004 | 0.105 | 0.100 | 1.048 | 0.020 | 1.647 |
| AMG(ii) | 1.004 | 1.004 | 0.225 | 0.223 | 1.011 | 0.293 | 3.427 | 1.005 | 1.009 | 0.176 | 0.183 | 0.961 | 0.106 | 2.635 | 1.003 | 1.002 | 0.144 | 0.142 | 1.014 | 0.132 | 2.253 | 1.004 | 1.006 | 0.105 | 0.100 | 1.047 | 0.007 | 1.494 |
| MG | 1.056 | 1.055 | 0.239 | 0.231 | 1.031 | 5.467 | 10.631 | 1.054 | 1.059 | 0.190 | 0.190 | 0.998 | 4.977 | 9.438 | 1.046 | 1.046 | 0.161 | 0.148 | 1.090 | 4.397 | 8.548 | 1.050 | 1.053 | 0.120 | 0.104 | 1.149 | 4.550 | 7.813 |
| MG(inf) | 1.001 | 1.005 | 0.222 | 0.221 | 1.004 | 0.012 | 1.069 | 1.004 | 1.010 | 0.175 | 0.181 | 0.968 | 0.019 | 0.851 | 1.002 | 0.998 | 0.142 | 0.141 | 1.012 | 0.008 | 0.643 | 1.004 | 1.005 | 0.104 | 0.099 | 1.048 | 0.014 | 0.456 |

**Notes**: DGP slope $\beta_i \sim N(1,1)$, persistence in $x$ variable $\rho = 0.25$, factor loadings in $y$ are $\lambda^y_{i1} \sim N(0.5, 0.1)$ and $\lambda^y_{i2} \sim N(0.75, 0.1)$, in $x$ $\lambda^x_{i1} \sim N(0.5, 2)$ and $\lambda^x_{i3} \sim N(0.75, 2)$. Factors nonstationary with a drift $\{1.5\%, 1.2\%, 1\}$ for $f_1t$, $f_2t$, $f_3t$ respectively, overlap between $x$ and $y$ equation in the form of factor #1. Error and deterministic terms as in Kapetanios et al. (2011). 1,000 replications; year dummies in the POLS or FE estimation equations; heterogeneous $\beta_i$ in all models.

## Table D-4: Bond and Eberhardt (2013) — Robustness Check (d) high variation in factor loadings in $y$

| $T=20$ | $N=20$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=30$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=50$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=100$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLS | 1.016 | 1.018 | 0.812 | 0.177 | 4.585 | 1.420 | 80.580 | 1.011 | 1.015 | 0.672 | 0.143 | 4.714 | 0.945 | 66.968 | 0.980 | 0.997 | 0.514 | 0.114 | 4.516 | 1.996 | 51.468 | 0.998 | 0.997 | 0.334 | 0.076 | 4.425 | 0.271 | 33.421 |
| 2FE | 1.073 | 1.055 | 0.477 | 0.166 | 2.865 | 7.117 | 47.658 | 1.051 | 1.042 | 0.383 | 0.136 | 2.810 | 4.923 | 38.317 | 1.053 | 1.037 | 0.300 | 0.106 | 2.835 | 5.313 | 30.269 | 1.013 | 1.014 | 0.201 | 0.074 | 2.704 | 1.299 | 20.012 |
| CCE | 1.010 | 1.008 | 0.133 | 0.078 | 1.695 | 0.814 | 12.017 | 1.003 | 1.008 | 0.103 | 0.063 | 1.628 | 0.155 | 9.258 | 0.999 | 0.999 | 0.079 | 0.048 | 1.645 | 0.085 | 7.300 | 0.996 | 0.998 | 0.059 | 0.034 | 1.727 | 0.412 | 5.419 |
| FD | 1.005 | 1.006 | 0.110 | 0.080 | 1.377 | 0.288 | 9.369 | 1.009 | 1.010 | 0.091 | 0.064 | 1.417 | 0.699 | 7.907 | 1.002 | 1.003 | 0.068 | 0.050 | 1.362 | 0.130 | 6.026 | 1.002 | 1.004 | 0.050 | 0.035 | 1.440 | 0.121 | 4.389 |
| FE(inf) | 1.001 | 1.004 | 0.069 | 0.036 | 1.917 | 0.111 | 4.107 | 1.002 | 1.003 | 0.058 | 0.029 | 1.980 | 0.010 | 3.730 | 1.000 | 0.998 | 0.044 | 0.023 | 1.922 | 0.071 | 2.758 | 1.000 | 0.999 | 0.031 | 0.016 | 1.954 | 0.069 | 1.992 |
| CMG | 1.009 | 1.005 | 0.132 | 0.119 | 1.108 | 0.767 | 11.883 | 1.004 | 1.009 | 0.102 | 0.100 | 1.023 | 0.225 | 9.208 | 0.999 | 1.000 | 0.078 | 0.077 | 1.018 | 0.128 | 7.248 | 0.998 | 1.000 | 0.059 | 0.055 | 1.079 | 0.278 | 5.464 |
| AMG(i) | 1.014 | 1.014 | 0.133 | 0.144 | 0.925 | 1.224 | 12.110 | 1.011 | 1.012 | 0.109 | 0.122 | 0.893 | 0.955 | 9.863 | 1.003 | 1.004 | 0.084 | 0.094 | 0.897 | 0.279 | 7.805 | 1.003 | 1.003 | 0.062 | 0.067 | 0.932 | 0.227 | 5.722 |
| AMG(ii) | 1.022 | 1.018 | 0.124 | 0.139 | 0.890 | 2.072 | 11.016 | 1.015 | 1.013 | 0.097 | 0.114 | 0.850 | 1.353 | 8.644 | 1.007 | 1.009 | 0.072 | 0.087 | 0.828 | 0.708 | 6.540 | 1.003 | 1.006 | 0.054 | 0.061 | 0.893 | 0.223 | 4.902 |
| MG | 1.112 | 1.097 | 0.219 | 0.148 | 1.474 | 10.989 | 23.903 | 1.133 | 1.120 | 0.218 | 0.126 | 1.733 | 13.100 | 24.972 | 1.106 | 1.093 | 0.175 | 0.096 | 1.813 | 10.570 | 20.214 | 1.121 | 1.111 | 0.174 | 0.069 | 2.527 | 12.057 | 21.105 |
| MG(inf) | 1.002 | 1.001 | 0.066 | 0.067 | 0.990 | 0.026 | 3.680 | 1.002 | 1.003 | 0.055 | 0.055 | 0.997 | 0.015 | 3.165 | 0.999 | 0.999 | 0.041 | 0.043 | 0.967 | 0.084 | 2.365 | 1.000 | 1.001 | 0.030 | 0.030 | 0.995 | 0.011 | 1.762 |

| $T=30$ | $N=20$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=30$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=50$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=100$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLS | 1.054 | 1.045 | 0.868 | 0.149 | 5.842 | 5.339 | 86.585 | 1.019 | 1.028 | 0.668 | 0.120 | 5.573 | 1.781 | 66.564 | 0.991 | 0.979 | 0.524 | 0.096 | 5.456 | 0.937 | 52.305 | 1.003 | 1.006 | 0.348 | 0.063 | 5.509 | 0.328 | 34.857 |
| 2FE | 1.080 | 1.077 | 0.624 | 0.158 | 3.947 | 7.957 | 62.414 | 1.072 | 1.059 | 0.504 | 0.130 | 3.881 | 7.125 | 50.337 | 1.077 | 1.059 | 0.394 | 0.100 | 3.939 | 7.724 | 39.964 | 1.015 | 1.011 | 0.266 | 0.070 | 3.792 | 1.478 | 26.535 |
| CCE | 1.008 | 1.008 | 0.136 | 0.068 | 1.998 | 0.722 | 12.638 | 1.002 | 1.002 | 0.109 | 0.054 | 2.003 | 0.112 | 9.845 | 1.000 | 1.000 | 0.085 | 0.042 | 2.049 | 0.033 | 7.864 | 1.001 | 1.001 | 0.061 | 0.030 | 2.075 | 0.077 | 5.614 |
| FD | 1.006 | 1.008 | 0.101 | 0.065 | 1.562 | 0.564 | 8.473 | 1.008 | 1.008 | 0.080 | 0.053 | 1.521 | 0.742 | 6.699 | 1.003 | 1.005 | 0.061 | 0.041 | 1.500 | 0.341 | 5.099 | 1.000 | 0.999 | 0.043 | 0.029 | 1.517 | 0.044 | 3.643 |
| FE(inf) | 1.003 | 1.004 | 0.067 | 0.027 | 2.489 | 0.204 | 3.838 | 1.002 | 1.004 | 0.053 | 0.022 | 2.456 | 0.137 | 3.006 | 1.001 | 1.001 | 0.040 | 0.017 | 2.373 | 0.088 | 2.293 | 0.999 | 0.999 | 0.030 | 0.012 | 2.499 | 0.055 | 1.675 |
| CMG | 1.007 | 1.007 | 0.130 | 0.123 | 1.060 | 0.579 | 11.981 | 1.003 | 1.002 | 0.106 | 0.099 | 1.071 | 0.167 | 9.458 | 0.999 | 1.001 | 0.083 | 0.078 | 1.056 | 0.068 | 7.567 | 1.001 | 1.002 | 0.058 | 0.057 | 1.027 | 0.062 | 5.262 |
| AMG(i) | 1.012 | 1.010 | 0.128 | 0.153 | 0.833 | 1.080 | 11.634 | 1.010 | 1.011 | 0.100 | 0.126 | 0.793 | 0.914 | 8.984 | 1.002 | 1.002 | 0.079 | 0.099 | 0.794 | 0.226 | 7.161 | 1.001 | 1.000 | 0.057 | 0.070 | 0.812 | 0.105 | 5.102 |
| AMG(ii) | 1.016 | 1.014 | 0.117 | 0.150 | 0.778 | 1.540 | 10.409 | 1.012 | 1.012 | 0.090 | 0.116 | 0.775 | 1.090 | 7.855 | 1.006 | 1.006 | 0.069 | 0.092 | 0.757 | 0.572 | 6.071 | 1.002 | 1.003 | 0.050 | 0.065 | 0.772 | 0.235 | 4.404 |
| MG | 1.133 | 1.113 | 0.245 | 0.157 | 1.560 | 13.222 | 27.156 | 1.155 | 1.137 | 0.228 | 0.129 | 1.759 | 15.391 | 27.020 | 1.118 | 1.098 | 0.201 | 0.102 | 1.973 | 11.773 | 23.257 | 1.137 | 1.122 | 0.196 | 0.072 | 2.703 | 13.688 | 23.833 |
| MG(inf) | 1.002 | 1.002 | 0.063 | 0.062 | 1.019 | 0.152 | 2.927 | 1.002 | 1.003 | 0.050 | 0.051 | 0.991 | 0.065 | 2.270 | 1.000 | 1.000 | 0.038 | 0.039 | 0.968 | 0.010 | 1.740 | 1.000 | 1.000 | 0.027 | 0.028 | 0.985 | 0.049 | 1.225 |

| $T=50$ | $N=20$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=30$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=50$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=100$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLS | 1.049 | 1.031 | 0.912 | 0.120 | 7.568 | 4.664 | 91.001 | 1.025 | 1.040 | 0.713 | 0.097 | 7.361 | 2.512 | 71.114 | 0.999 | 0.987 | 0.553 | 0.078 | 7.112 | 0.065 | 55.236 | 1.001 | 0.990 | 0.359 | 0.051 | 6.983 | 0.153 | 35.902 |
| 2FE | 1.126 | 1.150 | 0.823 | 0.141 | 5.831 | 12.372 | 82.706 | 1.090 | 1.060 | 0.683 | 0.114 | 5.977 | 9.010 | 68.633 | 1.088 | 1.082 | 0.513 | 0.088 | 5.809 | 8.857 | 52.091 | 1.021 | 1.026 | 0.342 | 0.062 | 5.536 | 2.147 | 34.154 |
| CCE | 1.009 | 1.002 | 0.165 | 0.058 | 2.852 | 0.611 | 15.609 | 1.004 | 0.997 | 0.126 | 0.047 | 2.716 | 0.412 | 11.943 | 1.000 | 1.001 | 0.097 | 0.035 | 2.747 | 0.043 | 9.110 | 0.998 | 0.998 | 0.073 | 0.025 | 2.888 | 0.110 | 6.827 |
| FD | 1.009 | 1.003 | 0.093 | 0.050 | 1.838 | 0.614 | 6.982 | 1.003 | 1.000 | 0.071 | 0.041 | 1.743 | 0.292 | 5.396 | 1.005 | 1.005 | 0.054 | 0.032 | 1.708 | 0.554 | 4.274 | 1.000 | 0.999 | 0.041 | 0.022 | 1.845 | 0.096 | 3.120 |
| FE(inf) | 1.004 | 1.005 | 0.063 | 0.018 | 3.460 | 0.100 | 3.137 | 1.000 | 1.001 | 0.052 | 0.015 | 3.466 | 0.002 | 2.493 | 0.999 | 0.999 | 0.040 | 0.012 | 3.413 | 0.020 | 2.024 | 0.999 | 0.998 | 0.030 | 0.008 | 3.597 | 0.029 | 1.427 |
| CMG | 1.007 | 1.003 | 0.149 | 0.135 | 1.108 | 0.417 | 13.915 | 1.002 | 0.998 | 0.117 | 0.112 | 1.045 | 0.251 | 10.893 | 0.998 | 1.003 | 0.092 | 0.087 | 1.057 | 0.114 | 8.483 | 0.998 | 0.997 | 0.068 | 0.063 | 1.067 | 0.155 | 6.295 |
| AMG(i) | 1.015 | 1.012 | 0.137 | 0.171 | 0.801 | 1.215 | 12.211 | 1.007 | 1.004 | 0.105 | 0.140 | 0.748 | 0.718 | 9.397 | 1.008 | 1.008 | 0.078 | 0.108 | 0.728 | 0.823 | 7.042 | 1.000 | 0.999 | 0.058 | 0.077 | 0.754 | 0.072 | 5.311 |
| AMG(ii) | 1.015 | 1.014 | 0.115 | 0.161 | 0.719 | 1.184 | 9.964 | 1.008 | 1.005 | 0.089 | 0.126 | 0.705 | 0.789 | 7.573 | 1.008 | 1.010 | 0.069 | 0.097 | 0.710 | 0.886 | 5.995 | 1.000 | 0.999 | 0.050 | 0.069 | 0.724 | 0.131 | 4.432 |
| MG | 1.175 | 1.163 | 0.283 | 0.175 | 1.615 | 17.226 | 32.607 | 1.181 | 1.171 | 0.261 | 0.144 | 1.816 | 18.131 | 31.332 | 1.152 | 1.145 | 0.227 | 0.110 | 2.061 | 15.254 | 27.212 | 1.162 | 1.149 | 0.231 | 0.079 | 2.922 | 16.312 | 28.270 |
| MG(inf) | 1.003 | 1.005 | 0.057 | 0.058 | 0.987 | 0.051 | 1.917 | 0.999 | 1.001 | 0.048 | 0.048 | 1.007 | 0.032 | 1.532 | 0.999 | 0.999 | 0.037 | 0.037 | 0.990 | 0.033 | 1.170 | 0.999 | 0.999 | 0.027 | 0.026 | 1.017 | 0.032 | 0.820 |

| $T=100$ | $N=20$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=30$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=50$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=100$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLS | 1.075 | 1.094 | 1.004 | 0.094 | 10.727 | 7.455 | 100.371 | 1.057 | 1.048 | 0.782 | 0.076 | 10.331 | 5.553 | 78.239 | 1.035 | 1.011 | 0.600 | 0.060 | 9.989 | 3.460 | 59.764 | 1.021 | 1.009 | 0.388 | 0.040 | 9.712 | 1.964 | 38.851 |
| 2FE | 1.150 | 1.146 | 1.047 | 0.108 | 9.650 | 14.932 | 105.566 | 1.134 | 1.103 | 0.848 | 0.088 | 9.675 | 13.252 | 85.641 | 1.124 | 1.113 | 0.627 | 0.068 | 9.227 | 12.336 | 63.529 | 1.026 | 1.024 | 0.439 | 0.047 | 9.265 | 2.533 | 43.990 |
| CCE | 1.004 | 0.996 | 0.233 | 0.049 | 4.759 | 0.381 | 22.511 | 1.002 | 1.001 | 0.182 | 0.039 | 4.653 | 0.124 | 17.923 | 1.005 | 1.007 | 0.157 | 0.030 | 5.162 | 0.409 | 15.052 | 1.000 | 0.998 | 0.098 | 0.021 | 4.586 | 0.100 | 9.357 |
| FD | 1.005 | 1.003 | 0.080 | 0.036 | 2.236 | 0.456 | 5.988 | 1.005 | 1.005 | 0.064 | 0.029 | 2.215 | 0.429 | 4.842 | 1.007 | 1.006 | 0.053 | 0.022 | 2.368 | 0.660 | 3.715 | 1.001 | 1.000 | 0.036 | 0.016 | 2.306 | 0.022 | 2.577 |
| FE(inf) | 1.000 | 1.001 | 0.062 | 0.011 | 5.600 | 0.047 | 3.039 | 1.001 | 1.002 | 0.051 | 0.009 | 5.641 | 0.008 | 2.631 | 1.000 | 0.999 | 0.041 | 0.007 | 5.974 | 0.028 | 2.068 | 1.001 | 1.002 | 0.029 | 0.005 | 5.913 | 0.001 | 1.457 |
| CMG | 1.008 | 0.998 | 0.203 | 0.182 | 1.121 | 0.719 | 19.503 | 1.000 | 1.002 | 0.157 | 0.147 | 1.073 | 0.058 | 15.456 | 1.004 | 1.006 | 0.136 | 0.118 | 1.151 | 0.389 | 12.856 | 1.001 | 1.004 | 0.087 | 0.084 | 1.033 | 0.030 | 8.245 |
| AMG(i) | 1.010 | 1.006 | 0.136 | 0.201 | 0.679 | 0.962 | 12.464 | 1.008 | 1.007 | 0.105 | 0.163 | 0.647 | 0.709 | 9.811 | 1.012 | 1.009 | 0.092 | 0.129 | 0.716 | 1.104 | 8.373 | 1.004 | 1.004 | 0.064 | 0.092 | 0.695 | 0.319 | 5.797 |
| AMG(ii) | 1.009 | 1.006 | 0.117 | 0.184 | 0.635 | 0.813 | 10.283 | 1.008 | 1.010 | 0.092 | 0.145 | 0.630 | 0.735 | 8.407 | 1.008 | 1.008 | 0.081 | 0.115 | 0.705 | 0.705 | 6.955 | 1.002 | 1.002 | 0.055 | 0.081 | 0.677 | 0.125 | 4.761 |
| MG | 1.206 | 1.193 | 0.327 | 0.205 | 1.599 | 20.516 | 38.260 | 1.209 | 1.194 | 0.308 | 0.167 | 1.840 | 20.768 | 36.885 | 1.185 | 1.168 | 0.283 | 0.132 | 2.149 | 18.486 | 33.537 | 1.196 | 1.186 | 0.273 | 0.095 | 2.886 | 19.505 | 33.516 |
| MG(inf) | 1.000 | 1.002 | 0.056 | 0.056 | 0.994 | 0.023 | 1.121 | 1.001 | 1.002 | 0.045 | 0.046 | 0.970 | 0.020 | 0.912 | 1.001 | 1.000 | 0.036 | 0.036 | 1.007 | 0.002 | 0.697 | 1.001 | 1.002 | 0.026 | 0.025 | 1.043 | 0.021 | 0.484 |

**Notes**: DGP slope $\beta_i \sim N(1,1)$, persistence in $x$ variable $\rho = 0.25$, factor loadings in $y$ are $\lambda^y_{i1} \sim N(0.5,2)$ and $\lambda^y_{i2} \sim N(0.75,2)$, in $x$ $\lambda^x_{i1} \sim N(0.5,0.1)$ and $\lambda^x_{i3} \sim N(0.75,0.1)$. Factors nonstationary with a drift $\{1.5\%, 1.2\%, 1\}$ for $f_1t$, $f_2t$, $f_3t$ respectively, overlap between $x$ and $y$ equation in the form of factor #1. Error and deterministic terms as in Kapetanios et al. (2011). 1,000 replications; year dummies in the POLS or FE estimation equations; heterogeneous $\beta_i$ in all models.

Table D-5: Bond and Eberhardt (2013) — Robustness Check (e) extreme slope heterogeneity ($\beta$)

| $T=20$ | $N=20$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=30$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=50$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=100$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLS | 0.974 | 0.981 | 1.969 | 0.400 | 4.926 | 4.051 | 190.264 | 1.013 | 0.941 | 1.477 | 0.312 | 4.739 | 0.244 | 144.569 | 1.035 | 1.030 | 1.202 | 0.249 | 4.829 | 3.288 | 116.867 | 1.022 | 1.000 | 0.792 | 0.171 | 4.632 | 1.913 | 77.535 |
| 2FE | 1.045 | 1.070 | 0.724 | 0.116 | 6.232 | 3.048 | 56.425 | 1.029 | 1.021 | 0.600 | 0.098 | 6.143 | 1.383 | 48.426 | 1.029 | 1.010 | 0.455 | 0.075 | 6.041 | 2.684 | 36.489 | 1.011 | 1.024 | 0.323 | 0.054 | 5.988 | 0.847 | 25.828 |
| CCE | 1.028 | 1.017 | 0.571 | 0.110 | 5.182 | 1.362 | 36.237 | 1.033 | 1.051 | 0.469 | 0.092 | 5.119 | 1.788 | 31.442 | 1.019 | 1.017 | 0.368 | 0.072 | 5.128 | 1.652 | 24.539 | 0.999 | 0.985 | 0.267 | 0.051 | 5.236 | 0.364 | 17.528 |
| FD | 1.015 | 1.001 | 0.548 | 0.112 | 4.903 | 0.131 | 33.048 | 1.027 | 1.043 | 0.456 | 0.092 | 4.940 | 1.160 | 28.478 | 1.015 | 1.005 | 0.345 | 0.071 | 4.848 | 1.269 | 21.036 | 1.004 | 0.999 | 0.250 | 0.050 | 4.962 | 0.102 | 15.269 |
| FE(inf) | 1.017 | 1.045 | 0.608 | 0.104 | 5.843 | 0.236 | 42.964 | 1.026 | 1.048 | 0.501 | 0.087 | 5.763 | 1.105 | 35.584 | 1.012 | 0.996 | 0.390 | 0.068 | 5.719 | 0.906 | 28.256 | 1.004 | 1.005 | 0.279 | 0.049 | 5.712 | 0.055 | 19.816 |
| CMG | 1.020 | 1.031 | 0.452 | 0.440 | 1.028 | 0.582 | 10.217 | 1.025 | 1.029 | 0.369 | 0.364 | 1.013 | 0.912 | 8.093 | 1.002 | 1.001 | 0.276 | 0.284 | 0.972 | 0.008 | 6.637 | 1.001 | 1.004 | 0.205 | 0.202 | 1.013 | 0.161 | 4.451 |
| AMG(i) | 1.023 | 1.040 | 0.452 | 0.453 | 0.999 | 0.852 | 8.751 | 1.025 | 1.026 | 0.368 | 0.371 | 0.993 | 0.949 | 7.190 | 1.008 | 1.006 | 0.275 | 0.286 | 0.961 | 0.576 | 5.730 | 1.004 | 1.005 | 0.204 | 0.203 | 1.005 | 0.138 | 3.988 |
| AMG(ii) | 1.021 | 1.036 | 0.451 | 0.452 | 0.997 | 0.641 | 8.326 | 1.019 | 1.023 | 0.367 | 0.370 | 0.990 | 0.388 | 6.744 | 1.005 | 1.002 | 0.274 | 0.286 | 0.958 | 0.270 | 5.547 | 1.005 | 1.004 | 0.204 | 0.203 | 1.006 | 0.188 | 3.691 |
| MG | 1.053 | 1.065 | 0.458 | 0.454 | 1.007 | 3.919 | 11.290 | 1.065 | 1.061 | 0.376 | 0.373 | 1.007 | 4.935 | 10.861 | 1.040 | 1.030 | 0.280 | 0.288 | 0.974 | 3.753 | 8.512 | 1.043 | 1.039 | 0.211 | 0.204 | 1.034 | 4.043 | 7.843 |
| MG(inf) | 1.013 | 1.030 | 0.442 | 0.446 | 0.992 | 0.078 | 3.304 | 1.016 | 1.009 | 0.362 | 0.365 | 0.991 | 0.058 | 2.863 | 1.002 | 0.993 | 0.271 | 0.282 | 0.961 | 0.038 | 2.086 | 1.003 | 1.004 | 0.201 | 0.200 | 1.008 | 0.022 | 1.539 |

| $T=30$ | $N=20$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=30$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=50$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=100$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLS | 1.033 | 1.017 | 1.916 | 0.309 | 6.201 | 2.634 | 185.992 | 1.101 | 1.063 | 1.392 | 0.240 | 5.814 | 9.309 | 135.998 | 1.036 | 1.075 | 1.140 | 0.192 | 5.947 | 3.709 | 110.260 | 1.017 | 1.035 | 0.809 | 0.132 | 6.133 | 1.678 | 78.394 |
| 2FE | 1.014 | 1.036 | 0.756 | 0.096 | 7.882 | 0.708 | 59.792 | 1.038 | 1.032 | 0.617 | 0.079 | 7.843 | 2.924 | 50.663 | 1.035 | 1.035 | 0.478 | 0.062 | 7.760 | 3.559 | 39.515 | 1.007 | 1.002 | 0.348 | 0.044 | 7.840 | 0.683 | 28.047 |
| CCE | 1.026 | 1.039 | 0.592 | 0.087 | 6.771 | 1.888 | 38.298 | 1.044 | 1.053 | 0.471 | 0.072 | 6.557 | 3.524 | 32.494 | 1.017 | 1.025 | 0.365 | 0.056 | 6.463 | 1.777 | 25.005 | 0.998 | 1.004 | 0.268 | 0.041 | 6.579 | 0.271 | 18.392 |
| FD | 1.013 | 1.023 | 0.559 | 0.092 | 6.090 | 0.654 | 32.208 | 1.034 | 1.049 | 0.436 | 0.075 | 5.840 | 2.565 | 27.769 | 1.024 | 1.020 | 0.339 | 0.058 | 5.849 | 2.431 | 20.758 | 1.001 | 1.009 | 0.247 | 0.041 | 5.972 | 0.052 | 15.182 |
| FE(inf) | 1.012 | 1.032 | 0.622 | 0.083 | 7.520 | 0.502 | 45.707 | 1.044 | 1.047 | 0.511 | 0.068 | 7.472 | 3.604 | 38.785 | 1.023 | 1.024 | 0.389 | 0.054 | 7.257 | 2.385 | 29.566 | 0.994 | 1.000 | 0.295 | 0.039 | 7.632 | 0.686 | 21.725 |
| CMG | 1.007 | 0.999 | 0.470 | 0.443 | 1.061 | 0.027 | 11.698 | 1.011 | 1.001 | 0.361 | 0.363 | 0.993 | 0.314 | 8.474 | 1.000 | 1.001 | 0.276 | 0.283 | 0.974 | 0.099 | 6.727 | 1.000 | 0.994 | 0.205 | 0.203 | 1.011 | 0.039 | 4.464 |
| AMG(i) | 1.019 | 1.011 | 0.467 | 0.454 | 1.030 | 1.246 | 9.356 | 1.017 | 1.013 | 0.361 | 0.370 | 0.977 | 0.832 | 7.241 | 1.003 | 1.009 | 0.275 | 0.286 | 0.960 | 0.375 | 5.927 | 1.000 | 1.001 | 0.205 | 0.203 | 1.010 | 0.040 | 4.123 |
| AMG(ii) | 1.018 | 1.006 | 0.467 | 0.454 | 1.029 | 1.127 | 8.810 | 1.013 | 1.006 | 0.358 | 0.370 | 0.969 | 0.486 | 7.027 | 1.002 | 1.007 | 0.275 | 0.286 | 0.963 | 0.292 | 5.633 | 1.001 | 0.997 | 0.204 | 0.203 | 1.002 | 0.029 | 3.881 |
| MG | 1.055 | 1.041 | 0.477 | 0.456 | 1.048 | 4.811 | 12.571 | 1.062 | 1.048 | 0.367 | 0.373 | 0.985 | 5.395 | 11.244 | 1.036 | 1.035 | 0.278 | 0.288 | 0.964 | 3.663 | 9.189 | 1.041 | 1.038 | 0.210 | 0.205 | 1.028 | 4.024 | 8.023 |
| MG(inf) | 1.007 | 1.000 | 0.457 | 0.445 | 1.026 | 0.067 | 2.498 | 1.009 | 1.009 | 0.351 | 0.364 | 0.966 | 0.054 | 2.012 | 1.000 | 1.002 | 0.271 | 0.281 | 0.966 | 0.017 | 1.583 | 1.000 | 0.999 | 0.199 | 0.200 | 0.997 | 0.053 | 1.091 |

| $T=50$ | $N=20$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=30$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=50$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=100$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLS | 1.073 | 1.056 | 1.658 | 0.212 | 7.817 | 5.092 | 160.519 | 1.012 | 1.001 | 1.303 | 0.167 | 7.824 | 1.426 | 124.805 | 0.990 | 0.974 | 1.045 | 0.132 | 7.896 | 0.621 | 99.942 | 1.026 | 1.032 | 0.705 | 0.092 | 7.666 | 3.349 | 68.307 |
| 2FE | 1.072 | 1.082 | 0.774 | 0.074 | 10.454 | 4.992 | 62.054 | 1.030 | 1.010 | 0.647 | 0.061 | 10.602 | 3.260 | 51.412 | 1.003 | 0.991 | 0.496 | 0.048 | 10.348 | 0.728 | 40.157 | 1.005 | 1.005 | 0.349 | 0.034 | 10.142 | 1.231 | 28.839 |
| CCE | 1.039 | 1.044 | 0.603 | 0.065 | 9.315 | 1.728 | 41.719 | 1.038 | 1.011 | 0.512 | 0.054 | 9.418 | 4.058 | 34.959 | 0.997 | 0.986 | 0.386 | 0.043 | 9.056 | 0.107 | 27.086 | 0.997 | 0.997 | 0.295 | 0.031 | 9.616 | 0.433 | 20.752 |
| FD | 1.045 | 1.036 | 0.542 | 0.070 | 7.706 | 2.306 | 30.882 | 1.016 | 1.010 | 0.451 | 0.058 | 7.789 | 1.887 | 25.385 | 1.005 | 1.002 | 0.341 | 0.045 | 7.572 | 0.889 | 19.860 | 1.001 | 1.005 | 0.251 | 0.032 | 7.812 | 0.828 | 14.437 |
| FE(inf) | 1.047 | 1.041 | 0.647 | 0.061 | 10.604 | 2.481 | 46.496 | 1.016 | 0.999 | 0.543 | 0.051 | 10.552 | 1.868 | 39.353 | 1.009 | 0.998 | 0.415 | 0.040 | 10.248 | 1.337 | 31.604 | 0.999 | 1.008 | 0.303 | 0.029 | 10.419 | 0.579 | 22.259 |
| CMG | 1.031 | 1.054 | 0.452 | 0.440 | 1.028 | 0.904 | 12.827 | 1.003 | 0.998 | 0.376 | 0.365 | 1.030 | 0.592 | 9.353 | 0.994 | 0.998 | 0.288 | 0.285 | 1.009 | 0.215 | 7.411 | 0.992 | 0.998 | 0.209 | 0.204 | 1.022 | 0.089 | 5.239 |
| AMG(i) | 1.032 | 1.046 | 0.445 | 0.450 | 0.989 | 0.970 | 9.875 | 1.005 | 1.011 | 0.371 | 0.370 | 1.001 | 0.730 | 8.121 | 1.002 | 0.999 | 0.283 | 0.287 | 0.985 | 0.591 | 6.125 | 0.992 | 0.992 | 0.207 | 0.204 | 1.016 | 0.123 | 4.432 |
| AMG(ii) | 1.029 | 1.049 | 0.443 | 0.449 | 0.986 | 0.731 | 9.260 | 1.000 | 1.007 | 0.371 | 0.369 | 1.003 | 0.247 | 7.375 | 0.999 | 0.999 | 0.284 | 0.286 | 0.993 | 0.296 | 5.752 | 0.993 | 0.993 | 0.207 | 0.203 | 1.018 | 0.021 | 4.188 |
| MG | 1.076 | 1.094 | 0.450 | 0.453 | 0.994 | 5.395 | 14.092 | 1.050 | 1.068 | 0.381 | 0.374 | 1.018 | 5.208 | 12.029 | 1.039 | 1.036 | 0.289 | 0.289 | 1.000 | 4.273 | 9.765 | 1.036 | 1.037 | 0.214 | 0.206 | 1.039 | 4.283 | 8.404 |
| MG(inf) | 1.022 | 1.038 | 0.435 | 0.440 | 0.987 | 0.025 | 1.724 | 0.997 | 0.996 | 0.362 | 0.362 | 0.998 | 0.009 | 1.402 | 0.996 | 0.999 | 0.278 | 0.280 | 0.992 | 0.012 | 1.074 | 0.993 | 0.998 | 0.204 | 0.199 | 1.021 | 0.003 | 0.724 |

| $T=100$ | $N=20$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=30$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=50$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N=100$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLS | 1.055 | 1.030 | 1.381 | 0.120 | 11.498 | 5.203 | 130.324 | 1.096 | 1.097 | 1.107 | 0.096 | 11.486 | 8.828 | 104.014 | 1.022 | 1.044 | 0.894 | 0.076 | 11.740 | 1.732 | 82.830 | 1.032 | 1.031 | 0.596 | 0.053 | 11.252 | 2.294 | 57.082 |
| 2FE | 1.052 | 1.033 | 0.800 | 0.052 | 15.513 | 4.937 | 66.304 | 1.048 | 1.046 | 0.663 | 0.044 | 15.177 | 4.051 | 55.298 | 1.026 | 1.024 | 0.530 | 0.034 | 15.725 | 2.172 | 43.505 | 1.023 | 1.028 | 0.365 | 0.024 | 15.064 | 1.455 | 31.125 |
| CCE | 1.011 | 1.012 | 0.634 | 0.046 | 13.888 | 0.793 | 47.505 | 1.030 | 1.017 | 0.529 | 0.038 | 13.893 | 2.220 | 40.284 | 1.009 | 1.007 | 0.427 | 0.030 | 14.320 | 0.431 | 32.518 | 1.003 | 1.005 | 0.315 | 0.021 | 14.912 | 0.562 | 22.783 |
| FD | 1.017 | 1.012 | 0.545 | 0.050 | 10.966 | 1.363 | 31.835 | 1.029 | 1.015 | 0.440 | 0.041 | 10.652 | 2.073 | 26.584 | 1.007 | 1.001 | 0.351 | 0.032 | 11.002 | 0.281 | 20.006 | 1.010 | 1.011 | 0.251 | 0.023 | 11.090 | 0.120 | 14.498 |
| FE(inf) | 1.021 | 1.004 | 0.671 | 0.042 | 16.018 | 1.834 | 51.528 | 1.029 | 1.044 | 0.562 | 0.036 | 15.791 | 2.059 | 44.977 | 0.982 | 0.982 | 0.447 | 0.028 | 15.971 | 2.221 | 34.695 | 1.009 | 0.996 | 0.317 | 0.020 | 15.796 | 0.036 | 24.670 |
| CMG | 1.006 | 1.011 | 0.473 | 0.450 | 1.052 | 0.277 | 15.513 | 1.006 | 1.009 | 0.367 | 0.373 | 0.983 | 0.215 | 12.259 | 1.009 | 1.004 | 0.302 | 0.292 | 1.033 | 0.519 | 9.758 | 1.008 | 1.010 | 0.219 | 0.207 | 1.060 | 0.102 | 6.415 |
| AMG(i) | 1.019 | 1.012 | 0.462 | 0.455 | 1.014 | 1.576 | 11.528 | 1.013 | 1.020 | 0.357 | 0.373 | 0.955 | 0.505 | 8.741 | 1.013 | 1.015 | 0.298 | 0.290 | 1.027 | 0.854 | 7.448 | 1.008 | 1.010 | 0.214 | 0.205 | 1.046 | 0.039 | 5.101 |
| AMG(ii) | 1.012 | 1.014 | 0.459 | 0.453 | 1.015 | 0.843 | 10.848 | 1.012 | 1.011 | 0.356 | 0.372 | 0.958 | 0.374 | 8.295 | 1.008 | 1.011 | 0.294 | 0.289 | 1.016 | 0.390 | 7.006 | 1.009 | 1.009 | 0.213 | 0.204 | 1.046 | 0.019 | 4.688 |
| MG | 1.069 | 1.063 | 0.467 | 0.459 | 1.018 | 6.562 | 16.037 | 1.062 | 1.067 | 0.363 | 0.377 | 0.964 | 5.371 | 12.945 | 1.053 | 1.054 | 0.306 | 0.293 | 1.045 | 4.850 | 11.143 | 1.055 | 1.059 | 0.220 | 0.207 | 1.063 | 4.590 | 9.137 |
| MG(inf) | 1.003 | 1.008 | 0.444 | 0.441 | 1.005 | 0.012 | 1.069 | 1.008 | 1.018 | 0.351 | 0.362 | 0.968 | 0.019 | 0.851 | 1.004 | 0.997 | 0.285 | 0.281 | 1.012 | 0.008 | 0.643 | 1.009 | 1.011 | 0.208 | 0.198 | 1.047 | 0.014 | 0.456 |

**Notes**: DGP slope $\beta_i \sim N(1,4)$, persistence in $x$ variable $\rho = 0.25$, factor loadings in $y$ are $\lambda^y_{i1} \sim N(0.5,1)$ and $\lambda^y_{i2} \sim N(0.75,1)$, in $x$ $\lambda^x_{i1} \sim N(0.5,2)$ and $\lambda^x_{i3} \sim N(0.75,2)$. Factors nonstationary with a drift $\{1.5\%, 1.2\%, 1\}$ for $f_1t$, $f_2t$, $f_3t$ respectively, overlap between $x$ and $y$ equation in the form of factor #1. Error and deterministic terms as in Kapetanios et al. (2011). 1,000 replications; year dummies in the POLS or FE estimation equations; heterogeneous $\beta_i$ in all models.

Table D-6: Bond and Eberhardt (2013) — Robustness check (f): large factor loading variation on $f_{1t}$

| $T = 20$ | $N = 20$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N = 30$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N = 50$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N = 100$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLS | 0.993 | 0.998 | 1.176 | 0.244 | 4.815 | 1.419 | 114.794 | 1.019 | 1.005 | 0.900 | 0.191 | 4.717 | 1.129 | 88.716 | 1.011 | 1.023 | 0.727 | 0.151 | 4.810 | 0.960 | 71.689 | 1.000 | 1.002 | 0.480 | 0.104 | 4.611 | 0.174 | 47.208 |
| 2FE | 1.036 | 1.035 | 0.415 | 0.079 | 5.238 | 2.897 | 34.983 | 1.021 | 1.016 | 0.344 | 0.066 | 5.223 | 1.376 | 29.763 | 1.031 | 1.015 | 0.269 | 0.051 | 5.319 | 2.936 | 23.240 | 1.007 | 1.013 | 0.188 | 0.036 | 5.211 | 0.566 | 15.919 |
| CCE | 1.020 | 1.028 | 0.304 | 0.070 | 4.327 | 1.329 | 20.566 | 1.013 | 1.022 | 0.246 | 0.058 | 4.220 | 0.512 | 17.053 | 1.011 | 1.002 | 0.190 | 0.045 | 4.194 | 0.970 | 13.466 | 1.001 | 0.998 | 0.138 | 0.032 | 4.268 | 0.024 | 9.342 |
| FD | 1.012 | 1.012 | 0.295 | 0.072 | 4.074 | 0.517 | 19.411 | 1.017 | 1.018 | 0.244 | 0.059 | 4.118 | 0.966 | 16.954 | 1.013 | 1.005 | 0.186 | 0.046 | 4.079 | 1.222 | 12.631 | 1.003 | 1.002 | 0.135 | 0.032 | 4.189 | 0.191 | 9.113 |
| FE(inf) | 1.005 | 1.007 | 0.246 | 0.062 | 3.957 | 0.233 | 11.085 | 1.008 | 1.017 | 0.203 | 0.051 | 3.957 | 0.004 | 9.727 | 1.001 | 0.995 | 0.155 | 0.040 | 3.888 | 0.006 | 7.436 | 0.999 | 1.001 | 0.112 | 0.028 | 3.962 | 0.243 | 5.319 |
| CMG | 1.017 | 1.014 | 0.250 | 0.238 | 1.050 | 1.005 | 11.286 | 1.018 | 1.023 | 0.203 | 0.198 | 1.023 | 1.059 | 9.085 | 1.005 | 1.001 | 0.151 | 0.156 | 0.968 | 0.405 | 7.501 | 1.002 | 1.001 | 0.112 | 0.111 | 1.011 | 0.091 | 5.151 |
| AMG(i) | 1.026 | 1.028 | 0.258 | 0.249 | 1.035 | 1.941 | 12.517 | 1.024 | 1.026 | 0.206 | 0.205 | 1.007 | 1.665 | 10.082 | 1.010 | 1.003 | 0.155 | 0.158 | 0.982 | 0.879 | 8.349 | 1.003 | 1.000 | 0.116 | 0.112 | 1.034 | 0.178 | 5.769 |
| AMG(ii) | 1.023 | 1.030 | 0.261 | 0.250 | 1.045 | 1.560 | 12.528 | 1.020 | 1.022 | 0.205 | 0.204 | 1.006 | 1.218 | 9.852 | 1.010 | 1.002 | 0.156 | 0.158 | 0.987 | 0.873 | 8.262 | 1.003 | 0.998 | 0.115 | 0.111 | 1.036 | 0.148 | 5.538 |
| MG | 1.062 | 1.064 | 0.272 | 0.253 | 1.073 | 5.502 | 16.337 | 1.073 | 1.075 | 0.229 | 0.210 | 1.095 | 6.504 | 15.206 | 1.046 | 1.038 | 0.176 | 0.161 | 1.090 | 4.446 | 12.483 | 1.050 | 1.050 | 0.150 | 0.115 | 1.307 | 4.866 | 12.071 |
| MG(inf) | 1.007 | 1.009 | 0.223 | 0.226 | 0.991 | 0.026 | 3.680 | 1.008 | 1.009 | 0.183 | 0.184 | 0.990 | 0.015 | 3.165 | 1.000 | 0.994 | 0.137 | 0.143 | 0.961 | 0.084 | 2.365 | 1.001 | 1.002 | 0.101 | 0.101 | 1.002 | 0.011 | 1.762 |

| $T = 30$ | $N = 20$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N = 30$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N = 50$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N = 100$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLS | 1.029 | 1.039 | 1.179 | 0.188 | 6.280 | 2.514 | 115.003 | 1.058 | 1.037 | 0.839 | 0.147 | 5.715 | 5.336 | 82.913 | 1.015 | 1.033 | 0.690 | 0.117 | 5.916 | 1.550 | 67.031 | 1.010 | 1.031 | 0.476 | 0.081 | 5.905 | 1.021 | 46.816 |
| 2FE | 1.030 | 1.035 | 0.451 | 0.066 | 6.883 | 2.666 | 38.229 | 1.036 | 1.033 | 0.352 | 0.053 | 6.578 | 3.140 | 30.262 | 1.030 | 1.026 | 0.277 | 0.041 | 6.697 | 3.068 | 24.248 | 1.006 | 1.009 | 0.194 | 0.030 | 6.577 | 0.625 | 16.863 |
| CCE | 1.017 | 1.017 | 0.321 | 0.056 | 5.723 | 1.348 | 22.037 | 1.018 | 1.019 | 0.247 | 0.046 | 5.373 | 1.400 | 17.150 | 1.013 | 1.014 | 0.194 | 0.036 | 5.374 | 1.309 | 14.178 | 1.001 | 1.007 | 0.140 | 0.026 | 5.432 | 0.099 | 9.927 |
| FD | 1.015 | 1.029 | 0.304 | 0.059 | 5.128 | 1.138 | 18.963 | 1.020 | 1.018 | 0.234 | 0.048 | 4.864 | 1.533 | 15.521 | 1.016 | 1.014 | 0.184 | 0.037 | 4.951 | 1.621 | 12.453 | 1.002 | 1.005 | 0.132 | 0.026 | 4.995 | 0.196 | 8.956 |
| FE(inf) | 1.006 | 1.011 | 0.248 | 0.048 | 5.114 | 0.243 | 11.162 | 1.009 | 1.005 | 0.197 | 0.040 | 4.959 | 0.454 | 9.009 | 1.003 | 1.001 | 0.149 | 0.031 | 4.816 | 0.335 | 6.858 | 0.999 | 1.001 | 0.112 | 0.022 | 5.086 | 0.090 | 5.102 |
| CMG | 1.011 | 1.007 | 0.261 | 0.244 | 1.071 | 0.769 | 12.337 | 1.012 | 1.009 | 0.204 | 0.200 | 1.024 | 0.825 | 9.880 | 1.005 | 1.005 | 0.154 | 0.157 | 0.976 | 0.535 | 7.892 | 1.000 | 0.997 | 0.113 | 0.112 | 1.004 | 0.003 | 5.477 |
| AMG(i) | 1.024 | 1.026 | 0.269 | 0.253 | 1.061 | 2.047 | 13.832 | 1.019 | 1.016 | 0.210 | 0.206 | 1.017 | 1.462 | 10.757 | 1.011 | 1.012 | 0.159 | 0.160 | 0.990 | 1.169 | 8.939 | 1.002 | 1.001 | 0.117 | 0.114 | 1.024 | 0.152 | 6.178 |
| AMG(ii) | 1.021 | 1.021 | 0.267 | 0.254 | 1.053 | 1.716 | 13.591 | 1.014 | 1.017 | 0.206 | 0.205 | 1.009 | 1.004 | 10.121 | 1.009 | 1.007 | 0.161 | 0.159 | 1.009 | 0.961 | 8.922 | 1.001 | 0.997 | 0.117 | 0.113 | 1.037 | 0.124 | 6.002 |
| MG | 1.065 | 1.071 | 0.293 | 0.258 | 1.136 | 6.164 | 18.241 | 1.074 | 1.064 | 0.232 | 0.212 | 1.097 | 6.966 | 16.272 | 1.047 | 1.037 | 0.184 | 0.163 | 1.129 | 4.748 | 14.435 | 1.052 | 1.048 | 0.153 | 0.116 | 1.317 | 5.205 | 13.122 |
| MG(inf) | 1.005 | 1.001 | 0.229 | 0.224 | 1.023 | 0.152 | 2.927 | 1.005 | 1.006 | 0.177 | 0.183 | 0.969 | 0.065 | 2.270 | 1.000 | 0.999 | 0.136 | 0.141 | 0.965 | 0.010 | 1.740 | 1.000 | 1.001 | 0.100 | 0.100 | 0.995 | 0.049 | 1.225 |

| $T = 50$ | $N = 20$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N = 30$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N = 50$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N = 100$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLS | 1.066 | 1.071 | 0.997 | 0.130 | 7.646 | 5.534 | 97.683 | 1.031 | 1.035 | 0.795 | 0.102 | 7.771 | 3.271 | 77.503 | 1.001 | 0.999 | 0.636 | 0.081 | 7.842 | 0.255 | 61.668 | 1.012 | 1.028 | 0.423 | 0.056 | 7.498 | 1.586 | 41.507 |
| 2FE | 1.046 | 1.045 | 0.464 | 0.050 | 9.187 | 3.547 | 40.448 | 1.029 | 1.019 | 0.371 | 0.041 | 9.016 | 3.022 | 31.824 | 1.014 | 1.012 | 0.290 | 0.032 | 9.049 | 1.612 | 25.266 | 1.006 | 1.000 | 0.205 | 0.023 | 8.973 | 0.924 | 17.981 |
| CCE | 1.029 | 1.022 | 0.334 | 0.042 | 7.896 | 1.834 | 24.903 | 1.022 | 1.017 | 0.266 | 0.035 | 7.604 | 2.351 | 19.287 | 1.005 | 1.009 | 0.206 | 0.028 | 7.494 | 0.724 | 15.108 | 1.000 | 0.998 | 0.151 | 0.020 | 7.687 | 0.379 | 11.088 |
| FD | 1.023 | 1.026 | 0.296 | 0.046 | 6.488 | 1.240 | 19.202 | 1.013 | 1.002 | 0.237 | 0.037 | 6.381 | 1.374 | 15.044 | 1.006 | 1.005 | 0.183 | 0.029 | 6.348 | 0.835 | 11.853 | 1.001 | 0.998 | 0.134 | 0.020 | 6.578 | 0.454 | 8.759 |
| FE(inf) | 1.013 | 1.017 | 0.246 | 0.035 | 6.989 | 0.217 | 10.850 | 1.000 | 0.999 | 0.201 | 0.029 | 6.877 | 0.120 | 8.664 | 0.998 | 0.998 | 0.154 | 0.023 | 6.768 | 0.018 | 7.057 | 0.996 | 0.994 | 0.115 | 0.016 | 7.052 | 0.016 | 4.987 |
| CMG | 1.025 | 1.025 | 0.261 | 0.250 | 1.044 | 1.420 | 14.436 | 1.012 | 1.010 | 0.215 | 0.207 | 1.042 | 1.292 | 11.190 | 1.003 | 1.003 | 0.162 | 0.162 | 0.998 | 0.471 | 8.772 | 0.996 | 0.995 | 0.117 | 0.116 | 1.012 | 0.013 | 6.027 |
| AMG(i) | 1.035 | 1.037 | 0.266 | 0.257 | 1.038 | 2.422 | 15.123 | 1.014 | 1.013 | 0.219 | 0.211 | 1.038 | 1.480 | 12.103 | 1.012 | 1.009 | 0.169 | 0.164 | 1.029 | 1.362 | 9.713 | 0.998 | 1.001 | 0.122 | 0.117 | 1.042 | 0.136 | 6.828 |
| AMG(ii) | 1.029 | 1.027 | 0.262 | 0.255 | 1.026 | 1.761 | 14.253 | 1.008 | 1.011 | 0.216 | 0.206 | 1.047 | 0.906 | 11.203 | 1.008 | 1.010 | 0.167 | 0.161 | 1.038 | 1.009 | 9.316 | 0.997 | 0.998 | 0.120 | 0.113 | 1.054 | 0.082 | 6.384 |
| MG | 1.086 | 1.094 | 0.287 | 0.263 | 1.090 | 7.504 | 20.736 | 1.069 | 1.072 | 0.249 | 0.217 | 1.143 | 7.041 | 17.938 | 1.051 | 1.051 | 0.200 | 0.168 | 1.194 | 5.309 | 15.758 | 1.050 | 1.045 | 0.166 | 0.120 | 1.390 | 5.331 | 14.392 |
| MG(inf) | 1.011 | 1.021 | 0.218 | 0.221 | 0.986 | 0.051 | 1.917 | 0.998 | 0.996 | 0.182 | 0.182 | 1.000 | 0.032 | 1.532 | 0.998 | 1.000 | 0.139 | 0.140 | 0.993 | 0.033 | 1.170 | 0.996 | 0.998 | 0.102 | 0.100 | 1.019 | 0.032 | 0.820 |

| $T = 100$ | $N = 20$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N = 30$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N = 50$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 | $N = 100$ Mean | Median | emp. ste* | mean ste* | OC ×100 | Bias ×100 | RMSE ×100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POLS | 1.066 | 1.055 | 0.827 | 0.075 | 11.061 | 6.477 | 79.323 | 1.071 | 1.046 | 0.671 | 0.060 | 11.274 | 6.707 | 64.672 | 1.038 | 1.041 | 0.518 | 0.047 | 11.068 | 3.610 | 48.867 | 1.010 | 0.996 | 0.356 | 0.033 | 10.942 | 0.531 | 34.308 |
| 2FE | 1.048 | 1.052 | 0.471 | 0.035 | 13.335 | 4.680 | 41.605 | 1.045 | 1.032 | 0.386 | 0.029 | 13.201 | 4.072 | 34.503 | 1.039 | 1.037 | 0.304 | 0.022 | 13.610 | 3.642 | 26.510 | 1.009 | 1.005 | 0.218 | 0.016 | 13.684 | 0.503 | 19.412 |
| CCE | 1.018 | 1.034 | 0.355 | 0.030 | 11.884 | 1.602 | 28.328 | 1.022 | 1.015 | 0.280 | 0.025 | 11.309 | 1.826 | 22.412 | 1.024 | 1.028 | 0.237 | 0.019 | 12.246 | 2.190 | 18.839 | 1.005 | 1.006 | 0.167 | 0.014 | 12.074 | 0.066 | 12.810 |
| FD | 1.013 | 1.017 | 0.287 | 0.032 | 8.895 | 1.161 | 18.532 | 1.017 | 1.006 | 0.234 | 0.026 | 8.820 | 1.349 | 15.619 | 1.019 | 1.013 | 0.190 | 0.020 | 9.342 | 1.636 | 12.134 | 1.006 | 1.004 | 0.136 | 0.014 | 9.409 | 0.123 | 8.828 |
| FE(inf) | 0.999 | 1.000 | 0.245 | 0.024 | 10.365 | 0.211 | 11.594 | 1.004 | 1.005 | 0.201 | 0.020 | 10.192 | 0.018 | 10.017 | 1.001 | 0.996 | 0.165 | 0.015 | 10.757 | 0.116 | 7.940 | 1.005 | 1.003 | 0.115 | 0.011 | 10.538 | 0.049 | 5.557 |
| CMG | 1.022 | 1.017 | 0.283 | 0.270 | 1.051 | 2.025 | 17.615 | 1.015 | 1.006 | 0.212 | 0.222 | 0.955 | 1.123 | 13.635 | 1.012 | 1.021 | 0.183 | 0.176 | 1.040 | 0.971 | 11.290 | 1.004 | 1.008 | 0.131 | 0.124 | 1.056 | 0.071 | 7.673 |
| AMG(i) | 1.029 | 1.025 | 0.283 | 0.267 | 1.062 | 2.695 | 17.610 | 1.019 | 1.013 | 0.213 | 0.219 | 0.975 | 1.467 | 13.295 | 1.018 | 1.023 | 0.184 | 0.171 | 1.077 | 1.587 | 11.072 | 1.006 | 1.007 | 0.129 | 0.121 | 1.060 | 0.148 | 7.833 |
| AMG(ii) | 1.019 | 1.020 | 0.279 | 0.263 | 1.059 | 1.749 | 16.432 | 1.012 | 1.007 | 0.211 | 0.213 | 0.988 | 0.797 | 12.238 | 1.013 | 1.018 | 0.182 | 0.167 | 1.091 | 1.062 | 10.670 | 1.005 | 1.006 | 0.124 | 0.117 | 1.065 | 0.040 | 6.977 |
| MG | 1.085 | 1.085 | 0.313 | 0.275 | 1.140 | 8.381 | 23.650 | 1.078 | 1.079 | 0.249 | 0.226 | 1.100 | 7.439 | 19.933 | 1.060 | 1.053 | 0.229 | 0.176 | 1.301 | 5.784 | 18.431 | 1.059 | 1.057 | 0.182 | 0.125 | 1.452 | 5.415 | 16.426 |
| MG(inf) | 1.001 | 1.002 | 0.222 | 0.221 | 1.002 | 0.023 | 1.121 | 1.004 | 1.009 | 0.176 | 0.181 | 0.969 | 0.020 | 0.912 | 1.002 | 0.998 | 0.142 | 0.141 | 1.011 | 0.002 | 0.697 | 1.004 | 1.007 | 0.104 | 0.099 | 1.046 | 0.021 | 0.484 |

**Notes**: DGP slope $\beta_i \sim N(4, 1)$, persistence in $x$ variable $\rho = 0.25$, factor loadings in $y$ are $\lambda^y_{i1} \sim N(0.5, 2)$ and $\lambda^y_{i1} \sim N(0.75, 2)$, in $x$ $\lambda^x_{i1} \sim N(0.5, 0.1)$ and $\lambda^x_{i3} \sim N(0.75, 0.1)$. Factors nonstationary with a drift $\{1.5\%, 1.2\%, 1\}$ for $f_1t$, $f_2t$, $f_3t$ respectively, overlap between $x$ and $y$ equation in the form of factor #1. Error and deterministic terms as in Kapetanios et al. (2011). 1,000 replications; year dummies in the POLS or FE estimation equations; heterogeneous $\beta_i$ in all models.

# References


Coakley, J., Fuertes, A.-M., & Smith, R. P. (2006). Unobserved heterogeneity in panel time series models. *Computational Statistics & Data Analysis*, *50*(9), 2361-2380.

Eberhardt, M., & Teal, F. (2013). Structural Change and Cross-Country Growth Empirics. *World Bank Economic Review*, *27*, 229-271.

Eberhardt, M., & Teal, F. (2014). No Mangoes in the Tundra: Spatial Heterogeneity in Agricultural Productivity Analysis. *Oxford Bulletin of Economics and Statistics*, *forthcoming*.

Kapetanios, G., Pesaran, M. H., & Yamagata, T. (2009). *Panels with Nonstationary Multifactor Error Structures* (Tech. Rep.). (Cambridge University, unpublished working paper, June)

Kapetanios, G., Pesaran, M. H., & Yamagata, T. (2011). Panels with Nonstationary Multifactor Error Structures. *Journal of Econometrics*, *160*(2), 326-348.

Pesaran, M. H. (2006). Estimation and inference in large heterogeneous panels with a multifactor error structure. *Econometrica*, *74*(4), 967-1012.

Pesaran, M. H., & Smith, R. P. (1995). Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics*, *68*(1), 79-113.

Phillips, P. C. B., & Moon, H. R. (1999). Linear regression limit theory for nonstationary panel data. *Econometrica*, *67*(5), 1057-1112.