A Supplement to
“Bias Correction and Refined Inferences for Fixed Effects Spatial Panel Data Models”

Zhenlin Yang[a,], Jihai Yu[b], and Shew Fan Liu[a]

[a] *School of Economics, Singapore Management University, 90 Stamford Road, Singapore 178903.*

[b] *Guanghua School of Management, Peking University, Beijing 100871, China.*

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This supplemental material adds the Monte Carlo results unreported in the above paper but necessary in supporting the discussions in the paper. It also presents an empirical application of the proposed methods together with the Matlab codes to facilitate the applied researchers.

1 Additional Monte Carlo Results

Tables 1a, 1b, 2, 3a, 3b, 4, 5a, 5b, 5c, and 6 correspond to the reported results in the paper, except that in Tables 1a, 1b, and 2, the results under $n = 500$ are replaced with the results under $n = 250$. The added results are summarized as follows.

Table 1a-r replicates Case (a) of Table 1a by using the wild bootstrap with perturbation distribution being the simple two-point (1 and -1) distribution with equal probabilities, and Case (b) of Table 1a by using `REG1` instead of `REG2`. These results show that wild bootstrap produces similar results as the iid bootstrap, and that use of iid regressors produces much different results compared with those from the non-iid regressors.

Table 2-r replicates Case (a) Table 2 by (a) changing $\beta = (1\ 1)'$ to $\beta = (.5\ .5)'$, and (b) using the wild bootstrap method with perturbation distribution being the two-pint distribution with unequal probabilities described in Footnote (11) in the paper. From these, we see that reducing SNR in the SED model does not affect much the QMLEs, and the wild bootstrap produces similar results.

Table 3a-r replicates Table 3a by using the wild bootstrap method with perturbation distribution being the two-point (1 and -1) distribution with equal probabilities, and **Table 3a-rr** replicates Table 3a using $\beta = (.5\ .5)'$. The results show that wild bootstrap gives similar results, and that SNR affects mainly the performance of spatial lag estimators.

Table 5a-r replicates Table 5a using the iid bootstrap method. The results show that iid method indeed performs better under normality, and not as good under extreme normality when n is large.

Table 6-r replicates Table 6 under a weaker spatial dependence or iid regressors. The results show that a weaker spatial dependence results in a better performance of the regular test, and that the way the regressors being generated has more significant effect on the performance of the tests for the covariate effects.

Table 6-rr further replicates Table 6 using $\lambda = \rho = 0.25$. The result show that the true values of the spatial parameters do not have noticeable effect.

2 An Empirical Application

The effectiveness of the bias and variance correction methods given in this paper is demonstrated in an empirical setting using the well known Munnell (1990) data set on public capital productivity. The dataset gives indicators related to public capital productivity for 48 US states observed over 17 years (1970-1986).[*,†] In Munnel (1990), the empirical model specifies a Cobb-Douglas production function of the form:

$$\lg(gsp) = \beta_0 + \beta_1 \lg(pcap) + \beta_2 \lg(pc) + \beta_3 \lg(emp) + \beta_4 unemp + \epsilon,$$

with possibly two-way fixed effects, where 'gsp' is the gross social product of a given state, 'pcap', 'pc' and 'emp' are the inputs of public capital, private capital, and labor respectively. In order to capture business cycle effects an additional variable 'unemp' is also added which indicates the state unemployment rate. The model now is extended by adding the spatial effects. The spatial weight matrix (W_n) is specified using a contiguity form where (i, j)th element is indicated as 1 if state i and j share a common border, otherwise 0. The final W_n is row normalised.

Table 7 gives the QML estimates and the second-order bias-corrected QML estimates of the model parameters for the full dataset spanning over the 17 years fitted using the 2FE-SPD model with five different types of spatial specifications: SARAR, SLD, SED, Durbin-SLD and Durbin-SED. When the full dataset is considered for a period of $T = 17$ and thus $N = (n-1)(T-1) = 752$ is relatively large, the difference between the original QMLE-based results and the bias-corrected results is not so much. This is in line with the theoretical results on the consistency of the QMLEs.

Table 8 gives the same results for a shorter time interval concentrating on the years 1982-84, allowing us to see the necessity of bias-correction and the effectiveness of the proposed bias-correction methods, when the sample size is not so large (here, $N = 94$). As can be seen from the estimation results of Table 8, there is a clear difference between the original QMLE-based results and the bias-corrected results. Point estimates of the bias-corrected QMLEs of the spatial parameters can be significantly larger than the corresponding QMLEs, in line with the theoretical results that the QMLEs are downward biased. The bias-corrected t-ratios for the spatial effects and the covariate effects can be noticeably smaller compared to the original t-ratios, showing that the original QMLE-based inferences can be conservative (or over rejection) when sample size is not large, in line with the theoretical results reported in the paper.

[*] The dataset can be downloaded from http://pages.stern.nyu.edu/∼wgreene/Text/Edition6/tablelist6.htm

[†] This dataset was previously used in Millo and Piras (2012) in order to illustrate fixed effects and random effects spatial panel data model estimation in a QMLE and GMM context.

Table 1a. Empirical Mean[rmse](sd) of Estimators of λ, 2FE-SPD Model with SLD, $T = 3, \beta = (\mathbf{1}, \mathbf{1})', \sigma = 1$

λ	$\hat{\lambda}_N$	$\hat{\lambda}_N^{\text{bc2}}$	$\hat{\lambda}_N^{\text{bc3}}$	$\hat{\lambda}_N$	$\hat{\lambda}_N^{\text{bc2}}$	$\hat{\lambda}_N^{\text{bc3}}$
	(a) Queen Contiguity, REG1			(b) Group Interaction, REG2		
	Normal Error, n=50					
.50	.484[.120](.119)	.502[.120](.120)	.502[.120](.120)	.469[.095](.089)	.497[.088](.088)	.499[.088](.088)
.25	.234[.142](.141)	.248[.143](.143)	.250[.143](.143)	.210[.130](.124)	.250[.123](.123)	.251[.123](.123)
.00	-.010[.158](.158)	.001[.161](.161)	.002[.161](.161)	-.049[.167](.159)	-.001[.160](.160)	.001[.160](.160)
-.25	-.258[.161](.161)	-.251[.164](.164)	-.250[.165](.165)	-.303[.189](.182)	-.250[.184](.184)	-.248[.184](.184)
-.50	-.504[.163](.163)	-.503[.166](.166)	-.502[.167](.167)	-.565[.214](.204)	-.509[.208](.208)	-.507[.208](.208)
	Normal Mixture, n=50					
.50	.483[.119](.117)	.500[.118](.118)	.501[.118](.118)	.470[.091](.086)	.498[.084](.084)	.499[.084](.084)
.25	.238[.139](.139)	.253[.141](.141)	.254[.141](.141)	.209[.128](.121)	.248[.120](.120)	.249[.120](.120)
.00	-.013[.155](.154)	-.002[.157](.157)	-.001[.157](.157)	-.048[.160](.152)	-.001[.153](.153)	.001[.153](.153)
-.25	-.257[.158](.158)	-.251[.161](.161)	-.250[.162](.162)	-.301[.188](.181)	-.248[.182](.182)	-.247[.183](.183)
-.50	-.504[.163](.163)	-.503[.166](.166)	-.503[.167](.167)	-.556[.206](.199)	-.500[.203](.203)	-.498[.203](.203)
	Lognormal Error, n=50					
.50	.485[.111](.110)	.501[.111](.111)	.502[.111](.111)	.470[.090](.085)	.497[.083](.083)	.498[.083](.083)
.25	.239[.133](.133)	.253[.134](.134)	.254[.134](.134)	.212[.122](.116)	.249[.115](.115)	.251[.115](.115)
.00	-.010[.146](.146)	.001[.149](.149)	.002[.149](.149)	-.045[.154](.147)	.000[.147](.147)	.002[.147](.147)
-.25	-.255[.151](.151)	-.249[.154](.154)	-.248[.154](.154)	-.302[.178](.171)	-.251[.173](.173)	-.250[.173](.173)
-.50	-.498[.152](.152)	-.499[.155](.155)	-.499[.156](.156)	-.556[.204](.196)	-.503[.200](.200)	-.501[.200](.200)
	Normal Error, n=100					
.50	.493[.079](.078)	.502[.078](.078)	.502[.078](.078)	.482[.067](.065)	.500[.064](.064)	.501[.064](.064)
.25	.243[.095](.095)	.251[.095](.095)	.252[.095](.095)	.222[.096](.092)	.248[.092](.092)	.248[.092](.092)
.00	-.007[.110](.109)	.000[.110](.110)	.000[.110](.110)	-.031[.123](.119)	.000[.120](.120)	.001[.120](.120)
-.25	-.255[.114](.114)	-.250[.115](.115)	-.250[.115](.115)	-.289[.146](.141)	-.254[.143](.143)	-.253[.143](.143)
-.50	-.503[.117](.117)	-.501[.118](.118)	-.501[.118](.118)	-.538[.162](.158)	-.503[.162](.162)	-.503[.162](.162)
	Normal Mixture, n=100					
.50	.490[.078](.078)	.499[.078](.078)	.500[.078](.078)	.482[.067](.065)	.500[.065](.065)	.500[.065](.065)
.25	.241[.095](.095)	.249[.095](.095)	.250[.095](.095)	.224[.095](.091)	.250[.091](.091)	.250[.091](.091)
.00	-.006[.106](.106)	.001[.107](.107)	.002[.107](.107)	-.034[.122](.117)	-.002[.118](.118)	-.002[.118](.118)
-.25	-.255[.112](.112)	-.250[.113](.113)	-.250[.113](.113)	-.286[.144](.140)	-.251[.142](.142)	-.250[.142](.142)
-.50	-.502[.117](.117)	-.499[.119](.119)	-.499[.119](.119)	-.535[.160](.156)	-.500[.159](.159)	-.500[.159](.159)
	Lognormal Error, n=100					
.50	.492[.075](.075)	.501[.075](.075)	.501[.075](.075)	.482[.065](.062)	.500[.062](.062)	.500[.062](.062)
.25	.242[.091](.091)	.250[.091](.091)	.250[.091](.091)	.225[.093](.090)	.250[.090](.090)	.250[.090](.090)
.00	-.006[.102](.102)	.001[.103](.103)	.001[.103](.103)	-.029[.116](.113)	.001[.113](.113)	.002[.113](.113)
-.25	-.255[.110](.110)	-.250[.111](.111)	-.250[.111](.111)	-.283[.138](.134)	-.249[.136](.136)	-.248[.136](.136)
-.50	-.503[.112](.112)	-.500[.113](.113)	-.500[.113](.113)	-.526[.157](.154)	-.492[.159](.159)	-.495[.159](.159)
	Normal Error, n=250					
.50	.497[.047](.046)	.501[.047](.047)	.501[.047](.047)	.490[.046](.045)	.499[.045](.045)	.499[.045](.045)
.25	.246[.060](.060)	.249[.060](.060)	.249[.060](.060)	.236[.069](.068)	.250[.068](.068)	.250[.068](.068)
.00	-.004[.066](.066)	-.001[.066](.066)	-.001[.066](.066)	-.017[.090](.088)	.001[.088](.088)	.001[.088](.088)
-.25	-.252[.071](.071)	-.250[.072](.072)	-.250[.072](.072)	-.269[.109](.107)	-.249[.107](.107)	-.249[.107](.107)
-.50	-.500[.073](.073)	-.499[.073](.073)	-.499[.073](.073)	-.525[.126](.123)	-.501[.124](.124)	-.501[.124](.124)
	Normal Mixture, n=250					
.50	.495[.047](.047)	.499[.047](.047)	.499[.047](.047)	.491[.046](.045)	.500[.045](.045)	.500[.045](.045)
.25	.248[.057](.057)	.251[.057](.057)	.251[.057](.057)	.238[.067](.066)	.251[.066](.066)	.251[.066](.066)
.00	-.003[.066](.066)	.000[.066](.066)	.000[.066](.066)	-.016[.088](.087)	.001[.087](.087)	.001[.087](.087)
-.25	-.251[.071](.071)	-.249[.071](.071)	-.249[.071](.071)	-.267[.106](.104)	-.247[.105](.104)	-.247[.105](.104)
-.50	-.501[.073](.073)	-.500[.074](.074)	-.500[.074](.074)	-.522[.125](.123)	-.499[.123](.123)	-.498[.123](.123)
	Lognormal Error, n=250					
.50	.497[.046](.046)	.500[.046](.046)	.500[.046](.046)	.491[.044](.043)	.500[.043](.043)	.500[.043](.043)
.25	.247[.056](.056)	.251[.056](.056)	.251[.056](.056)	.238[.065](.064)	.251[.064](.064)	.251[.064](.064)
.00	-.003[.064](.064)	.000[.064](.064)	.000[.064](.064)	-.017[.085](.083)	.000[.083](.083)	.000[.083](.083)
-.25	-.252[.069](.069)	-.250[.069](.069)	-.250[.069](.069)	-.268[.104](.103)	-.247[.103](.103)	-.247[.103](.103)
-.50	-.499[.070](.070)	-.499[.070](.070)	-.499[.070](.070)	-.522[.125](.123)	-.498[.123](.123)	-.498[.123](.123)

Table 1a-r. Replicates of Table 1a

λ	$\hat{\lambda}_N$	$\hat{\lambda}_N^{\text{bc2}}$	$\hat{\lambda}_N^{\text{bc3}}$	$\hat{\lambda}_N$	$\hat{\lambda}_N^{\text{bc2}}$	$\hat{\lambda}_N^{\text{bc3}}$
	(a) Wild Bootstrap, Queen, REG1			(b) iid Bootstrap, Group, REG1		
	Normal Error, n=50					
.50	.484[.121](.120)	.502[.121](.121)	.502[.121](.121)	.481[.098](.096)	.500[.094](.094)	.500[.093](.093)
.25	.234[.143](.142)	.248[.145](.145)	.249[.145](.145)	.221[.137](.134)	.247[.131](.131)	.248[.131](.131)
.00	-.011[.159](.159)	.000[.162](.162)	.001[.162](.162)	-.037[.171](.167)	-.005[.164](.164)	-.004[.164](.164)
-.25	-.256[.163](.163)	-.250[.168](.168)	-.249[.168](.168)	-.285[.198](.195)	-.251[.193](.193)	-.249[.193](.193)
-.50	-.499[.161](.161)	-.497[.166](.166)	-.497[.166](.166)	-.539[.227](.224)	-.502[.224](.224)	-.500[.223](.223)
	Normal Mixture, n=50					
.50	.480[.119](.117)	.497[.120](.120)	.498[.119](.119)	.481[.094](.092)	.501[.089](.089)	.501[.089](.089)
.25	.234[.142](.141)	.249[.144](.144)	.250[.144](.144)	.225[.132](.130)	.251[.127](.127)	.252[.127](.127)
.00	-.008[.152](.152)	.002[.156](.156)	.004[.156](.156)	-.031[.167](.164)	.000[.162](.162)	.001[.161](.161)
-.25	-.255[.159](.159)	-.248[.164](.164)	-.247[.164](.164)	-.289[.199](.195)	-.253[.193](.193)	-.252[.193](.193)
-.50	-.500[.158](.158)	-.498[.163](.163)	-.498[.164](.164)	-.536[.223](.220)	-.500[.220](.220)	-.498[.219](.219)
	Lognormal Error, n=50					
.50	.483[.112](.111)	.499[.114](.114)	.500[.113](.113)	.485[.086](.085)	.504[.083](.083)	.505[.083](.083)
.25	.237[.133](.132)	.251[.136](.136)	.252[.136](.136)	.228[.122](.120)	.254[.118](.117)	.255[.117](.117)
.00	-.011[.144](.144)	-.001[.149](.149)	.001[.149](.149)	-.028[.157](.154)	.004[.152](.152)	.005[.152](.152)
-.25	-.258[.147](.146)	-.253[.152](.152)	-.252[.152](.152)	-.280[.184](.181)	-.245[.180](.180)	-.243[.180](.179)
-.50	-.503[.152](.152)	-.503[.158](.158)	-.502[.158](.158)	-.535[.211](.208)	-.499[.208](.208)	-.496[.208](.208)
	Normal Error, n=100					
.50	.488[.080](.080)	.498[.080](.080)	.498[.080](.080)	.485[.079](.078)	.499[.076](.076)	.499[.076](.076)
.25	.239[.097](.096)	.248[.098](.097)	.248[.097](.097)	.231[.112](.111)	.251[.109](.109)	.250[.109](.109)
.00	-.008[.108](.108)	-.001[.109](.109)	-.001[.109](.109)	-.025[.145](.143)	-.001[.141](.141)	-.001[.141](.141)
-.25	-.258[.112](.112)	-.252[.114](.114)	-.252[.114](.114)	-.279[.173](.170)	-.251[.169](.169)	-.252[.169](.169)
-.50	-.506[.120](.120)	-.503[.122](.122)	-.503[.122](.122)	-.533[.199](.197)	-.504[.196](.196)	-.504[.196](.196)
	Normal Mixture, n=100					
.50	.489[.079](.078)	.498[.079](.079)	.499[.079](.079)	.485[.077](.076)	.500[.074](.074)	.499[.074](.074)
.25	.241[.094](.094)	.250[.095](.095)	.250[.095](.095)	.229[.111](.110)	.250[.107](.107)	.249[.107](.107)
.00	-.005[.106](.106)	.002[.108](.108)	.003[.108](.108)	-.024[.145](.143)	.001[.141](.141)	.000[.141](.141)
-.25	-.251[.115](.115)	-.246[.117](.117)	-.246[.117](.117)	-.280[.173](.171)	-.252[.169](.169)	-.253[.169](.169)
-.50	-.501[.115](.115)	-.499[.117](.117)	-.498[.117](.117)	-.526[.192](.190)	-.497[.190](.190)	-.498[.190](.190)
	Lognormal Error, n=100					
.50	.492[.075](.075)	.501[.075](.075)	.502[.075](.075)	.487[.073](.072)	.502[.070](.070)	.501[.070](.070)
.25	.242[.090](.090)	.250[.091](.091)	.251[.091](.091)	.231[.106](.104)	.252[.102](.102)	.251[.102](.102)
.00	-.008[.103](.102)	.000[.104](.104)	.000[.104](.104)	-.021[.135](.133)	.004[.131](.131)	.003[.131](.131)
-.25	-.252[.110](.110)	-.247[.112](.112)	-.247[.112](.112)	-.273[.160](.158)	-.244[.157](.157)	-.245[.157](.157)
-.50	-.499[.110](.110)	-.496[.112](.112)	-.496[.112](.112)	-.524[.185](.183)	-.495[.183](.183)	-.495[.183](.183)
	Normal Error, n=250					
.50	.496[.047](.046)	.500[.046](.046)	.500[.046](.046)	.492[.053](.052)	.500[.051](.051)	.500[.051](.051)
.25	.246[.057](.057)	.250[.057](.057)	.250[.057](.057)	.237[.077](.076)	.249[.075](.075)	.248[.075](.075)
.00	-.004[.066](.066)	-.001[.066](.066)	-.001[.066](.066)	-.012[.100](.099)	.003[.098](.098)	.003[.098](.098)
-.25	-.251[.072](.072)	-.249[.073](.073)	-.249[.073](.073)	-.267[.122](.121)	-.250[.120](.120)	-.251[.120](.120)
-.50	-.501[.072](.072)	-.500[.073](.073)	-.500[.073](.073)	-.521[.142](.141)	-.502[.140](.140)	-.502[.140](.140)
	Normal Mixture, n=250					
.50	.496[.046](.046)	.500[.046](.046)	.500[.046](.046)	.492[.052](.051)	.500[.050](.050)	.500[.050](.050)
.25	.248[.059](.059)	.251[.059](.059)	.251[.059](.059)	.238[.077](.076)	.249[.075](.075)	.249[.075](.075)
.00	-.002[.066](.066)	.001[.066](.066)	.001[.066](.066)	-.016[.099](.097)	-.001[.096](.096)	-.002[.096](.096)
-.25	-.252[.070](.070)	-.250[.071](.071)	-.250[.071](.071)	-.265[.119](.118)	-.248[.117](.117)	-.248[.117](.117)
-.50	-.500[.072](.072)	-.499[.073](.073)	-.499[.073](.073)	-.521[.143](.142)	-.501[.141](.140)	-.501[.141](.141)
	Lognormal Error, n=250					
.50	.496[.046](.046)	.500[.046](.046)	.500[.046](.046)	.492[.052](.051)	.500[.050](.050)	.500[.050](.050)
.25	.247[.056](.056)	.251[.057](.057)	.251[.057](.057)	.238[.075](.075)	.250[.074](.074)	.250[.074](.074)
.00	-.004[.065](.065)	-.001[.066](.066)	-.001[.066](.066)	-.015[.096](.095)	.000[.094](.094)	-.001[.094](.094)
-.25	-.252[.068](.068)	-.250[.069](.069)	-.250[.069](.069)	-.266[.118](.117)	-.248[.116](.116)	-.249[.116](.116)
-.50	-.503[.070](.070)	-.502[.070](.070)	-.502[.070](.070)	-.521[.143](.141)	-.500[.140](.140)	-.501[.140](.140)

Table 1b. Empirical Mean[rmse](sd) of Estimators of λ, 2FE-SPD Model with SLD, $T = 3, \beta = (.5, .5)', \sigma = 1$

λ	$\hat{\lambda}_N$	$\hat{\lambda}_N^{\text{bc2}}$	$\hat{\lambda}_N^{\text{bc3}}$	$\hat{\lambda}_N$	$\hat{\lambda}_N^{\text{bc2}}$	$\hat{\lambda}_N^{\text{bc3}}$
	(a) Queen Contiguity, REG1			(b) Group Interaction, REG2		
	Normal Error, n=50					
.50	.477[.133](.132)	.500[.133](.133)	.500[.132](.132)	.449[.122](.111)	.498[.105](.105)	.500[.105](.105)
.25	.231[.157](.156)	.251[.159](.159)	.252[.158](.158)	.179[.171](.156)	.248[.150](.150)	.250[.150](.150)
.00	-.015[.176](.175)	.000[.180](.180)	.002[.180](.180)	-.086[.214](.196)	-.002[.191](.191)	.001[.191](.191)
-.25	-.261[.180](.180)	-.252[.185](.185)	-.251[.185](.185)	-.348[.247](.227)	-.252[.224](.224)	-.249[.224](.224)
-.50	-.505[.185](.184)	-.502[.190](.190)	-.501[.190](.190)	-.609[.283](.262)	-.504[.261](.261)	-.502[.262](.262)
	Normal Mixture, n=50					
.50	.478[.133](.132)	.501[.133](.133)	.500[.132](.132)	.449[.120](.109)	.498[.103](.103)	.500[.103](.103)
.25	.229[.158](.157)	.248[.159](.159)	.249[.159](.159)	.180[.168](.153)	.248[.147](.147)	.250[.147](.147)
.00	-.017[.174](.173)	-.002[.177](.177)	.000[.177](.177)	-.088[.212](.193)	-.003[.188](.188)	.000[.188](.188)
-.25	-.260[.176](.176)	-.251[.181](.181)	-.250[.181](.181)	-.346[.247](.227)	-.250[.224](.224)	-.247[.225](.225)
-.50	-.502[.181](.181)	-.499[.186](.186)	-.499[.186](.186)	-.608[.281](.260)	-.503[.260](.260)	-.500[.260](.260)
	Lognormal Error, n=50					
.50	.480[.123](.122)	.502[.123](.123)	.502[.122](.122)	.454[.112](.102)	.502[.097](.097)	.504[.097](.097)
.25	.229[.148](.147)	.249[.150](.149)	.250[.149](.149)	.184[.157](.143)	.251[.138](.138)	.254[.138](.138)
.00	-.013[.162](.161)	.002[.165](.165)	.003[.165](.165)	-.079[.193](.176)	.003[.172](.172)	.006[.172](.172)
-.25	-.258[.168](.167)	-.248[.172](.172)	-.247[.172](.172)	-.341[.225](.206)	-.247[.203](.203)	-.244[.203](.203)
-.50	-.504[.173](.172)	-.501[.177](.177)	-.501[.178](.178)	-.598[.258](.239)	-.495[.239](.239)	-.493[.240](.240)
	Normal Error, n=100					
.50	.490[.090](.090)	.502[.090](.090)	.502[.089](.089)	.469[.087](.081)	.499[.079](.079)	.500[.079](.079)
.25	.242[.108](.108)	.253[.109](.109)	.253[.109](.109)	.205[.127](.119)	.248[.117](.117)	.248[.117](.117)
.00	-.003[.122](.122)	.006[.123](.123)	.006[.123](.123)	-.058[.166](.155)	-.004[.153](.153)	-.003[.153](.153)
-.25	-.256[.130](.129)	-.250[.131](.131)	-.249[.131](.131)	-.313[.192](.181)	-.249[.179](.179)	-.249[.179](.179)
-.50	-.505[.131](.131)	-.503[.133](.133)	-.503[.133](.133)	-.578[.223](.209)	-.506[.209](.208)	-.506[.209](.209)
	Normal Mixture, n=100					
.50	.491[.088](.088)	.502[.088](.088)	.502[.088](.088)	.470[.087](.082)	.500[.080](.080)	.500[.079](.079)
.25	.241[.105](.105)	.252[.106](.106)	.252[.106](.106)	.207[.124](.116)	.249[.113](.113)	.250[.113](.113)
.00	-.010[.120](.120)	-.002[.121](.121)	-.001[.121](.121)	-.056[.160](.150)	-.001[.148](.148)	-.001[.148](.148)
-.25	-.254[.129](.129)	-.248[.131](.131)	-.247[.131](.131)	-.314[.195](.184)	-.251[.182](.182)	-.250[.182](.182)
-.50	-.503[.130](.130)	-.500[.131](.131)	-.500[.132](.132)	-.567[.217](.207)	-.496[.206](.206)	-.495[.206](.206)
	Lognormal Error, n=100					
.50	.490[.084](.084)	.502[.084](.084)	.502[.084](.084)	.470[.084](.079)	.500[.077](.077)	.500[.077](.077)
.25	.235[.102](.101)	.246[.102](.102)	.246[.102](.102)	.208[.120](.113)	.250[.110](.110)	.251[.110](.110)
.00	-.005[.116](.116)	.004[.117](.117)	.004[.117](.117)	-.050[.151](.143)	.003[.141](.141)	.004[.141](.141)
-.25	-.258[.121](.121)	-.252[.123](.123)	-.252[.123](.123)	-.316[.185](.172)	-.253[.171](.171)	-.253[.171](.171)
-.50	-.502[.125](.125)	-.499[.126](.126)	-.499[.126](.126)	-.565[.208](.197)	-.495[.197](.197)	-.495[.197](.197)
	Normal Error, n=250					
.50	.496[.055](.055)	.501[.055](.055)	.501[.055](.055)	.483[.061](.058)	.499[.057](.057)	.499[.057](.057)
.25	.245[.068](.068)	.250[.068](.068)	.250[.068](.068)	.225[.091](.088)	.249[.087](.087)	.249[.087](.087)
.00	-.002[.075](.075)	.002[.076](.076)	.002[.076](.076)	-.028[.115](.112)	.003[.111](.111)	.003[.111](.111)
-.25	-.252[.082](.082)	-.250[.082](.082)	-.250[.082](.082)	-.288[.144](.139)	-.250[.138](.138)	-.249[.138](.138)
-.50	-.502[.083](.083)	-.501[.083](.083)	-.501[.083](.083)	-.546[.167](.160)	-.502[.159](.159)	-.502[.159](.159)
	Normal Mixture, n=250					
.50	.496[.054](.054)	.501[.054](.054)	.501[.054](.054)	.484[.061](.059)	.501[.059](.059)	.501[.059](.059)
.25	.246[.067](.067)	.250[.067](.067)	.250[.067](.067)	.223[.092](.087)	.247[.086](.086)	.247[.086](.086)
.00	-.003[.075](.075)	.000[.076](.076)	.000[.076](.076)	-.032[.117](.112)	-.001[.111](.111)	.000[.111](.111)
-.25	-.255[.081](.081)	-.252[.082](.082)	-.252[.082](.082)	-.286[.140](.135)	-.248[.134](.134)	-.248[.134](.134)
-.50	-.501[.083](.083)	-.501[.083](.083)	-.500[.083](.083)	-.544[.171](.165)	-.500[.164](.164)	-.499[.164](.164)
	Lognormal Error, n=250					
.50	.495[.054](.053)	.500[.053](.053)	.500[.053](.053)	.484[.059](.057)	.501[.056](.056)	.501[.056](.056)
.25	.246[.066](.066)	.251[.066](.066)	.251[.066](.066)	.224[.088](.084)	.248[.083](.083)	.248[.083](.083)
.00	-.003[.075](.075)	.001[.075](.075)	.001[.075](.075)	-.033[.114](.109)	-.002[.108](.108)	-.002[.108](.108)
-.25	-.253[.079](.079)	-.250[.079](.079)	-.250[.079](.079)	-.287[.138](.133)	-.249[.132](.132)	-.249[.132](.132)
-.50	-.499[.081](.081)	-.498[.081](.081)	-.498[.081](.081)	-.541[.164](.159)	-.497[.158](.158)	-.497[.158](.158)

Table 2. Empirical Mean[rmse](sd) of Estimators of ρ - 2FE-SPD Model with SED, $T = 3, \beta = (1, 1)', \sigma = 1$

ρ	$\hat{\rho}_N$	$\hat{\rho}_N^{\text{bc2}}$	$\hat{\rho}_N^{\text{bc3}}$	$\hat{\rho}_N$	$\hat{\rho}_N^{\text{bc2}}$	$\hat{\rho}_N^{\text{bc3}}$
	(a) Queen Contiguity, REG1			(b) Group Interaction, REG2		
	Normal Error, n=50					
.50	.481[.144](.142)	.500[.143](.143)	.500[.142](.142)	.457[.139](.132)	.503[.116](.116)	.503[.115](.115)
.25	.233[.171](.170)	.252[.171](.171)	.254[.171](.171)	.177[.202](.188)	.258[.167](.167)	.260[.167](.166)
.00	-.018[.190](.189)	-.001[.190](.190)	.001[.191](.190)	-.115[.266](.240)	-.004[.221](.221)	-.001[.220](.220)
-.25	-.271[.202](.201)	-.255[.203](.203)	-.254[.204](.204)	-.382[.299](.268)	-.250[.256](.256)	-.249[.256](.256)
-.50	-.516[.203](.202)	-.503[.205](.205)	-.502[.206](.206)	-.637[.321](.290)	-.496[.287](.287)	-.497[.288](.288)
	Normal Mixture, n=50					
.50	.480[.139](.138)	.500[.138](.138)	.500[.137](.137)	.458[.137](.130)	.504[.114](.114)	.504[.113](.113)
.25	.233[.166](.165)	.252[.166](.166)	.251[.166](.166)	.168[.210](.194)	.251[.172](.172)	.250[.171](.171)
.00	-.016[.186](.185)	.002[.186](.186)	.003[.186](.186)	-.108[.258](.234)	.004[.214](.214)	.003[.214](.214)
-.25	-.267[.195](.194)	-.252[.196](.196)	-.250[.197](.197)	-.381[.293](.262)	-.248[.251](.251)	-.249[.251](.251)
-.50	-.511[.198](.197)	-.498[.200](.200)	-.498[.201](.201)	-.636[.313](.282)	-.493[.280](.280)	-.495[.281](.281)
	Lognormal Error, n=50					
.50	.483[.135](.133)	.504[.134](.134)	.503[.133](.133)	.454[.136](.128)	.502[.112](.112)	.502[.111](.111)
.25	.237[.160](.159)	.256[.161](.160)	.255[.160](.160)	.174[.196](.181)	.257[.160](.160)	.256[.160](.160)
.00	-.012[.179](.179)	.006[.180](.180)	.005[.180](.180)	-.105[.242](.218)	.009[.199](.199)	.002[.199](.199)
-.25	-.264[.186](.186)	-.248[.188](.188)	-.249[.188](.188)	-.368[.273](.247)	-.233[.235](.235)	-.239[.236](.235)
-.50	-.512[.191](.191)	-.499[.194](.194)	-.499[.194](.194)	-.632[.305](.275)	-.489[.272](.272)	-.489[.274](.273)
	Normal Error, n=100					
.50	.490[.096](.095)	.500[.095](.095)	.500[.095](.095)	.467[.107](.102)	.501[.093](.093)	.501[.093](.093)
.25	.241[.119](.119)	.251[.119](.119)	.251[.118](.118)	.196[.152](.142)	.252[.132](.132)	.251[.132](.132)
.00	-.011[.132](.132)	-.001[.132](.132)	.000[.132](.132)	-.074[.192](.177)	-.002[.171](.171)	-.002[.171](.171)
-.25	-.259[.141](.140)	-.249[.141](.141)	-.249[.141](.141)	-.333[.215](.199)	-.255[.199](.199)	-.255[.199](.199)
-.50	-.510[.142](.142)	-.501[.143](.143)	-.501[.143](.143)	-.574[.220](.207)	-.500[.215](.215)	-.500[.215](.215)
	Normal Mixture, n=100					
.50	.489[.095](.094)	.500[.094](.094)	.500[.094](.094)	.465[.104](.098)	.500[.090](.090)	.500[.090](.090)
.25	.240[.118](.117)	.250[.117](.117)	.250[.117](.117)	.196[.149](.139)	.253[.130](.130)	.253[.130](.130)
.00	-.010[.130](.130)	.001[.130](.130)	.001[.130](.130)	-.073[.189](.174)	.000[.168](.168)	.000[.168](.168)
-.25	-.260[.138](.138)	-.250[.138](.138)	-.249[.138](.138)	-.327[.211](.196)	-.249[.197](.197)	-.249[.197](.197)
-.50	-.510[.138](.138)	-.501[.139](.139)	-.501[.139](.139)	-.569[.220](.209)	-.495[.219](.219)	-.495[.219](.219)
	Lognormal Error, n=100					
.50	.494[.088](.088)	.505[.088](.088)	.505[.088](.088)	.465[.107](.101)	.501[.092](.092)	.500[.092](.092)
.25	.240[.110](.110)	.251[.110](.110)	.251[.110](.110)	.198[.145](.135)	.256[.126](.126)	.256[.126](.125)
.00	-.006[.126](.126)	.004[.127](.126)	.003[.127](.126)	-.064[.174](.162)	.010[.156](.156)	.010[.156](.156)
-.25	-.259[.136](.136)	-.250[.136](.136)	-.249[.136](.136)	-.320[.200](.188)	-.239[.189](.188)	-.239[.189](.189)
-.50	-.508[.135](.135)	-.500[.136](.136)	-.500[.136](.136)	-.561[.214](.205)	-.485[.215](.215)	-.486[.215](.215)
	Normal Error, n=250					
.50	.496[.059](.059)	.500[.059](.059)	.500[.059](.059)	.477[.080](.077)	.498[.073](.073)	.498[.073](.073)
.25	.246[.072](.072)	.250[.072](.072)	.250[.072](.072)	.215[.117](.111)	.251[.105](.105)	.251[.105](.105)
.00	-.003[.083](.083)	.001[.083](.083)	.001[.083](.083)	-.053[.157](.147)	-.003[.140](.140)	-.003[.140](.140)
-.25	-.255[.088](.087)	-.251[.088](.088)	-.251[.088](.088)	-.313[.186](.175)	-.250[.168](.168)	-.250[.168](.168)
-.50	-.505[.089](.089)	-.501[.090](.090)	-.501[.090](.090)	-.577[.212](.198)	-.505[.193](.193)	-.506[.193](.193)
	Normal Mixture, n=250					
.50	.497[.059](.059)	.501[.059](.059)	.501[.059](.059)	.482[.077](.075)	.503[.070](.070)	.502[.070](.070)
.25	.245[.072](.072)	.249[.072](.072)	.249[.072](.072)	.214[.117](.111)	.250[.105](.105)	.250[.105](.105)
.00	-.004[.081](.081)	.000[.081](.081)	.000[.081](.081)	-.052[.154](.144)	-.001[.137](.137)	-.001[.137](.137)
-.25	-.256[.088](.088)	-.252[.088](.088)	-.252[.088](.088)	-.314[.180](.168)	-.250[.161](.161)	-.251[.161](.161)
-.50	-.503[.088](.088)	-.500[.089](.089)	-.500[.089](.089)	-.570[.212](.200)	-.498[.195](.195)	-.498[.195](.195)
	Logmormal Error, n=250					
.50	.496[.057](.057)	.500[.057](.057)	.500[.057](.057)	.478[.080](.077)	.500[.072](.072)	.499[.072](.072)
.25	.248[.070](.070)	.252[.070](.070)	.252[.070](.070)	.216[.114](.109)	.254[.103](.103)	.253[.103](.103)
.00	-.003[.081](.081)	.001[.081](.081)	.001[.081](.081)	-.051[.147](.138)	.002[.131](.131)	.001[.131](.131)
-.25	-.255[.085](.085)	-.251[.085](.085)	-.251[.085](.085)	-.306[.176](.167)	-.241[.160](.160)	-.242[.160](.160)
-.50	-.505[.087](.087)	-.502[.087](.087)	-.501[.087](.087)	-.564[.211](.201)	-.490[.196](.196)	-.491[.196](.196)

Table 2-r. Replicates of Case (a) Table 2: Queen Contiguity, REG1

ρ	$\hat{\rho}_N$	$\hat{\rho}_N^{\text{bc2}}$	$\hat{\rho}_N^{\text{bc3}}$	$\hat{\rho}_N$	$\hat{\rho}_N^{\text{bc2}}$	$\hat{\rho}_N^{\text{bc3}}$
	(a) $\beta=(.5\ .5)'$, iid Bootstrap			(b) $\beta=(1\ 1)'$, Wild Bootstrap		
	Normal Error, n=50					
.50	.481[.144](.142)	.502[.143](.143)	.502[.142](.142)	.480[.144](.142)	.501[.145](.145)	.501[.144](.144)
.25	.235[.169](.168)	.255[.169](.169)	.256[.169](.169)	.233[.171](.170)	.254[.172](.172)	.255[.172](.172)
.00	-.016[.188](.188)	.003[.189](.189)	.005[.189](.189)	-.017[.191](.190)	.002[.194](.194)	.004[.194](.194)
-.25	-.267[.203](.202)	-.250[.205](.205)	-.249[.205](.205)	-.267[.199](.198)	-.251[.204](.204)	-.249[.204](.204)
-.50	-.511[.205](.205)	-.497[.208](.208)	-.497[.209](.209)	-.516[.201](.201)	-.503[.207](.207)	-.502[.208](.208)
	Normal Mixture, n=50					
.50	.479[.142](.141)	.499[.141](.141)	.499[.140](.140)	.481[.142](.141)	.502[.144](.144)	.502[.143](.143)
.25	.228[.169](.167)	.248[.168](.168)	.249[.167](.167)	.234[.168](.168)	.254[.172](.172)	.256[.172](.172)
.00	-.016[.187](.186)	.003[.187](.187)	.005[.187](.187)	-.015[.188](.188)	.004[.192](.192)	.006[.192](.192)
-.25	-.262[.199](.198)	-.246[.200](.200)	-.244[.201](.201)	-.265[.199](.199)	-.249[.205](.205)	-.248[.205](.205)
-.50	-.512[.199](.199)	-.499[.202](.202)	-.498[.203](.203)	-.509[.196](.196)	-.496[.203](.203)	-.495[.204](.203)
	Lognormal Error, n=50					
.50	.483[.132](.131)	.504[.131](.131)	.504[.130](.130)	.482[.132](.130)	.503[.135](.135)	.503[.134](.134)
.25	.234[.159](.158)	.254[.159](.159)	.256[.159](.159)	.235[.158](.157)	.256[.163](.162)	.257[.162](.162)
.00	-.015[.177](.177)	.003[.178](.178)	.005[.178](.178)	-.016[.177](.177)	.003[.183](.183)	.005[.183](.183)
-.25	-.262[.190](.190)	-.245[.192](.192)	-.244[.192](.192)	-.265[.188](.187)	-.246[.195](.195)	-.245[.195](.195)
-.50	-.513[.192](.192)	-.500[.194](.194)	-.499[.195](.195)	-.510[.193](.193)	-.496[.202](.202)	-.495[.202](.202)
	Normal Error, n=100					
.50	.489[.096](.096)	.500[.096](.096)	.500[.095](.095)	.491[.096](.095)	.501[.096](.096)	.501[.095](.095)
.25	.242[.116](.116)	.253[.116](.116)	.253[.116](.116)	.241[.117](.117)	.251[.118](.118)	.251[.118](.118)
.00	-.010[.133](.133)	.000[.133](.133)	.001[.133](.133)	-.007[.131](.131)	.003[.132](.132)	.004[.132](.132)
-.25	-.262[.142](.142)	-.252[.142](.142)	-.252[.142](.142)	-.258[.140](.139)	-.248[.141](.141)	-.248[.141](.141)
-.50	-.507[.139](.139)	-.498[.140](.140)	-.498[.140](.140)	-.507[.142](.141)	-.498[.143](.143)	-.498[.143](.143)
	Normal Mixture, n=100					
.50	.491[.095](.095)	.501[.095](.095)	.501[.095](.095)	.492[.095](.094)	.503[.096](.096)	.503[.096](.096)
.25	.240[.115](.115)	.250[.115](.115)	.251[.115](.115)	.240[.115](.115)	.251[.116](.116)	.251[.116](.116)
.00	-.010[.129](.129)	.001[.129](.129)	.001[.129](.129)	-.010[.128](.127)	.000[.129](.129)	.001[.129](.129)
-.25	-.259[.140](.139)	-.250[.140](.140)	-.249[.140](.140)	-.258[.140](.140)	-.248[.142](.142)	-.248[.142](.142)
-.50	-.507[.142](.142)	-.499[.143](.143)	-.499[.143](.143)	-.508[.143](.143)	-.499[.146](.146)	-.499[.146](.146)
	Lognormal Error, n=100					
.50	.492[.092](.092)	.503[.092](.092)	.503[.091](.091)	.489[.091](.091)	.501[.092](.092)	.501[.092](.092)
.25	.241[.112](.112)	.252[.112](.112)	.252[.112](.112)	.240[.111](.111)	.251[.113](.113)	.252[.113](.113)
.00	-.012[.126](.125)	-.001[.126](.126)	-.001[.126](.126)	-.008[.126](.126)	.003[.129](.129)	.003[.129](.129)
-.25	-.260[.134](.134)	-.250[.134](.134)	-.250[.134](.134)	-.258[.132](.132)	-.248[.135](.135)	-.248[.135](.135)
-.50	-.510[.137](.137)	-.502[.138](.138)	-.502[.138](.138)	-.509[.136](.136)	-.500[.140](.140)	-.500[.140](.140)
	Normal Error, n=250					
.50	.496[.058](.058)	.500[.058](.058)	.500[.058](.058)	.495[.059](.058)	.499[.059](.059)	.499[.059](.059)
.25	.247[.073](.073)	.251[.073](.073)	.251[.073](.073)	.246[.073](.073)	.250[.073](.073)	.250[.073](.073)
.00	-.004[.082](.082)	.000[.082](.082)	.000[.082](.082)	-.004[.083](.083)	.000[.084](.084)	.000[.084](.084)
-.25	-.254[.089](.089)	-.251[.089](.089)	-.250[.089](.089)	-.254[.089](.089)	-.250[.090](.090)	-.250[.090](.090)
-.50	-.501[.090](.090)	-.497[.091](.091)	-.497[.091](.091)	-.505[.090](.090)	-.501[.090](.090)	-.501[.090](.090)
	Normal Mixture, n=250					
.50	.496[.059](.059)	.500[.059](.059)	.500[.059](.059)	.495[.059](.059)	.499[.059](.059)	.499[.059](.059)
.25	.247[.071](.071)	.251[.071](.071)	.251[.071](.071)	.247[.072](.072)	.251[.073](.073)	.251[.073](.073)
.00	-.004[.082](.082)	.000[.082](.082)	.000[.082](.082)	-.002[.081](.081)	.002[.081](.081)	.002[.081](.081)
-.25	-.254[.088](.088)	-.250[.088](.088)	-.250[.088](.088)	-.253[.087](.087)	-.249[.088](.088)	-.249[.088](.088)
-.50	-.504[.090](.090)	-.501[.090](.090)	-.501[.090](.090)	-.503[.089](.089)	-.500[.090](.090)	-.500[.090](.090)
	Lognormal Error, n=250					
.50	.496[.057](.057)	.500[.057](.057)	.500[.057](.057)	.497[.056](.056)	.501[.056](.056)	.501[.056](.056)
.25	.246[.071](.071)	.250[.071](.071)	.250[.071](.071)	.246[.071](.070)	.250[.071](.071)	.250[.071](.071)
.00	-.003[.080](.080)	.001[.080](.080)	.001[.080](.080)	-.005[.078](.078)	-.001[.079](.079)	-.001[.079](.079)
-.25	-.252[.087](.087)	-.248[.087](.087)	-.248[.087](.087)	-.253[.084](.084)	-.250[.085](.085)	-.249[.085](.085)
-.50	-.504[.086](.086)	-.501[.087](.087)	-.501[.087](.087)	-.503[.087](.087)	-.500[.088](.088)	-.500[.088](.088)

Table 3a. Empirical Mean[rmse](sd) of Estimators of λ and ρ, 2FE-SPD Model with SARAR, $T = 3, \beta = (1, 1)', \sigma = 1$, Queen Contiguity, REG-1

λ	ρ	$\hat\lambda_N$	$\hat\lambda_N^{\rm bc2}$	$\hat\rho_N$	$\hat\rho_N^{\rm bc2}$	$\hat\lambda_N$	$\hat\lambda_N^{\rm bc2}$	$\hat\rho_N$	$\hat\rho_N^{\rm bc2}$
		(a) Normal Error, $n = 50$				(b) Lognormal Error, $n = 50$			
.50	.50	.484[.116](.115)	.500[.116](.116)	.483[.143](.142)	.500[.143](.143)	.486[.105](.104)	.502[.105](.105)	.484[.131](.130)	.502[.131](.131)
	.25	.484[.119](.117)	.501[.118](.118)	.226[.176](.174)	.242[.175](.175)	.485[.114](.113)	.501[.113](.113)	.233[.162](.161)	.250[.161](.161)
	.00	.483[.118](.116)	.500[.117](.117)	-.019[.192](.191)	-.002[.192](.192)	.486[.110](.109)	.503[.110](.110)	-.015[.177](.176)	.002[.177](.177)
	-.25	.482[.124](.122)	.500[.123](.123)	-.267[.202](.202)	-.251[.203](.203)	.487[.112](.111)	.503[.112](.112)	-.265[.193](.193)	-.249[.193](.193)
	-.50	.484[.125](.123)	.500[.124](.124)	-.513[.208](.208)	-.498[.209](.209)	.489[.111](.110)	.505[.111](.111)	-.514[.195](.194)	-.499[.196](.196)
-.50	.50	-.502[.158](.158)	-.500[.161](.161)	.486[.144](.143)	.504[.144](.144)	-.502[.145](.145)	-.500[.148](.148)	.486[.132](.131)	.504[.132](.131)
	.25	-.506[.165](.165)	-.504[.168](.168)	.232[.174](.173)	.249[.174](.174)	-.505[.152](.151)	-.503[.155](.154)	.233[.161](.160)	.250[.160](.160)
	.00	-.501[.163](.163)	-.499[.167](.167)	-.006[.187](.187)	.010[.187](.187)	-.499[.159](.159)	-.497[.162](.162)	-.018[.180](.179)	-.001[.180](.180)
	-.25	-.500[.164](.164)	-.498[.168](.168)	-.262[.209](.209)	-.246[.210](.210)	-.501[.152](.152)	-.499[.155](.155)	-.263[.197](.197)	-.246[.197](.197)
	-.50	-.506[.169](.169)	-.505[.172](.172)	-.518[.207](.206)	-.503[.208](.208)	-.498[.157](.157)	-.497[.160](.160)	-.513[.194](.194)	-.498[.195](.195)
		(c) Normal Error, $n = 100$				(d) Lognormal Error, $n = 100$			
.50	.50	.494[.078](.077)	.502[.078](.078)	.490[.096](.096)	.499[.096](.096)	.490[.078](.078)	.499[.078](.078)	.493[.090](.090)	.502[.090](.090)
	.25	.490[.080](.080)	.499[.080](.080)	.244[.117](.116)	.253[.117](.117)	.491[.081](.080)	.500[.080](.080)	.243[.111](.111)	.252[.111](.111)
	.00	.493[.083](.083)	.502[.083](.083)	-.011[.132](.131)	-.002[.131](.131)	.494[.079](.079)	.503[.079](.079)	-.009[.126](.126)	.001[.126](.126)
	-.25	.491[.084](.083)	.500[.083](.083)	-.258[.142](.142)	-.249[.142](.142)	.490[.077](.077)	.499[.077](.077)	-.264[.138](.137)	-.254[.138](.137)
	-.50	.490[.079](.078)	.499[.078](.078)	-.509[.142](.141)	-.499[.142](.142)	.493[.077](.077)	.501[.077](.077)	-.509[.137](.137)	-.499[.137](.137)
-.50	.50	-.494[.118](.118)	-.493[.119](.119)	.492[.094](.094)	.501[.094](.094)	-.503[.106](.106)	-.503[.107](.107)	.491[.089](.088)	.500[.088](.088)
	.25	-.501[.119](.119)	-.500[.121](.121)	.242[.117](.117)	.251[.117](.117)	-.502[.112](.112)	-.501[.113](.113)	.240[.111](.111)	.249[.111](.111)
	.00	-.496[.115](.115)	-.495[.117](.117)	-.008[.133](.133)	.001[.133](.133)	-.498[.114](.114)	-.498[.115](.115)	-.007[.129](.129)	.003[.128](.128)
	-.25	-.505[.118](.118)	-.504[.120](.120)	-.258[.143](.143)	-.248[.143](.143)	-.497[.112](.112)	-.496[.113](.113)	-.257[.136](.136)	-.248[.136](.136)
	-.50	-.501[.118](.118)	-.500[.120](.120)	-.504[.148](.148)	-.495[.149](.149)	-.505[.109](.109)	-.504[.110](.110)	-.507[.137](.137)	-.498[.138](.137)
		(e) Normal Error, $n = 500$				(f) Lognormal Error, $n = 500$			
.50	.50	.497[.033](.033)	.499[.033](.033)	.499[.041](.041)	.501[.041](.041)	.499[.030](.030)	.501[.030](.030)	.497[.040](.040)	.499[.040](.040)
	.25	.497[.033](.033)	.499[.033](.033)	.247[.052](.052)	.249[.052](.052)	.499[.032](.032)	.501[.032](.032)	.249[.050](.050)	.250[.050](.050)
	.00	.499[.033](.033)	.501[.033](.033)	.001[.057](.057)	.003[.058](.057)	.498[.033](.033)	.500[.033](.033)	-.001[.057](.057)	.001[.057](.057)
	-.25	.498[.033](.032)	.499[.033](.033)	-.254[.062](.062)	-.252[.062](.062)	.498[.033](.033)	.500[.033](.033)	-.250[.061](.061)	-.248[.061](.061)
	-.50	.498[.032](.032)	.500[.032](.032)	-.503[.062](.062)	-.501[.062](.062)	.497[.032](.032)	.499[.032](.032)	-.501[.062](.062)	-.499[.062](.062)
-.50	.50	-.502[.049](.049)	-.501[.049](.049)	.498[.041](.041)	.500[.041](.041)	-.499[.049](.049)	-.499[.049](.049)	.498[.040](.040)	.500[.040](.040)
	.25	-.503[.051](.051)	-.502[.051](.051)	.249[.051](.051)	.250[.051](.051)	-.500[.051](.051)	-.499[.051](.051)	.248[.050](.050)	.250[.050](.050)
	.00	-.501[.050](.050)	-.501[.050](.050)	-.001[.060](.060)	.001[.060](.060)	-.501[.051](.051)	-.500[.052](.052)	-.002[.058](.058)	.000[.058](.058)
	-.25	-.502[.051](.050)	-.502[.051](.051)	-.253[.061](.061)	-.251[.061](.061)	-.499[.051](.051)	-.498[.051](.051)	-.252[.062](.062)	-.250[.062](.062)
	-.50	-.500[.049](.049)	-.499[.049](.049)	-.501[.063](.063)	-.499[.064](.064)	-.500[.048](.048)	-.500[.049](.049)	-.503[.062](.062)	-.502[.062](.062)

Table 3a-r. Replicates of Table 1a using Wild Bootstrap

λ	ρ	$\hat{\lambda}_N$	$\hat{\lambda}_N^{\text{bc2}}$	$\hat{\rho}_N$	$\hat{\rho}_N^{\text{bc2}}$	$\hat{\lambda}_N$	$\hat{\lambda}_N^{\text{bc2}}$	$\hat{\rho}_N$	$\hat{\rho}_N^{\text{bc2}}$
		Normal Error, $n = 50$				Normal Error, $n = 100$			
.50	.50	.480[.109](.108)	.498[.109](.109)	.481[.145](.144)	.499[.146](.146)	.491[.075](.074)	.499[.075](.075)	.490[.095](.095)	.499[.096](.096)
	.25	.481[.113](.111)	.500[.113](.113)	.234[.175](.174)	.251[.177](.177)	.491[.076](.075)	.499[.075](.075)	.240[.118](.117)	.249[.118](.118)
	.00	.481[.114](.113)	.500[.114](.114)	-.017[.194](.193)	.001[.195](.195)	.493[.077](.077)	.501[.077](.077)	-.011[.136](.136)	-.002[.136](.136)
	-.25	.481[.115](.114)	.499[.115](.115)	-.269[.211](.210)	-.250[.212](.212)	.490[.077](.076)	.499[.077](.077)	-.257[.143](.143)	-.247[.144](.144)
	-.50	.482[.113](.112)	.500[.113](.113)	-.521[.209](.208)	-.503[.211](.211)	.492[.075](.074)	.500[.075](.075)	-.512[.145](.145)	-.503[.146](.146)
-.50	.50	-.505[.157](.157)	-.500[.162](.162)	.487[.143](.142)	.505[.144](.144)	-.499[.105](.105)	-.498[.107](.107)	.491[.096](.095)	.500[.096](.096)
	.25	-.510[.165](.165)	-.505[.170](.170)	.230[.173](.171)	.248[.173](.173)	-.499[.112](.112)	-.498[.114](.114)	.242[.119](.119)	.251[.119](.119)
	.00	-.505[.166](.166)	-.499[.172](.172)	-.013[.195](.195)	.006[.197](.197)	-.503[.112](.112)	-.502[.114](.114)	-.008[.132](.132)	.001[.133](.133)
	-.25	-.507[.165](.165)	-.501[.171](.171)	-.268[.210](.209)	-.248[.211](.211)	-.500[.110](.110)	-.499[.112](.112)	-.257[.140](.140)	-.248[.141](.141)
	-.50	-.504[.159](.159)	-.500[.164](.164)	-.524[.207](.206)	-.504[.210](.210)	-.501[.108](.108)	-.500[.110](.110)	-.509[.142](.142)	-.500[.143](.143)
		Normal Mixture, $n = 50$				Normal Mixture, $n = 100$			
.50	.50	.485[.106](.105)	.503[.107](.107)	.483[.139](.138)	.501[.139](.139)	.493[.071](.071)	.501[.072](.072)	.493[.094](.093)	.502[.095](.095)
	.25	.481[.112](.111)	.500[.113](.113)	.235[.173](.173)	.253[.176](.176)	.492[.074](.074)	.500[.074](.074)	.240[.116](.116)	.249[.117](.117)
	.00	.478[.115](.113)	.497[.115](.115)	-.021[.193](.192)	-.002[.195](.195)	.492[.076](.076)	.501[.077](.077)	-.006[.131](.131)	.004[.132](.132)
	-.25	.478[.113](.111)	.497[.113](.113)	-.270[.203](.202)	-.252[.207](.207)	.491[.076](.075)	.500[.076](.076)	-.259[.139](.138)	-.250[.139](.139)
	-.50	.480[.112](.110)	.497[.113](.112)	-.518[.208](.207)	-.500[.212](.212)	.493[.075](.074)	.500[.075](.075)	-.511[.141](.140)	-.501[.142](.142)
-.50	.50	-.509[.154](.154)	-.503[.160](.160)	.486[.142](.142)	.503[.144](.144)	-.499[.104](.104)	-.498[.106](.106)	.492[.094](.094)	.501[.095](.095)
	.25	-.499[.159](.159)	-.494[.166](.166)	.234[.171](.171)	.251[.174](.174)	-.501[.108](.108)	-.500[.110](.110)	.241[.114](.114)	.251[.116](.116)
	.00	-.507[.160](.160)	-.502[.166](.166)	-.019[.193](.192)	.001[.196](.196)	-.502[.110](.110)	-.501[.112](.112)	-.009[.132](.132)	.000[.133](.133)
	-.25	-.505[.160](.160)	-.499[.167](.167)	-.269[.206](.205)	-.248[.210](.210)	-.501[.110](.110)	-.500[.112](.112)	-.262[.140](.140)	-.253[.142](.142)
	-.50	-.502[.157](.157)	-.498[.164](.164)	-.514[.205](.205)	-.495[.210](.210)	-.499[.106](.106)	-.498[.108](.108)	-.508[.143](.143)	-.499[.145](.145)
		Lognormal Error, $n = 50$				Lognormal Error, $n = 100$			
.50	.50	.484[.102](.101)	.501[.104](.104)	.487[.133](.132)	.505[.135](.135)	.493[.068](.068)	.501[.069](.069)	.492[.090](.090)	.502[.091](.091)
	.25	.481[.108](.106)	.500[.108](.108)	.232[.163](.162)	.250[.166](.166)	.491[.073](.072)	.499[.074](.074)	.242[.113](.112)	.251[.114](.114)
	.00	.481[.107](.105)	.500[.109](.109)	-.018[.183](.182)	.001[.186](.186)	.492[.074](.073)	.500[.075](.075)	-.006[.127](.126)	.003[.128](.128)
	-.25	.482[.108](.106)	.500[.111](.111)	-.265[.193](.193)	-.246[.200](.200)	.491[.072](.071)	.499[.072](.072)	-.258[.136](.136)	-.248[.138](.138)
	-.50	.485[.105](.104)	.502[.107](.107)	-.515[.201](.200)	-.497[.208](.208)	.493[.072](.071)	.501[.072](.072)	-.508[.134](.134)	-.500[.137](.137)
-.50	.50	-.500[.150](.150)	-.495[.157](.157)	.484[.135](.135)	.503[.137](.137)	-.497[.100](.100)	-.497[.103](.103)	.490[.091](.090)	.500[.092](.092)
	.25	-.506[.154](.154)	-.500[.162](.162)	.233[.167](.166)	.252[.169](.169)	-.501[.105](.105)	-.500[.107](.107)	.240[.110](.110)	.249[.111](.111)
	.00	-.505[.156](.156)	-.499[.164](.164)	-.020[.189](.188)	-.001[.193](.193)	-.502[.105](.105)	-.501[.107](.107)	-.008[.126](.125)	.002[.127](.127)
	-.25	-.502[.153](.153)	-.497[.161](.161)	-.262[.196](.195)	-.244[.202](.202)	-.502[.103](.103)	-.502[.106](.106)	-.258[.136](.136)	-.248[.137](.137)
	-.50	-.508[.150](.150)	-.504[.157](.157)	-.518[.200](.199)	-.499[.206](.206)	-.499[.102](.102)	-.498[.105](.105)	-.512[.135](.135)	-.502[.138](.138)

Table 3a-rr. Replicates of Table 1a using $\beta = (.5\ .5)'$

λ	ρ	$\hat{\lambda}_N$	$\hat{\lambda}_N^{\text{bc2}}$	$\hat{\rho}_N$	$\hat{\rho}_N^{\text{bc2}}$	$\hat{\lambda}_N$	$\hat{\lambda}_N^{\text{bc2}}$	$\hat{\rho}_N$	$\hat{\rho}_N^{\text{bc2}}$
			Normal Error, $n = 50$				Normal Error, $n = 100$		
.50	.50	.475[.130](.128)	.497[.128](.128)	.481[.146](.145)	.501[.145](.145)	.491[.086](.086)	.501[.086](.086)	.488[.096](.095)	.497[.095](.095)
.50	.25	.477[.134](.132)	.500[.133](.133)	.228[.173](.171)	.248[.171](.171)	.492[.091](.090)	.502[.091](.091)	.244[.117](.117)	.252[.117](.117)
.50	.00	.475[.138](.136)	.498[.137](.137)	-.022[.194](.192)	-.001[.192](.192)	.489[.092](.092)	.500[.092](.092)	-.012[.134](.133)	-.003[.133](.133)
.50	-.25	.476[.132](.130)	.498[.131](.131)	-.272[.203](.202)	-.251[.203](.203)	.492[.091](.091)	.502[.091](.091)	-.256[.138](.138)	-.247[.138](.138)
.50	-.50	.475[.134](.131)	.497[.132](.132)	-.523[.207](.206)	-.503[.208](.208)	.489[.090](.089)	.498[.089](.089)	-.509[.143](.142)	-.500[.143](.143)
-.50	.50	-.501[.179](.179)	-.497[.184](.184)	.479[.143](.142)	.500[.141](.141)	-.501[.128](.128)	-.501[.130](.130)	.491[.096](.096)	.500[.096](.096)
-.50	.25	-.507[.184](.184)	-.502[.189](.189)	.233[.173](.172)	.254[.172](.171)	-.503[.130](.130)	-.502[.132](.132)	.242[.117](.117)	.251[.117](.117)
-.50	.00	-.502[.189](.189)	-.497[.194](.194)	-.026[.195](.194)	-.003[.193](.193)	-.500[.133](.133)	-.499[.135](.135)	-.009[.132](.131)	-.001[.132](.132)
-.50	-.25	-.504[.185](.185)	-.500[.190](.190)	-.272[.204](.203)	-.249[.204](.204)	-.498[.131](.131)	-.498[.133](.133)	-.260[.142](.142)	-.251[.142](.142)
-.50	-.50	-.498[.180](.180)	-.493[.185](.185)	-.523[.208](.207)	-.502[.209](.209)	-.499[.131](.131)	-.499[.133](.133)	-.505[.145](.145)	-.497[.145](.145)
			Normal Mixture, $n = 50$				Normal Mixture, $n = 100$		
.50	.50	.478[.125](.123)	.501[.124](.124)	.480[.142](.141)	.500[.140](.140)	.488[.085](.084)	.499[.084](.084)	.490[.095](.094)	.500[.094](.094)
.50	.25	.474[.133](.131)	.499[.131](.131)	.227[.176](.174)	.249[.173](.173)	.489[.090](.089)	.500[.089](.089)	.239[.118](.118)	.249[.117](.117)
.50	.00	.479[.132](.130)	.504[.131](.131)	-.025[.193](.192)	-.001[.191](.191)	.490[.091](.091)	.501[.091](.091)	-.010[.134](.133)	.001[.133](.133)
.50	-.25	.473[.136](.133)	.498[.134](.134)	-.278[.207](.205)	-.253[.206](.206)	.491[.088](.088)	.503[.088](.088)	-.262[.137](.137)	-.251[.137](.137)
.50	-.50	.478[.128](.126)	.502[.126](.126)	-.527[.208](.206)	-.503[.208](.208)	.488[.087](.087)	.499[.087](.087)	-.514[.141](.140)	-.503[.141](.141)
-.50	.50	-.509[.174](.174)	-.503[.178](.178)	.479[.145](.144)	.500[.143](.143)	-.506[.124](.124)	-.503[.126](.126)	.491[.094](.094)	.500[.094](.094)
-.50	.25	-.506[.179](.179)	-.498[.184](.184)	.229[.173](.172)	.251[.171](.171)	-.503[.130](.130)	-.500[.132](.132)	.240[.117](.117)	.251[.117](.117)
-.50	.00	-.504[.180](.180)	-.496[.185](.185)	-.022[.190](.189)	.002[.188](.188)	-.502[.129](.129)	-.499[.131](.131)	-.011[.132](.131)	.000[.131](.131)
-.50	-.25	-.508[.182](.182)	-.500[.187](.187)	-.272[.201](.200)	-.247[.200](.200)	-.501[.130](.130)	-.499[.132](.132)	-.262[.140](.139)	-.250[.139](.139)
-.50	-.50	-.509[.177](.177)	-.501[.182](.182)	-.523[.200](.199)	-.499[.201](.201)	-.501[.128](.128)	-.498[.130](.130)	-.511[.141](.140)	-.500[.141](.141)
			Lognormal Error, $n = 50$				Lognormal Error, $n = 100$		
.50	.50	.480[.122](.120)	.501[.121](.121)	.484[.134](.133)	.503[.134](.134)	.491[.082](.082)	.501[.082](.082)	.491[.089](.089)	.501[.089](.089)
.50	.25	.478[.125](.123)	.501[.124](.124)	.237[.163](.162)	.256[.162](.162)	.490[.083](.082)	.501[.082](.082)	.239[.111](.110)	.249[.110](.110)
.50	.00	.481[.126](.125)	.505[.126](.126)	-.014[.184](.184)	.005[.184](.183)	.491[.083](.083)	.502[.083](.083)	-.011[.126](.126)	-.001[.125](.125)
.50	-.25	.477[.127](.125)	.501[.125](.125)	-.266[.195](.194)	-.247[.194](.194)	.491[.085](.085)	.502[.085](.085)	-.260[.135](.135)	-.250[.135](.135)
.50	-.50	.477[.123](.121)	.501[.122](.122)	-.513[.199](.199)	-.495[.200](.200)	.490[.083](.082)	.500[.082](.082)	-.510[.139](.139)	-.499[.139](.139)
-.50	.50	-.502[.169](.169)	-.500[.174](.174)	.483[.135](.134)	.501[.134](.134)	-.500[.121](.121)	-.498[.122](.122)	.495[.090](.090)	.504[.090](.090)
-.50	.25	-.505[.174](.174)	-.502[.179](.179)	.236[.164](.163)	.255[.163](.163)	-.501[.127](.127)	-.499[.128](.128)	.240[.113](.112)	.250[.112](.112)
-.50	.00	-.504[.176](.176)	-.501[.182](.182)	-.013[.182](.181)	.006[.181](.181)	-.503[.128](.128)	-.501[.130](.130)	-.010[.126](.126)	.001[.125](.125)
-.50	-.25	-.505[.170](.170)	-.501[.175](.175)	-.269[.194](.193)	-.250[.193](.193)	-.501[.122](.122)	-.499[.123](.123)	-.260[.138](.138)	-.250[.138](.138)
-.50	-.50	-.503[.168](.168)	-.498[.173](.173)	-.524[.193](.191)	-.506[.193](.193)	-.501[.122](.122)	-.499[.124](.124)	-.511[.139](.139)	-.501[.140](.140)

Table 3b. Empirical Mean[rmse](sd) of Estimators of λ and ρ, 2FE-SPD Model with SARAR, $T = 3, \beta = (1,1)', \sigma = 1$, `Group Interaction, REG-2`

λ	ρ	$\hat\lambda_N$	$\hat\lambda_N^{\rm bc2}$	$\hat\rho_N$	$\hat\rho_N^{\rm bc2}$	$\hat\lambda_N$	$\hat\lambda_N^{\rm bc2}$	$\hat\rho_N$	$\hat\rho_N^{\rm bc2}$
		(a) Normal Error, $n = 50$				(b) Lognormal Error, $n = 50$			
.50	.50	.484[.095](.094)	.499[.092](.092)	.453[.156](.149)	.500[.129](.129)	.484[.089](.088)	.500[.087](.087)	.456[.146](.140)	.505[.121](.121)
	.25	.480[.103](.101)	.497[.099](.099)	.162[.238](.221)	.248[.194](.194)	.484[.096](.095)	.501[.093](.093)	.161[.237](.220)	.251[.193](.193)
	.00	.481[.104](.102)	.498[.100](.100)	-.120[.298](.272)	.001[.243](.243)	.486[.097](.096)	.501[.093](.093)	-.120[.301](.276)	.005[.247](.247)
	-.25	.481[.104](.102)	.496[.100](.100)	-.408[.362](.326)	-.257[.299](.299)	.488[.097](.096)	.502[.094](.094)	-.407[.365](.330)	-.252[.306](.306)
	-.50	.484[.099](.098)	.498[.096](.096)	-.685[.400](.354)	-.512[.335](.334)	.491[.095](.095)	.504[.093](.093)	-.682[.413](.370)	-.506[.354](.354)
-.50	.50	-.527[.218](.216)	-.499[.218](.218)	.453[.158](.150)	.501[.130](.130)	-.522[.214](.213)	-.494[.215](.215)	.458[.147](.141)	.507[.123](.122)
	.25	-.534[.237](.235)	-.505[.237](.236)	.164[.235](.219)	.251[.191](.191)	-.524[.226](.225)	-.495[.227](.227)	.171[.220](.205)	.259[.179](.179)
	.00	-.532[.239](.237)	-.504[.239](.239)	-.117[.301](.277)	.004[.249](.249)	-.528[.239](.237)	-.501[.239](.239)	-.114[.293](.270)	.010[.242](.242)
	-.25	-.530[.237](.235)	-.504[.237](.237)	-.407[.357](.320)	-.257[.295](.295)	-.519[.240](.240)	-.494[.241](.241)	-.396[.349](.317)	-.243[.293](.293)
	-.50	-.524[.233](.232)	-.500[.233](.233)	-.689[.403](.355)	-.518[.337](.336)	-.528[.251](.250)	-.505[.252](.252)	-.661[.399](.364)	-.489[.345](.345)
		(c) Normal Error, $n = 250$				(d) Lognormal Error, $n = 250$			
.50	.50	.497[.044](.044)	.501[.044](.044)	.477[.082](.079)	.500[.074](.074)	.497[.043](.043)	.500[.042](.042)	.477[.081](.078)	.500[.073](.073)
	.25	.497[.043](.043)	.500[.043](.043)	.209[.124](.117)	.250[.110](.110)	.497[.042](.042)	.500[.042](.042)	.209[.119](.112)	.250[.105](.105)
	.00	.497[.041](.040)	.499[.040](.040)	-.056[.161](.151)	.001[.142](.142)	.498[.040](.040)	.500[.039](.039)	-.056[.158](.148)	.002[.138](.138)
	-.25	.498[.038](.038)	.500[.038](.038)	-.327[.204](.189)	-.253[.178](.178)	.498[.038](.038)	.500[.038](.038)	-.322[.194](.180)	-.247[.169](.169)
	-.50	.499[.035](.035)	.500[.035](.035)	-.590[.232](.214)	-.501[.203](.203)	.500[.035](.035)	.501[.035](.035)	-.588[.229](.211)	-.497[.200](.200)
-.50	.50	-.508[.123](.122)	-.498[.122](.122)	.476[.082](.078)	.499[.073](.073)	-.509[.122](.121)	-.498[.121](.121)	.476[.081](.078)	.500[.073](.073)
	.25	-.510[.118](.118)	-.502[.118](.118)	.213[.121](.115)	.253[.108](.108)	-.504[.118](.118)	-.496[.118](.118)	.210[.120](.113)	.251[.106](.106)
	.00	-.507[.116](.116)	-.500[.116](.116)	-.063[.167](.155)	-.005[.146](.146)	-.509[.113](.113)	-.502[.113](.113)	-.058[.161](.150)	.000[.140](.140)
	-.25	-.502[.105](.105)	-.497[.105](.105)	-.326[.201](.186)	-.252[.175](.175)	-.507[.105](.105)	-.502[.105](.105)	-.320[.192](.179)	-.245[.169](.169)
	-.50	-.506[.099](.099)	-.502[.099](.099)	-.592[.235](.216)	-.503[.204](.204)	-.503[.100](.100)	-.499[.100](.100)	-.589[.234](.217)	-.498[.205](.205)
		(e) Normal Error, $n = 500$				(f) Lognormal Error, $n = 500$			
.50	.50	.498[.030](.030)	.500[.030](.030)	.484[.065](.063)	.500[.060](.060)	.498[.030](.030)	.500[.030](.030)	.484[.065](.063)	.501[.060](.060)
	.25	.499[.029](.029)	.500[.029](.029)	.220[.098](.093)	.248[.089](.089)	.498[.029](.029)	.500[.029](.029)	.223[.096](.092)	.252[.087](.087)
	.00	.500[.027](.027)	.501[.027](.027)	-.040[.128](.122)	.001[.116](.116)	.500[.027](.027)	.501[.027](.027)	-.044[.128](.120)	-.001[.114](.114)
	-.25	.500[.025](.025)	.501[.025](.025)	-.303[.160](.151)	-.249[.144](.144)	.500[.025](.025)	.501[.025](.025)	-.305[.158](.148)	-.249[.141](.141)
	-.50	.499[.023](.023)	.500[.023](.023)	-.562[.187](.176)	-.496[.168](.168)	.499[.022](.022)	.500[.022](.022)	-.565[.192](.180)	-.497[.172](.172)
-.50	.50	-.505[.087](.087)	-.500[.087](.087)	.485[.065](.063)	.500[.060](.060)	-.505[.085](.085)	-.499[.085](.085)	.484[.064](.062)	.501[.059](.059)
	.25	-.507[.082](.082)	-.503[.082](.082)	.220[.098](.094)	.248[.089](.089)	-.504[.081](.081)	-.500[.081](.081)	.223[.096](.092)	.252[.088](.088)
	.00	-.503[.075](.075)	-.500[.075](.075)	-.041[.131](.124)	.000[.118](.118)	-.502[.075](.075)	-.499[.075](.075)	-.044[.127](.119)	-.001[.113](.113)
	-.25	-.504[.070](.070)	-.502[.070](.070)	-.303[.161](.152)	-.249[.145](.145)	-.501[.071](.071)	-.499[.071](.071)	-.303[.159](.150)	-.248[.143](.143)
	-.50	-.501[.065](.065)	-.499[.065](.065)	-.569[.192](.179)	-.503[.171](.171)	-.502[.065](.065)	-.500[.065](.065)	-.562[.187](.176)	-.494[.168](.168)

Table 4. Empirical Means of the Non-Spatial Estimators, 2FE-SPD Model with SLD

`Group Interaction, REG2`, $T = 3$

λ	$\hat\beta_{1N}$	$\hat\beta_{2N}$	$\hat\sigma^2_N$	$\hat\beta^{\rm bc}_{1N}$	$\hat\beta^{\rm bc}_{2N}$	$\hat\sigma^{2,\rm bc}_N$	$\hat\beta_{1N}$	$\hat\beta_{2N}$	$\hat\sigma^2_N$	$\hat\beta^{\rm bc}_{1N}$	$\hat\beta^{\rm bc}_{2N}$	$\hat\sigma^{2,\rm bc}_N$
	(a) $\beta=(1,1)', \sigma=1$						(b) $\beta=(.5,.5)', \sigma=1$					
	Normal Error, n=50											
.50	1.041	1.035	0.984	0.996	0.998	0.992	0.533	0.530	0.985	0.496	0.499	0.991
.25	1.039	1.030	0.982	0.997	0.995	0.992	0.532	0.524	0.981	0.498	0.496	0.991
.00	1.035	1.023	0.980	0.997	0.992	0.992	0.529	0.519	0.978	0.498	0.494	0.991
-.25	1.032	1.023	0.978	0.997	0.995	0.992	0.524	0.519	0.975	0.496	0.496	0.992
-.50	1.030	1.019	0.974	0.999	0.994	0.989	0.527	0.514	0.970	0.501	0.494	0.990
	Normal Mixture, n=50											
.50	1.040	1.031	0.975	0.996	0.994	0.982	0.532	0.520	0.981	0.495	0.490	0.988
.25	1.041	1.030	0.973	1.000	0.996	0.982	0.531	0.523	0.973	0.497	0.495	0.983
.00	1.038	1.030	0.973	1.001	0.998	0.984	0.526	0.518	0.973	0.495	0.493	0.986
-.25	1.035	1.025	0.966	1.001	0.997	0.980	0.524	0.515	0.963	0.496	0.492	0.979
-.50	1.028	1.023	0.969	0.997	0.997	0.985	0.521	0.520	0.962	0.496	0.500	0.981
	Lognormal Error, n=50											
.50	1.036	1.031	0.944	0.994	0.995	0.951	0.529	0.523	0.946	0.493	0.493	0.952
.25	1.036	1.032	0.947	0.996	0.999	0.957	0.529	0.521	0.946	0.496	0.494	0.956
.00	1.028	1.020	0.936	0.992	0.990	0.947	0.525	0.519	0.944	0.495	0.494	0.957
-.25	1.029	1.019	0.942	0.996	0.992	0.955	0.522	0.517	0.943	0.494	0.494	0.959
-.50	1.026	1.017	0.940	0.996	0.993	0.956	0.518	0.514	0.926	0.494	0.494	0.945
	Normal Error, n=100											
.50	1.028	1.023	0.993	1.000	0.999	0.996	0.526	0.521	0.993	0.501	0.499	0.996
.25	1.027	1.019	0.991	1.000	0.996	0.995	0.524	0.517	0.990	0.500	0.496	0.995
.00	1.023	1.020	0.990	0.998	0.999	0.996	0.524	0.516	0.991	0.501	0.496	0.997
-.25	1.020	1.020	0.989	0.996	1.000	0.995	0.521	0.514	0.988	0.499	0.496	0.995
-.50	1.024	1.018	0.988	1.002	0.999	0.995	0.520	0.514	0.986	0.500	0.497	0.994
	Normal Mixture, n=100											
.50	1.026	1.022	0.990	0.998	0.998	0.993	0.523	0.518	0.988	0.497	0.497	0.991
.25	1.024	1.019	0.987	0.998	0.996	0.992	0.525	0.519	0.986	0.501	0.498	0.990
.00	1.022	1.018	0.985	0.997	0.996	0.990	0.522	0.515	0.985	0.499	0.496	0.991
-.25	1.023	1.018	0.987	1.000	0.998	0.994	0.523	0.517	0.983	0.501	0.499	0.991
-.50	1.022	1.019	0.982	1.000	1.001	0.989	0.518	0.515	0.983	0.498	0.498	0.992
	Lognormal Error, n=100											
.50	1.024	1.021	0.973	0.997	0.998	0.977	0.524	0.518	0.969	0.499	0.497	0.972
.25	1.025	1.023	0.964	1.000	1.002	0.968	0.522	0.516	0.966	0.498	0.496	0.971
.00	1.023	1.015	0.963	0.999	0.995	0.969	0.520	0.514	0.962	0.497	0.495	0.968
-.25	1.022	1.016	0.970	0.999	0.997	0.977	0.520	0.516	0.964	0.499	0.498	0.972
-.50	1.021	1.012	0.960	1.000	0.995	0.966	0.516	0.514	0.958	0.497	0.498	0.967
	Normal Error, n=250											
.50	1.011	1.010	0.997	0.999	0.998	0.999	0.512	0.512	0.997	0.499	0.499	0.998
.25	1.010	1.009	0.996	0.998	0.997	0.998	0.512	0.512	0.996	0.500	0.500	0.998
.00	1.009	1.009	0.996	0.998	0.997	0.998	0.509	0.509	0.996	0.497	0.497	0.998
-.25	1.009	1.010	0.996	0.997	0.998	0.999	0.508	0.511	0.995	0.497	0.500	0.998
-.50	1.009	1.010	0.995	0.998	0.999	0.998	0.511	0.510	0.994	0.500	0.499	0.997
	Normal Mixture, n=250											
.50	1.014	1.013	0.997	1.002	1.000	0.998	0.513	0.509	0.996	0.500	0.497	0.997
.25	1.012	1.010	0.993	1.000	0.998	0.995	0.512	0.511	0.995	0.500	0.498	0.996
.00	1.010	1.011	0.995	0.998	0.999	0.997	0.510	0.512	0.993	0.498	0.500	0.996
-.25	1.012	1.011	0.996	1.001	1.000	0.998	0.510	0.510	0.997	0.498	0.498	1.000
-.50	1.009	1.008	0.994	0.998	0.997	0.996	0.510	0.509	0.993	0.499	0.498	0.996
	Lognormal Error, n=250											
.50	1.011	1.010	0.986	0.999	0.998	0.987	0.511	0.511	0.982	0.498	0.498	0.983
.25	1.012	1.013	0.985	1.000	1.001	0.987	0.513	0.513	0.986	0.501	0.501	0.988
.00	1.010	1.009	0.983	0.998	0.998	0.985	0.511	0.511	0.984	0.499	0.499	0.987
-.25	1.010	1.009	0.982	0.999	0.997	0.985	0.512	0.510	0.984	0.500	0.498	0.987
-.50	1.007	1.007	0.985	0.996	0.997	0.987	0.509	0.508	0.983	0.498	0.497	0.986

Table 4-r. Empirical Means of the Non-Spatial Estimators, 2FE-SPD Model with SLD

$\beta = (1\ 1)'$, $\sigma = 1$, REG1, $T = 3$

λ	$\hat\beta_{1N}$	$\hat\beta_{2N}$	$\hat\sigma^2_N$	$\hat\beta^{\rm bc}_{1N}$	$\hat\beta^{\rm bc}_{2N}$	$\hat\sigma^{2,\rm bc}_N$	$\hat\beta_{1N}$	$\hat\beta_{2N}$	$\hat\sigma^2_N$	$\hat\beta^{\rm bc}_{1N}$	$\hat\beta^{\rm bc}_{2N}$	$\hat\sigma^{2,\rm bc}_N$
	(a) Group Interaction, iid Bootstrap						(b) Queen Contiguity, Wild Bootstrap					
	Normal Error, n=50											
.50	.999	.997	.982	.999	.996	.990	.998	.993	.980	.998	.992	.989
.25	.995	.999	.982	.997	.999	.992	.993	.998	.982	.993	.998	.992
.00	.993	.992	.981	.996	.993	.992	.998	.995	.980	.999	.996	.990
-.25	.991	.994	.978	.995	.996	.990	.996	.997	.979	.996	.997	.990
-.50	.993	.994	.975	.998	.997	.988	.997	.995	.981	.997	.995	.992
	Normal Mixture, n=50											
.50	.997	1.000	.978	.998	.999	.987	.993	.998	.974	.993	.997	.983
.25	.996	.998	.969	.997	.998	.979	.999	.997	.972	1.000	.997	.981
.00	.991	.999	.974	.993	1.000	.985	.995	.996	.972	.995	.996	.983
-.25	.993	.997	.973	.997	.999	.985	.994	.994	.971	.995	.994	.981
-.50	.995	.992	.973	.999	.995	.986	.997	.999	.976	.997	.999	.986
	Lognormal Error, n=50											
.50	.997	.997	.945	.997	.995	.953	.996	.999	.945	.996	.998	.954
.25	.999	.995	.942	1.000	.995	.951	.999	.995	.939	1.000	.995	.949
.00	.994	.991	.942	.997	.992	.952	.998	.997	.939	.999	.997	.949
-.25	.996	.996	.938	.999	.998	.950	.998	.995	.943	.998	.995	.953
-.50	.995	.997	.937	.999	1.000	.950	.996	.994	.939	.996	.994	.949
	Normal Error, n=100											
.50	1.001	1.000	.992	1.001	1.000	.996	1.001	1.000	.992	1.000	.998	.996
.25	.999	.997	.990	.999	.997	.995	.996	.996	.991	.996	.995	.996
.00	.996	.999	.989	.997	1.000	.995	.999	.999	.991	.998	.999	.996
-.25	.995	.999	.989	.997	1.001	.995	1.002	.998	.990	1.002	.998	.995
-.50	.996	.994	.989	.999	.997	.995	1.000	.998	.990	1.000	.998	.995
	Normal Mixture, n=100											
.50	.998	.999	.987	.998	.999	.991	.997	1.001	.986	.996	.999	.991
.25	.997	.998	.985	.997	.999	.989	1.001	.996	.989	1.000	.995	.994
.00	.999	.997	.984	1.000	.998	.989	1.001	.999	.990	1.001	.998	.995
-.25	.996	.997	.985	.998	.998	.991	1.000	.999	.985	1.000	.998	.991
-.50	.998	.996	.987	1.001	.998	.994	1.000	.998	.986	1.001	.998	.991
	Lognormal Error, n=100											
.50	.999	.999	.976	.999	.998	.980	1.000	.998	.968	.999	.996	.972
.25	.999	.998	.966	1.000	.999	.970	.999	.998	.965	.998	.997	.969
.00	.999	.998	.964	1.000	1.000	.969	.999	.998	.969	.999	.998	.974
-.25	.996	.998	.964	.998	1.000	.970	.998	1.001	.967	.998	1.001	.972
-.50	.997	.996	.968	.999	.998	.974	1.000	.997	.964	1.000	.997	.969
	Normal Error, n=250											
.50	1.000	1.002	.996	.999	1.001	.998	.999	1.001	.997	.999	1.001	.998
.25	.999	1.000	.997	.998	.999	.999	1.000	.999	.996	.999	.999	.998
.00	.999	.999	.996	.999	.998	.999	.999	.999	.996	.998	.998	.998
-.25	.997	.999	.996	.997	.999	.998	1.000	.999	.996	1.000	.999	.998
-.50	.998	1.000	.996	.998	1.000	.998	.999	.999	.996	.999	.999	.998
	Normal Mixture, n=250											
.50	1.000	1.001	.996	.999	1.000	.998	.999	1.002	.994	.999	1.001	.996
.25	1.000	1.001	.995	.999	1.000	.997	1.000	1.001	.993	1.000	1.000	.995
.00	1.000	.999	.995	1.000	.999	.997	.999	.998	.994	.999	.998	.996
-.25	.999	.999	.993	.999	.999	.995	.999	.997	.995	.999	.997	.997
-.50	.998	1.000	.994	.998	1.000	.997	1.000	1.001	.996	1.000	1.001	.998
	Lognormal Error, n=250											
.50	1.001	1.002	.986	1.000	1.001	.988	1.000	.998	.989	.999	.998	.991
.25	.999	.999	.987	.999	.999	.989	.999	.998	.983	.999	.997	.985
.00	1.000	.998	.984	1.000	.998	.986	.999	.999	.985	.999	.999	.987
-.25	1.000	1.000	.984	.999	1.000	.987	.998	.999	.983	.998	.999	.985
-.50	1.000	1.000	.986	1.000	1.000	.988	1.000	.998	.986	1.000	.998	.988

Table 5a. Empirical Sizes: Two-Sided Tests of Spatial Dependence in SARAR Model

`Group Interaction, REG2,` $T = 3, \beta = (1,1)', \sigma = 1$`, Wild Bootstrap`

n	Test	10%	5%	1%	10%	5%	1%	10%	5%	1%
		Normal Errors			Normal Mixture			Lognormal Errors		
					$H_0 : \lambda = \rho = 0$					
50	$\mathcal{W}_{11}$	.1974	.1288	.0546	.1918	.1232	.0450	.1616	.1062	.0456
	$\mathcal{W}_{22}$	.1896	.1196	.0516	.1846	.1222	.0470	.1584	.1008	.0408
	$\mathcal{W}_{33}$	.1520	.0906	.0388	.1428	.0874	.0302	.1318	.0778	.0300
100	$\mathcal{W}_{11}$	.1732	.1048	.0348	.1652	.0964	.0384	.1416	.0860	.0286
	$\mathcal{W}_{22}$	.1754	.1116	.0366	.1684	.1070	.0388	.1416	.0858	.0284
	$\mathcal{W}_{33}$	.1290	.0764	.0224	.1228	.0734	.0266	.1192	.0676	.0208
250	$\mathcal{W}_{11}$	.1406	.0808	.0208	.1364	.0736	.0198	.1104	.0620	.0162
	$\mathcal{W}_{22}$	.1390	.0788	.0234	.1350	.0758	.0206	.1170	.0712	.0196
	$\mathcal{W}_{33}$	.1148	.0618	.0174	.1102	.0576	.0154	.1026	.0564	.0170
500	$\mathcal{W}_{11}$	.1334	.0740	.0176	.1168	.0682	.0142	.1128	.0630	.0136
	$\mathcal{W}_{22}$	.1358	.0752	.0178	.1270	.0674	.0176	.1338	.0730	.0196
	$\mathcal{W}_{33}$	.1088	.0548	.0128	.1000	.0528	.0118	.1096	.0552	.0118
					$H_0 : \lambda = 0$, (true $\rho = 0$)					
50	$\mathcal{W}_{11}$	.1660	.1024	.0392	.1436	.0920	.0320	.1450	.0920	.0360
	$\mathcal{W}_{22}$	.1622	.1044	.0382	.1578	.0968	.0378	.1590	.0970	.0410
	$\mathcal{W}_{33}$	.1354	.0842	.0294	.1260	.0758	.0246	.1284	.0798	.0286
100	$\mathcal{W}_{11}$	.1362	.0798	.0256	.1352	.0812	.0268	.1302	.0734	.0230
	$\mathcal{W}_{22}$	.1532	.0908	.0282	.1494	.0906	.0294	.1332	.0758	.0230
	$\mathcal{W}_{33}$	.1174	.0668	.0212	.1162	.0686	.0202	.1186	.0670	.0178
250	$\mathcal{W}_{11}$	.1232	.0732	.0174	.1228	.0690	.0158	.1134	.0576	.0154
	$\mathcal{W}_{22}$	.1266	.0726	.0170	.1238	.0682	.0160	.1174	.0616	.0154
	$\mathcal{W}_{33}$	.1126	.0630	.0132	.1100	.0594	.0118	.1052	.0542	.0126
500	$\mathcal{W}_{11}$	.1108	.0578	.0142	.1094	.0556	.0116	.1116	.0616	.0138
	$\mathcal{W}_{22}$	.1198	.0588	.0148	.1120	.0576	.0128	.1198	.0662	.0160
	$\mathcal{W}_{33}$	.1050	.0530	.0122	.1030	.0524	.0098	.1070	.0572	.0130
					$H_0 : \rho = 0$ (true $\lambda = 0$)					
50	$\mathcal{W}_{11}$	.1730	.1054	.0392	.1714	.1070	.0382	.1498	.0902	.0328
	$\mathcal{W}_{22}$	.1366	.0850	.0326	.1418	.0822	.0312	.1202	.0692	.0192
	$\mathcal{W}_{33}$	.1268	.0794	.0280	.1214	.0710	.0262	.1056	.0598	.0170
100	$\mathcal{W}_{11}$	.1604	.0980	.0268	.1478	.0856	.0250	.1292	.0710	.0198
	$\mathcal{W}_{22}$	.1302	.0758	.0252	.1274	.0732	.0260	.1142	.0672	.0220
	$\mathcal{W}_{33}$	.1124	.0630	.0198	.1056	.0612	.0196	.0952	.0568	.0164
250	$\mathcal{W}_{11}$	.1358	.0742	.0192	.1304	.0724	.0192	.1030	.0506	.0122
	$\mathcal{W}_{22}$	.1216	.0694	.0166	.1226	.0670	.0176	.1036	.0552	.0168
	$\mathcal{W}_{33}$	.1074	.0570	.0132	.1054	.0556	.0126	.0880	.0456	.0132
500	$\mathcal{W}_{11}$	.1306	.0704	.0158	.1126	.0600	.0140	.0976	.0514	.0124
	$\mathcal{W}_{22}$	.1208	.0682	.0170	.1110	.0590	.0150	.1154	.0616	.0146
	$\mathcal{W}_{33}$	.1030	.0528	.0114	.0928	.0466	.0106	.0966	.0478	.0116

Note: $\mathcal{W}_{jj}$ are defined in (3.12) for joint tests and (3.13) for one-directional tests.

Table 5a-r. Empirical Sizes: Two-Sided Tests of Spatial Dependence in SARAR Model

`Group Interaction, REG2,` $T = 3, \beta = (1, 1)', \sigma = 1$`, iid Bootstrap`

n	Test	10%	5%	1%	10%	5%	1%	10%	5%	1%
		Normal Errors			Normal Mixture			Lognormal Errors		
					$H_0 : \lambda = \rho = 0$					
50	$\mathcal{W}_{11}$	.1738	.1114	.0392	.1616	.1038	.0426	.1390	.0896	.0374
	$\mathcal{W}_{22}$	.1556	.0978	.0332	.1454	.0906	.0368	.1326	.0824	.0346
	$\mathcal{W}_{33}$	.1390	.0824	.0252	.1322	.0778	.0296	.1180	.0730	.0302
100	$\mathcal{W}_{11}$	.1420	.0776	.0244	.1314	.0726	.0238	.1098	.0628	.0178
	$\mathcal{W}_{22}$	.1268	.0668	.0214	.1156	.0662	.0212	.1172	.0704	.0200
	$\mathcal{W}_{33}$	.1164	.0618	.0174	.1046	.0580	.0166	.0948	.0528	.0152
250	$\mathcal{W}_{11}$	.1266	.0654	.0174	.1196	.0638	.0126	.1088	.0580	.0154
	$\mathcal{W}_{22}$	.1242	.0666	.0150	.1114	.0604	.0132	.1086	.0566	.0146
	$\mathcal{W}_{33}$	.1126	.0606	.0118	.1004	.0534	.0106	.0962	.0492	.0124
500	$\mathcal{W}_{11}$	.1230	.0656	.0158	.1176	.0628	.0128	.1026	.0514	.0124
	$\mathcal{W}_{22}$	.1182	.0656	.0162	.1126	.0600	.0130	.1070	.0532	.0144
	$\mathcal{W}_{33}$	.1104	.0584	.0152	.1014	.0524	.0112	.0922	.0472	.0114
					$H_0 : \lambda = 0$, (true $\rho = 0$)					
50	$\mathcal{W}_{11}$	.1510	.0942	.0354	.1392	.0858	.0324	.1432	.0888	.0370
	$\mathcal{W}_{22}$	.1568	.1004	.0378	.1498	.0910	.0338	.1380	.0884	.0374
	$\mathcal{W}_{33}$	.1296	.0804	.0258	.1246	.0742	.0266	.1246	.0744	.0308
100	$\mathcal{W}_{11}$	.1242	.0748	.0188	.1222	.0692	.0174	.1136	.0620	.0168
	$\mathcal{W}_{22}$	.1224	.0734	.0194	.1198	.0686	.0188	.1250	.0726	.0208
	$\mathcal{W}_{33}$	.1096	.0622	.0144	.1066	.0578	.0146	.0992	.0552	.0142
250	$\mathcal{W}_{11}$	.1224	.0648	.0156	.1152	.0630	.0138	.1144	.0608	.0172
	$\mathcal{W}_{22}$	.1228	.0654	.0160	.1180	.0634	.0142	.1206	.0648	.0186
	$\mathcal{W}_{33}$	.1118	.0580	.0134	.1056	.0548	.0118	.1022	.0540	.0142
500	$\mathcal{W}_{11}$	.1114	.0612	.0134	.1102	.0568	.0132	.1046	.0544	.0128
	$\mathcal{W}_{22}$	.1134	.0618	.0144	.1142	.0588	.0132	.1100	.0610	.0152
	$\mathcal{W}_{33}$	.1026	.0552	.0114	.1032	.0504	.0118	.0970	.0510	.0122
					$H_0 : \rho = 0$ (true $\lambda = 0$)					
50	$\mathcal{W}_{11}$	.1530	.0882	.0256	.1494	.0906	.0316	.1248	.0744	.0266
	$\mathcal{W}_{22}$	.1104	.0582	.0136	.1098	.0622	.0192	.0994	.0572	.0212
	$\mathcal{W}_{33}$	.1154	.0634	.0176	.1160	.0648	.0214	.1030	.0600	.0212
100	$\mathcal{W}_{11}$	.1400	.0810	.0202	.1226	.0638	.0170	.1124	.0590	.0112
	$\mathcal{W}_{22}$	.1120	.0584	.0150	.0946	.0514	.0128	.0920	.0496	.0138
	$\mathcal{W}_{33}$	.1108	.0572	.0156	.0934	.0516	.0124	.0858	.0462	.0134
250	$\mathcal{W}_{11}$	.1184	.0636	.0122	.1164	.0614	.0120	.0988	.0514	.0104
	$\mathcal{W}_{22}$	.1098	.0552	.0104	.1004	.0504	.0130	.0910	.0460	.0120
	$\mathcal{W}_{33}$	.1082	.0530	.0102	.0962	.0480	.0120	.0836	.0426	.0108
500	$\mathcal{W}_{11}$	.1234	.0684	.0132	.1148	.0608	.0106	.0922	.0442	.0112
	$\mathcal{W}_{22}$	.1132	.0562	.0150	.1044	.0516	.0104	.0856	.0454	.0114
	$\mathcal{W}_{33}$	.1094	.0534	.0150	.1010	.0490	.0100	.0810	.0420	.0102

Note: $\mathcal{W}_{jj}$ are defined in (3.12) for joint tests and (3.13) for one-directional tests.

Table 5b. Empirical Sizes: Two-Sided Tests of $H_0 : \lambda = 0$ in SLD Model

`Group Interaction, REG2,` $T = 3, \beta = (1,1)', \sigma = 1$. $\mathcal{T}_{jj}$ `are defined in (3.14)`

n	Test	10%	5%	1%	10%	5%	1%	10%	5%	1%
		Normal Errors			Normal Mixture			Lognormal Errors		
50	$\mathcal{T}_{11}$	.1422	.0850	.0232	.1254	.0676	.0190	.1068	.0552	.0140
	$\mathcal{T}_{22}$	.1348	.0808	.0212	.1154	.0586	.0162	.1042	.0586	.0134
	$\mathcal{T}_{33}$	.1120	.0616	.0146	.0992	.0472	.0126	.0918	.0484	.0102
100	$\mathcal{T}_{11}$	.1224	.0622	.0174	.1186	.0660	.0136	.1070	.0590	.0116
	$\mathcal{T}_{22}$	.1142	.0604	.0128	.1214	.0654	.0158	.1108	.0600	.0130
	$\mathcal{T}_{33}$	.1004	.0478	.0102	.1046	.0518	.0118	.0958	.0502	.0084
250	$\mathcal{T}_{11}$	.1148	.0584	.0176	.1042	.0540	.0112	.1006	.0512	.0142
	$\mathcal{T}_{22}$	.1130	.0622	.0172	.1128	.0604	.0128	.1140	.0572	.0150
	$\mathcal{T}_{33}$	.1006	.0526	.0130	.0946	.0506	.0086	.0996	.0466	.0124
500	$\mathcal{T}_{11}$	.1126	.0560	.0106	.1082	.0528	.0122	.0970	.0472	.0082
	$\mathcal{T}_{22}$	.1154	.0646	.0140	.1066	.0564	.0118	.1064	.0554	.0106
	$\mathcal{T}_{33}$	.1010	.0554	.0110	.0972	.0484	.0104	.0960	.0474	.0080

Table 5c. Empirical Sizes: Two-Sided Tests of $H_0 : \rho = 0$ in SED Model

`Group Interaction, REG2,` $T = 3, \beta = (1,1)', \sigma = 1$. $\mathcal{T}_{jj}$ `are defined in (3.14)`

n	Test	10%	5%	1%	10%	5%	1%	10%	5%	1%
		Normal Errors			Normal Mixture			Lognormal Errors		
50	$\mathcal{T}_{11}$	.1572	.0920	.0282	.1492	.0846	.0236	.1282	.0666	.0164
	$\mathcal{T}_{22}$	.1386	.0758	.0234	.1242	.0734	.0220	.1030	.0572	.0152
	$\mathcal{T}_{33}$	.1146	.0620	.0172	.1152	.0640	.0176	.0928	.0518	.0142
100	$\mathcal{T}_{11}$	.1420	.0798	.0224	.1324	.0738	.0142	.1170	.0598	.0126
	$\mathcal{T}_{22}$	.1274	.0736	.0202	.1248	.0700	.0160	.1010	.0550	.0140
	$\mathcal{T}_{33}$	.1116	.0594	.0154	.1054	.0540	.0112	.0840	.0444	.0116
250	$\mathcal{T}_{11}$	.1224	.0630	.0140	.1128	.0568	.0114	.1028	.0544	.0124
	$\mathcal{T}_{22}$	.1190	.0656	.0172	.1096	.0560	.0142	.1056	.0566	.0166
	$\mathcal{T}_{33}$	.1006	.0518	.0124	.0882	.0450	.0114	.0880	.0466	.0114
500	$\mathcal{T}_{11}$	.1124	.0578	.0120	.1126	.0526	.0098	.1004	.0518	.0116
	$\mathcal{T}_{22}$	.1136	.0624	.0142	.1202	.0604	.0148	.1164	.0610	.0178
	$\mathcal{T}_{33}$	.0952	.0492	.0098	.1004	.0482	.0108	.0982	.0476	.0126

Table 6. Empirical Sizes: Two-Sided Tests of $H_0 : \beta_1 = \beta_2$ in SARAR Model

`Group Interaction, REG2,` $T = 3, \sigma = 1, \lambda = \rho = 0$

n	Test	10%	5%	1%	10%	5%	1%	10%	5%	1%
		Normal Errors			Normal Mixture			Lognormal Errors		
50	$\mathcal{T}_{11}$	.1608	.1020	.0386	.1630	.1046	.0386	.1604	.0978	.0344
	$\mathcal{T}_{22}$	.1154	.0650	.0214	.1190	.0678	.0206	.1138	.0614	.0204
100	$\mathcal{T}_{11}$	.1334	.0744	.0228	.1344	.0794	.0218	.1334	.0782	.0218
	$\mathcal{T}_{22}$	.1012	.0546	.0138	.1042	.0536	.0126	.1032	.0534	.0120
250	$\mathcal{T}_{11}$	.1240	.0642	.0166	.1210	.0680	.0204	.1196	.0670	.0184
	$\mathcal{T}_{22}$	.1066	.0524	.0120	.1060	.0564	.0152	.1018	.0580	.0114
500	$\mathcal{T}_{11}$	.1092	.0548	.0116	.1100	.0564	.0140	.1154	.0616	.0200
	$\mathcal{T}_{22}$	.0958	.0472	.0092	.0978	.0472	.0100	.1022	.0536	.0146
50	$\mathcal{T}_{11}$	.1624	.1004	.0376	.1624	.1024	.0390	.1610	.0992	.0376
	$\mathcal{T}_{22}$	.1136	.0654	.0196	.1204	.0666	.0208	.1136	.0640	.0216
100	$\mathcal{T}_{11}$	.1282	.0742	.0196	.1394	.0810	.0208	.1420	.0808	.0250
	$\mathcal{T}_{22}$	.0968	.0496	.0114	.1068	.0540	.0090	.1060	.0564	.0118
250	$\mathcal{T}_{11}$	.1254	.0688	.0190	.1224	.0642	.0140	.1146	.0622	.0180
	$\mathcal{T}_{22}$	.1050	.0568	.0142	.1024	.0480	.0094	.0990	.0526	.0132
500	$\mathcal{T}_{11}$	.1240	.0626	.0152	.1130	.0594	.0130	.1220	.0650	.0160
	$\mathcal{T}_{22}$	.1102	.0502	.0124	.0978	.0482	.0096	.1084	.0552	.0122

Note: $\beta = (1,1)'$ for upper panel, and $(.5,.5)'$ for lower panel. $\mathcal{T}_{jj}$ are defined in (3.15).

Table 6-r. Empirical Sizes: Two-Sided Tests of $H_0 : \beta_1 = \beta_2$ in SARAR Model

`Group Interaction, REG2,` $T = 3, \sigma = 1, \lambda = 0, \rho = 0$.

n	Test	10%	5%	1%	10%	5%	1%	10%	5%	1%
		Normal Errors			Normal Mixture			Lognormal Errors		
		`iid Bootstrap, RGE2`, $k = n^{0.6}$, $\beta = (1,\ 1)'$								
50	1	.1424	.0806	.0232	.1314	.0748	.0218	.1294	.0722	.0232
	2	.1126	.0582	.0154	.1078	.0548	.0152	.1014	.0566	.0142
100	1	.1202	.0684	.0180	.1190	.0672	.0198	.1168	.0628	.0178
	2	.1062	.0582	.0142	.1046	.0556	.0146	.1022	.0530	.0142
		$\beta = (.5,\ .5)'$								
50	1	.1376	.0770	.0224	.1338	.0804	.0212	.1294	.0746	.0220
	2	.1066	.0564	.0136	.1068	.0574	.0134	.1026	.0574	.0126
100	1	.1184	.0648	.0166	.1164	.0666	.0158	.1224	.0656	.0168
	2	.1022	.0540	.0132	.1046	.0534	.0118	.1062	.0536	.0114
		`Wild Bootstrap, RGE2`, $k = n^{0.6}$, $\beta = (1,\ 1)'$								
50	1	.1398	.0756	.0224	.1326	.0774	.0252	.1298	.0796	.0212
	2	.1256	.0680	.0180	.1240	.0694	.0214	.1220	.0704	.0214
100	1	.1098	.0620	.0186	.1172	.0616	.0160	.1184	.0634	.0180
	2	.1060	.0598	.0162	.1106	.0606	.0132	.1132	.0588	.0138
		$\beta = (.5,\ .5)'$								
50	1	.1370	.0738	.0204	.1346	.0812	.0230	.1412	.0800	.0214
	2	.1200	.0646	.0174	.1252	.0710	.0192	.1218	.0678	.0190
100	1	.1236	.0704	.0184	.1198	.0636	.0176	.1170	.0628	.0154
	2	.1210	.0684	.0190	.1118	.0578	.0142	.1106	.0582	.0120
		`iid Bootstrap, RGE1`, $k = n^{0.5}$, $\beta = (1,\ 1)'$								
50	1	.1166	.0602	.0126	.1202	.0598	.0146	.1058	.0552	.0128
	2	.1150	.0600	.0128	.1204	.0596	.0148	.1082	.0536	.0130
100	1	.1076	.0596	.0138	.1108	.0600	.0142	.1122	.0570	.0152
	2	.1050	.0610	.0134	.1120	.0584	.0138	.1108	.0548	.0150
		$\beta = (.5,\ .5)'$								
50	1	.1132	.0612	.0128	.1216	.0644	.0152	.0984	.0542	.0144
	2	.1148	.0598	.0136	.1192	.0646	.0162	.1016	.0556	.0142
100	1	.1112	.0628	.0134	.1064	.0556	.0124	.1054	.0536	.0098
	2	.1110	.0614	.0134	.1054	.0540	.0120	.1052	.0528	.0096

Note: Test 1 = $\mathcal{T}_{11}$, and Test 2 = $\mathcal{T}_{22}$, which are defined in (3.15).

Table 6-rr. Empirical Sizes: Two-Sided Tests of $H_0 : \beta_1 = \beta_2$ in SARAR Model

`Group Interaction, REG2,` $T = 3, \sigma = 1, \lambda = .25, \rho = .25$.

n	Test	10%	5%	1%	10%	5%	1%	10%	5%	1%
		Normal Errors			Normal Mixture			Lognormal Errors		
						iid Bootstrap, RGE1, $k = n^{0.5}$, $\beta = (1,\ 1)'$				
50	1	.1112	.0604	.0124	.1124	.0554	.0116	.1120	.0600	.0118
	2	.1144	.0602	.0136	.1154	.0586	.0110	.1136	.0614	.0132
100	1	.1136	.0570	.0120	.1056	.0578	.0108	.1018	.0548	.0112
	2	.1136	.0578	.0118	.1072	.0578	.0120	.1018	.0558	.0122
										$\beta = (.5,\ .5)'$
50	1	.1114	.0606	.0126	.1206	.0626	.0160	.1188	.0602	.0162
	2	.1148	.0598	.0138	.1220	.0644	.0160	.1218	.0628	.0166
100	1	.1072	.0530	.0094	.1006	.0480	.0096	.1030	.0508	.0134
	2	.1086	.0564	.0108	.1030	.0498	.0098	.1030	.0526	.0130
						iid Bootstrap, RGE2, $k = n^{0.5}$, $\beta = (1,\ 1)'$				
50	1	.1484	.0882	.0310	.1428	.0842	.0286	.1402	.0820	.0260
	2	.1138	.0644	.0194	.1114	.0600	.0186	.1088	.0570	.0158
100	1	.1290	.0752	.0256	.1228	.0734	.0214	.1256	.0702	.0222
	2	.1022	.0554	.0154	.1006	.0528	.0124	.0980	.0516	.0144
										$\beta = (.5,\ .5)'$
50	1	.1496	.0900	.0308	.1510	.0836	.0274	.1492	.0894	.0306
	2	.1146	.0636	.0212	.1124	.0572	.0158	.1120	.0626	.0180
100	1	.1306	.0742	.0208	.1292	.0728	.0230	.1394	.0790	.0238
	2	.1012	.0508	.0108	.0992	.0504	.0138	.1084	.0574	.0144
						Wild Bootstrap, RGE2, $k = n^{0.5}$, $\beta = (1,\ 1)'$				
50	1	.1484	.0888	.0312	.1388	.0798	.0276	.1456	.0880	.0306
	2	.1268	.0730	.0244	.1108	.0608	.0200	.1244	.0718	.0186
100	1	.1330	.0740	.0210	.1356	.0758	.0244	.1284	.0716	.0248
	2	.1074	.0648	.0170	.1166	.0644	.0192	.1120	.0624	.0186
										$\beta = (.5,\ .5)'$
50	1	.1502	.0898	.0316	.1406	.0836	.0264	.1436	.0806	.0280
	2	.1270	.0722	.0250	.1120	.0602	.0188	.1106	.0616	.0154
100	1	.1272	.0754	.0212	.1330	.0730	.0226	.1406	.0784	.0224
	2	.1076	.0606	.0150	.1116	.0568	.0172	.1206	.0644	.0176

Note: Test 1 = $\mathcal{T}_{11}$, and Test 2 = $\mathcal{T}_{22}$, which are defined in (3.15).

Table 7: QMLEs and Bias-Corrected QMLEs for the SPD-FE Models Based on the Full Data (Years 1970-86).

	SARAR		SAR		SED		Durbin-SAR		Durbin-SED	
	$\hat{\theta}_{\text{ML}}$	$\hat{\theta}^{\text{bc2}}_{\text{ML}}$	$\hat{\theta}_{\text{ML}}$	$\hat{\theta}^{\text{bc2}}_{\text{ML}}$	$\hat{\theta}_{\text{ML}}$	$\hat{\theta}^{\text{bc2}}_{\text{ML}}$	$\hat{\theta}_{\text{ML}}$	$\hat{\theta}^{\text{bc2}}_{\text{ML}}$	$\hat{\theta}_{\text{ML}}$	$\hat{\theta}^{\text{bc2}}_{\text{ML}}$
SLD effect (λ)	0.0270	0.0294	0.2100	0.2129			0.4124	0.4205		
s.e	(0.0384)	(0.0388)	(0.0284)	(0.0287)			(0.0433)	(0.0440)		
t-ratio	0.7037	0.7563	7.3923	7.4118			9.5186	9.5559		
SED effect (ρ)	0.4068	0.4095			0.4374	0.4403			0.4101	0.4168
s.e	(0.0536)	(0.0552)			(0.0425)	(0.0429)			0.0436	(0.0443)
t-ratio	7.5937	7.4208			10.2813	10.2547			9.4120	9.4037
lg($pcap$)	-0.0145	-0.0145	-0.0352	-0.0352	-0.0122	-0.0121	-0.0090	-0.0088	-0.0184	-0.0183
s.e	(0.0258)	(0.0254)	(0.0258)	(0.0256)	(0.0257)	(0.0251)	(0.0433)	(0.0258)	0.0268	(0.0263)
t-ratio	-0.5599	-0.5697	-1.3637	-1.3771	-0.4749	-0.4817	-0.3420	-0.3430	-0.6867	-0.6960
lg(pcp)	0.1553	0.1553	0.1585	0.1583	0.1548	0.1547	0.1591	0.1591	0.1662	0.1662
s.e	(0.0265)	(0.0264)	(0.0265)	(0.0258)	(0.0264)	(0.0264)	(0.0266)	(0.0264)	0.0272	(0.0268)
t-ratio	5.8638	5.8822	5.9803	6.1402	5.8581	5.8662	5.9888	6.0288	6.1140	6.1957
lg(emp)	0.7555	0.7553	0.6824	0.6812	0.7584	0.7583	0.7514	0.7515	0.7539	0.7539
s.e	(0.0294)	(0.0298)	(0.0298)	(0.0302)	(0.0290)	(0.0294)	(0.0299)	(0.0301)	0.0294	(0.0297)
t-ratio	25.7262	25.3540	22.8939	22.5454	26.1169	25.7695	25.1208	24.9504	25.6309	25.4225
$unemp$	-0.0012	-0.0012	-0.0015	-0.0015	-0.0012	-0.0012	-0.0006	-0.0006	-0.0009	-0.0009
s.e	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0006)	(0.0005)	0.0005	(0.0005)
t-ratio	-2.3652	-2.3935	-3.1327	-3.1614	-2.3511	-2.3807	-1.1295	-1.1574	-1.7158	-1.7599
$W \cdot$ lg($pcap$)							-0.0567	-0.0558	-0.0750	-0.0745
s.e							(0.0481)	(0.0475)	0.0575	(0.0569)
t-ratio							-1.1809	-1.1734	-1.3044	-1.3110
$W \cdot$ lg(pcp)							0.0066	0.0046	0.0901	0.0897
s.e							(0.0476)	(0.0483)	0.0594	(0.0608)
t-ratio							0.1391	0.0950	1.5161	1.4757
$W \cdot$ lg(emp)							-0.3159	-0.3228	-0.0130	-0.0141
s.e							(0.0544)	(0.0556)	0.0507	(0.0510)
t-ratio							-5.8105	-5.7999	-0.2559	-0.2758
$W \cdot unemp$							-0.0013	-0.0013	-0.0017	-0.0017
s.e							(0.0008)	(0.0008)	0.0010	(0.0010)
t-ratio							-1.5365	-1.5334	-1.7525	-1.7440

Table 8: QMLEs and Bias-Corrected QMLEs for the SPD-FE Models Based on a Subset Data (Years 1982-84).

	SARAR		SAR		SED		Durbin-SAR		Durbin-SED	
	$\hat{\theta}_{\text{ML}}$	$\hat{\theta}_{\text{ML}}^{\text{bc2}}$	$\hat{\theta}_{\text{ML}}$	$\hat{\theta}_{\text{ML}}^{\text{bc2}}$	$\hat{\theta}_{\text{ML}}$	$\hat{\theta}_{\text{ML}}^{\text{bc2}}$	$\hat{\theta}_{\text{ML}}$	$\hat{\theta}_{\text{ML}}^{\text{bc2}}$	$\hat{\theta}_{\text{ML}}$	$\hat{\theta}_{\text{ML}}^{\text{bc2}}$
SLD effect (λ)	0.0552	0.0524	0.3074	0.3231			0.4963	0.5635		
s.e	(0.1218)	(0.1326)	(0.0763)	(0.0804)			(0.1117)	(0.1225)		
t-ratio	0.4529	0.3948	4.0296	4.0207			4.4443	4.6018		
SED effect (ρ)	0.5516	0.5940			0.6160	0.6371			0.5230	0.5788
s.e	(0.1360)	(0.1545)			(0.0979)	(0.1028)			(0.1104)	(0.1274)
t-ratio	4.0558	3.8449			6.2920	6.1987			4.7379	4.5433
lg($pcap$)	-0.2469	-0.2361	-0.2839	-0.2799	-0.2322	-0.2262	-0.1069	-0.1108	-0.1168	-0.1161
s.e	(0.1046)	(0.1133)	(0.0853)	(0.0883)	(0.1065)	(0.1135)	(0.1177)	(0.1230)	(0.1139)	(0.1176)
t-ratio	-2.3605	-2.0841	-3.3297	-3.1705	-2.1801	-1.9933	-0.9088	-0.9007	-1.0261	-0.9876
lg(pcp)	0.5663	0.5368	0.5132	0.4902	0.5522	0.5344	0.3309	0.3325	0.4619	0.4768
s.e	(0.2343)	(0.2478)	(0.2078)	(0.2164)	(0.2289)	(0.2415)	(0.2439)	(0.2522)	(0.2328)	(0.2392)
t-ratio	2.4170	2.1668	2.4694	2.2659	2.4118	2.2126	1.3570	1.3184	1.9837	1.9932
lg(emp)	1.1873	1.1880	1.1149	1.1113	1.1796	1.1795	1.1393	1.1385	1.1046	1.0963
s.e	(0.0848)	(0.0862)	(0.0877)	(0.0890)	(0.0826)	(0.0828)	(0.0863)	(0.0886)	(0.0911)	(0.0942)
t-ratio	13.9952	13.7878	12.7139	12.4853	14.2798	14.2521	13.1989	12.8462	12.1188	11.6417
$unemp$	-0.0009	-0.0008	-0.0014	-0.0014	-0.0008	-0.0008	-0.0010	-0.0010	-0.0015	-0.0015
s.e	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
t-ratio	-1.0818	-1.0203	-1.7243	-1.6917	-1.0505	-1.0297	-1.3149	-1.2655	-1.7725	-1.8093
$W \cdot$ lg($pcap$)							-0.0698	-0.0302	-0.1609	-0.1305
s.e							(0.1751)	(0.1816)	(0.2069)	(0.2134)
t-ratio							-0.3984	-0.1663	-0.7779	-0.6117
$W \cdot$ lg(pcp)							0.3929	0.3195	0.9698	0.9718
s.e							(0.3661)	(0.3858)	(0.4193)	(0.4364)
t-ratio							1.0732	0.8280	2.3128	2.2267
$W \cdot$ lg(emp)							-0.6881	-0.7761	-0.2377	-0.2664
s.e							(0.1959)	(0.2076)	(0.1862)	(0.1937)
t-ratio							-3.5131	-3.7384	-1.2768	-1.3755
$W \cdot unemp$							-0.0023	-0.0022	-0.0034	-0.0033
s.e							(0.0015)	(0.0015)	(0.0018)	(0.0018)
t-ratio							-1.5803	-1.4514	-1.9087	-1.8428

Additional References

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