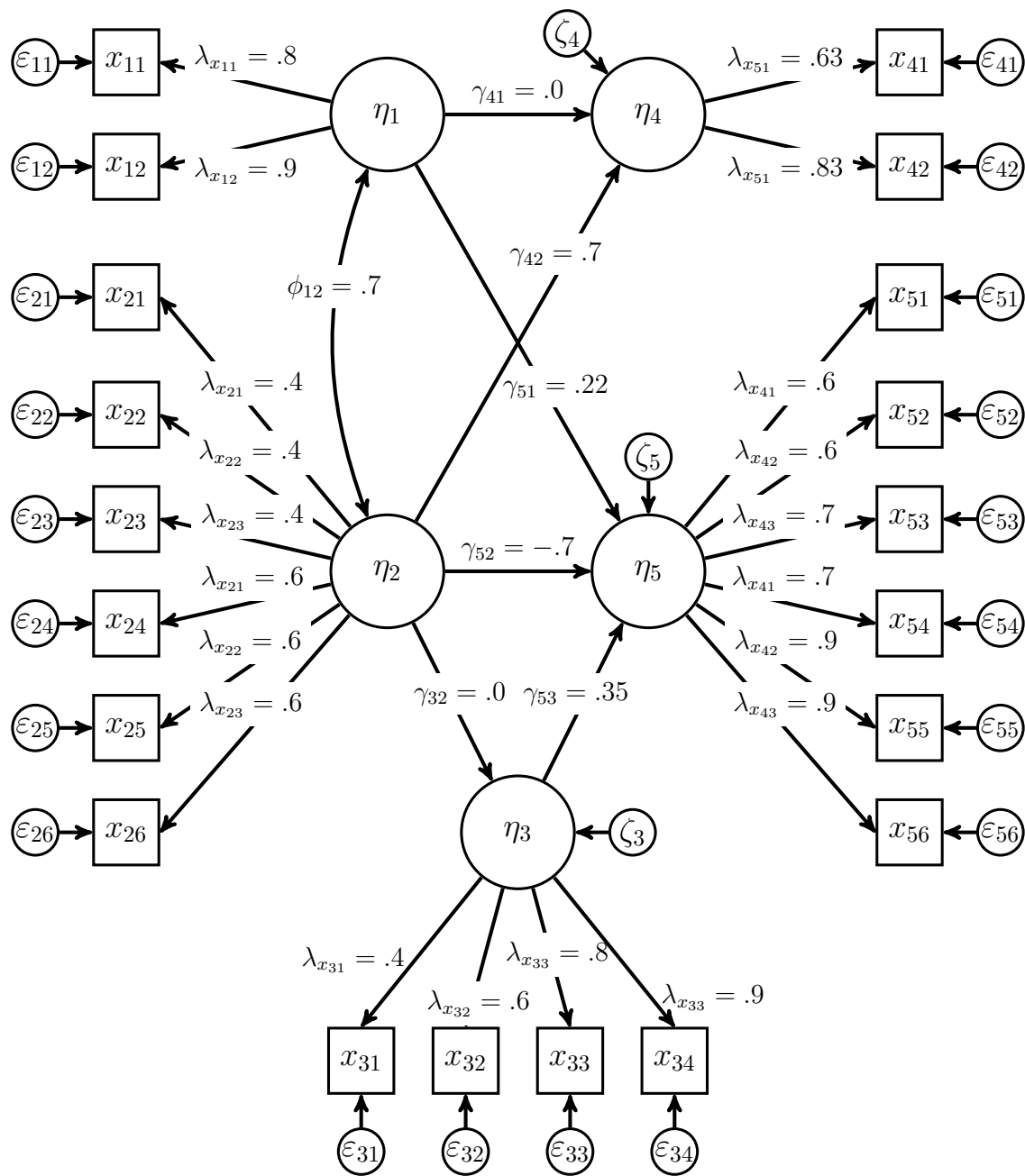


# 1 Additional population models

## 1.1 Population model containing five common factors



**Figure 1** Population model containing five common factors

Indicator's population correlation matrix for the population model containing five common factors:<sup>1</sup>

$$\Sigma = \begin{pmatrix} \underline{x_{11}} & \underline{x_{12}} & \underline{x_{21}} & \underline{x_{22}} & \underline{x_{23}} & \underline{x_{24}} & \underline{x_{25}} & \underline{x_{26}} & \underline{x_{31}} & \underline{x_{32}} & \underline{x_{33}} & \underline{x_{34}} & \underline{x_{41}} & \underline{x_{42}} & \underline{x_{51}} & \underline{x_{52}} & \underline{x_{53}} & \underline{x_{54}} & \underline{x_{55}} & \underline{x_{56}} \\ 1.000 & & & & & & & & & & & & & & & & & & & & \\ 0.720 & 1.000 & & & & & & & & & & & & & & & & & & & \\ 0.224 & 0.252 & 1.000 & & & & & & & & & & & & & & & & & & \\ 0.224 & 0.252 & 0.160 & 1.000 & & & & & & & & & & & & & & & & & \\ 0.224 & 0.252 & 0.160 & 0.160 & 1.000 & & & & & & & & & & & & & & & & \\ 0.336 & 0.378 & 0.240 & 0.240 & 0.240 & 1.000 & & & & & & & & & & & & & & & \\ 0.336 & 0.378 & 0.240 & 0.240 & 0.240 & 0.360 & 1.000 & & & & & & & & & & & & & & \\ 0.336 & 0.378 & 0.240 & 0.240 & 0.240 & 0.360 & 0.360 & 1.000 & & & & & & & & & & & & & \\ 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 1.000 & & & & & & & & & & & & \\ 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.240 & 1.000 & & & & & & & & & & & \\ 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.320 & 0.480 & 1.000 & & & & & & & & & & \\ 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.360 & 0.540 & 0.720 & 1.000 & & & & & & & & & \\ 0.235 & 0.265 & 0.168 & 0.168 & 0.168 & 0.252 & 0.252 & 0.252 & 0.000 & 0.000 & 0.000 & 0.000 & 1.000 & & & & & & & & \\ 0.314 & 0.353 & 0.224 & 0.224 & 0.224 & 0.336 & 0.336 & 0.336 & 0.000 & 0.000 & 0.000 & 0.000 & 0.480 & 1.000 & & & & & & & \\ -0.139 & -0.157 & -0.134 & -0.134 & -0.134 & -0.202 & -0.202 & -0.202 & 0.072 & 0.108 & 0.144 & 0.162 & -0.141 & -0.188 & 1.000 & & & & & & \\ -0.139 & -0.157 & -0.134 & -0.134 & -0.134 & -0.202 & -0.202 & -0.202 & 0.072 & 0.108 & 0.144 & 0.162 & -0.141 & -0.188 & 0.360 & 1.000 & & & & & \\ -0.162 & -0.183 & -0.157 & -0.157 & -0.157 & -0.235 & -0.235 & -0.235 & 0.084 & 0.126 & 0.168 & 0.189 & -0.165 & -0.220 & 0.420 & 0.420 & 1.000 & & & & \\ -0.162 & -0.183 & -0.157 & -0.157 & -0.157 & -0.235 & -0.235 & -0.235 & 0.084 & 0.126 & 0.168 & 0.189 & -0.165 & -0.220 & 0.420 & 0.420 & 0.490 & 1.000 & & & \\ -0.209 & -0.235 & -0.202 & -0.202 & -0.202 & -0.302 & -0.302 & -0.302 & 0.108 & 0.162 & 0.216 & 0.243 & -0.212 & -0.282 & 0.540 & 0.540 & 0.630 & 0.630 & 1.000 & & \\ -0.209 & -0.235 & -0.202 & -0.202 & -0.202 & -0.302 & -0.302 & -0.302 & 0.108 & 0.162 & 0.216 & 0.243 & -0.212 & -0.282 & 0.540 & 0.540 & 0.630 & 0.630 & 0.810 & 1.000 \end{pmatrix} \quad (1)$$

<sup>1</sup>All correlations are rounded on three decimal places.

1.2 Population model containing five composites

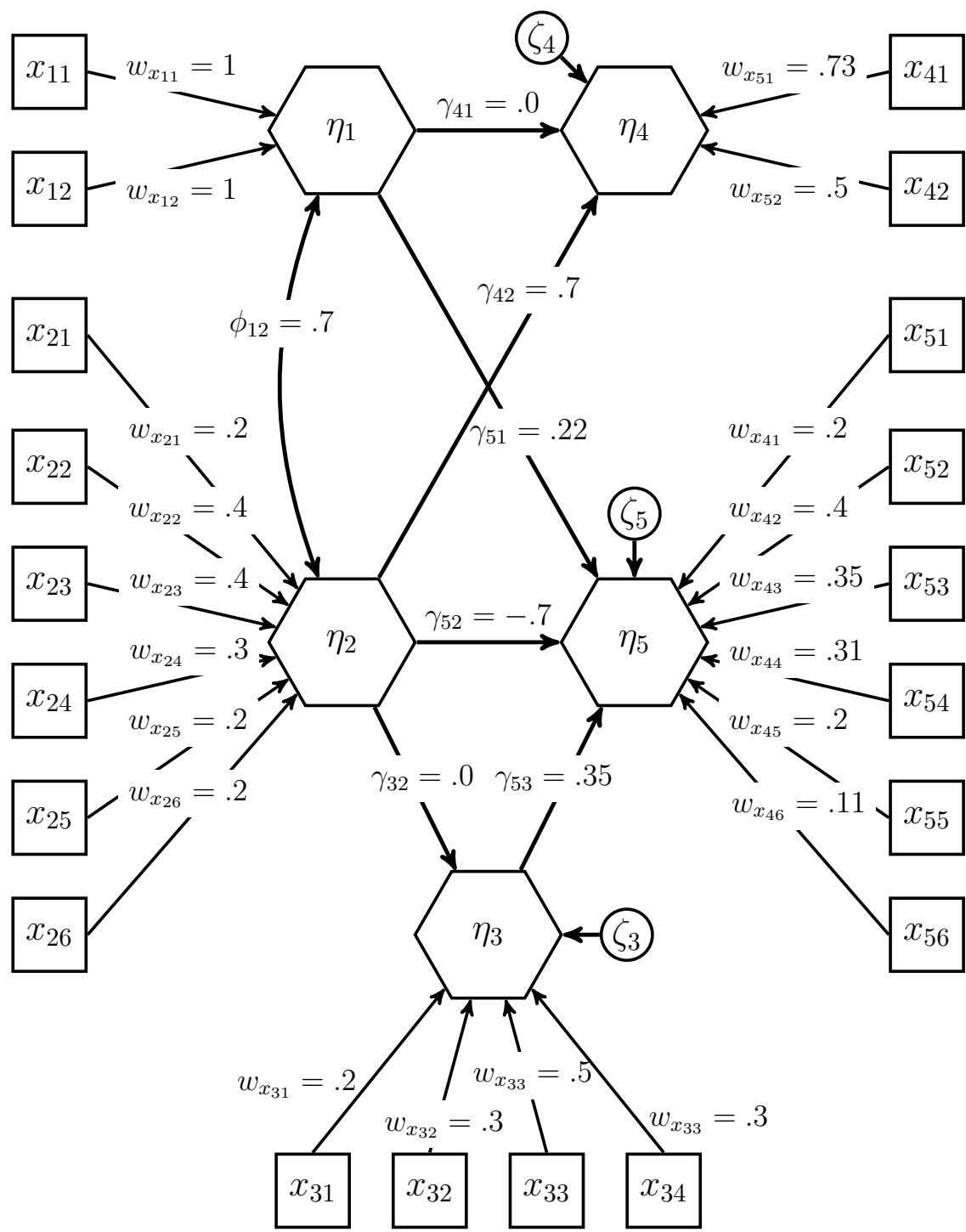


Figure 2 Population model containing five composites

Indicator's population matrix for the population model containing five composites:<sup>2</sup>

$$\Sigma = \begin{pmatrix} \underline{x_{11}} & \underline{x_{12}} & \underline{x_{21}} & \underline{x_{22}} & \underline{x_{23}} & \underline{x_{24}} & \underline{x_{25}} & \underline{x_{26}} & \underline{x_{31}} & \underline{x_{32}} & \underline{x_{33}} & \underline{x_{34}} & \underline{x_{41}} & \underline{x_{42}} & \underline{x_{51}} & \underline{x_{52}} & \underline{x_{53}} & \underline{x_{54}} & \underline{x_{55}} & \underline{x_{56}} \\ 1.000 & & & & & & & & & & & & & & & & & & & & \\ -0.500 & 1.000 & & & & & & & & & & & & & & & & & & & \\ 0.192 & 0.192 & 1.000 & & & & & & & & & & & & & & & & & & \\ 0.230 & 0.230 & 0.250 & 1.000 & & & & & & & & & & & & & & & & & \\ 0.230 & 0.230 & 0.250 & 0.160 & 1.000 & & & & & & & & & & & & & & & & \\ 0.228 & 0.228 & 0.250 & 0.240 & 0.240 & 1.000 & & & & & & & & & & & & & & & \\ 0.205 & 0.205 & 0.245 & 0.240 & 0.240 & 0.360 & 1.000 & & & & & & & & & & & & & & \\ 0.182 & 0.182 & 0.240 & 0.240 & 0.240 & 0.360 & 0.360 & 1.000 & & & & & & & & & & & & & \\ 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 1.000 & & & & & & & & & & & & \\ 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.100 & 1.000 & & & & & & & & & & & \\ 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.200 & 0.400 & 1.000 & & & & & & & & & & \\ 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.000 & 0.200 & 0.600 & 0.750 & 1.000 & & & & & & & & & \\ 0.215 & 0.215 & 0.337 & 0.405 & 0.405 & 0.400 & 0.360 & 0.320 & 0.000 & 0.000 & 0.000 & 0.000 & 1.000 & & & & & & & & \\ 0.176 & 0.176 & 0.276 & 0.331 & 0.331 & 0.327 & 0.294 & 0.261 & 0.000 & 0.000 & 0.000 & 0.000 & 0.300 & 1.000 & & & & & & & \\ -0.082 & -0.082 & -0.174 & -0.209 & -0.209 & -0.206 & -0.186 & -0.165 & 0.066 & 0.119 & 0.150 & 0.152 & -0.195 & -0.159 & 1.000 & & & & & & \\ -0.105 & -0.105 & -0.222 & -0.267 & -0.267 & -0.264 & -0.237 & -0.211 & 0.085 & 0.152 & 0.192 & 0.194 & -0.250 & -0.204 & 0.240 & 1.000 & & & & & \\ -0.100 & -0.100 & -0.212 & -0.255 & -0.255 & -0.252 & -0.227 & -0.201 & 0.081 & 0.145 & 0.184 & 0.186 & -0.238 & -0.195 & 0.245 & 0.360 & 1.000 & & & & \\ -0.089 & -0.089 & -0.188 & -0.225 & -0.225 & -0.222 & -0.200 & -0.178 & 0.072 & 0.128 & 0.162 & 0.164 & -0.211 & -0.172 & 0.235 & 0.240 & 0.235 & 1.000 & & & \\ -0.081 & -0.081 & -0.170 & -0.205 & -0.205 & -0.202 & -0.182 & -0.162 & 0.065 & 0.117 & 0.148 & 0.149 & -0.191 & -0.156 & 0.360 & 0.240 & 0.240 & 0.245 & 1.000 & & \\ -0.072 & -0.072 & -0.152 & -0.183 & -0.183 & -0.180 & -0.162 & -0.144 & 0.058 & 0.104 & 0.132 & 0.133 & -0.171 & -0.140 & 0.360 & 0.250 & 0.250 & 0.245 & 0.250 & 1.000 \end{pmatrix} \quad (2)$$

<sup>2</sup>All correlations are rounded on three decimal places.

## 2 Complete results of the Monte Carlo simulation

Tables 1 - 16 show the complete results of the Monte Carlo simulation<sup>3</sup>, where:

- out: share of outliers in percentage
- estim: estimator used during the estimation (robust or traditional PLS/PLSc).

The experimental design was full factorial and we varied the following experimental conditions:

- concept operationalization (all constructs are specified either as composites or common factors),
- model complexity (model containing either three or five constructs),
- sample size ( $n = 100, 300$  and  $500$ ),
- share of outliers (0%, 5%, 10%, 20%, 40% and 50%),
- kind of outliers (unsystematic and systematic) and
- number of observed variables that are contaminated by outliers (either all or two indicators).

The unsystematic outliers were drawn from a continuous univariate uniform distribution with a lower bound -10 and an upper bound 10 while the systematic outliers were drawn from the same distribution, but with a lower bound 2 and an upper bound 5.

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<sup>3</sup>All results are rounded on three decimal places.

## 2.1 Unsystematic outliers

This section shows the complete results for unsystematic outliers.

**Table 1** Results for traditional and robust PLSc for three common factors and unsystematic outliers in all indicators

|      | n   | out | estim. | $\gamma_{21}$ | $\gamma_{31}$ | $\gamma_{32}$ | $\lambda_{11}$ | $\lambda_{12}$ | $\lambda_{13}$ | $\lambda_{21}$ | $\lambda_{22}$ | $\lambda_{23}$ | $\lambda_{31}$ | $\lambda_{32}$ | $\lambda_{33}$ |
|------|-----|-----|--------|---------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| mean | 100 | 0   | trad.  | 0.018         | 0.039         | 0.013         | -0.026         | -0.000         | 0.011          | -0.015         | 0.000          | -0.015         | -0.042         | -0.036         | 0.004          |
| sd   |     |     | trad.  | 0.097         | 0.152         | 0.176         | 0.066          | 0.089          | 0.105          | 0.131          | 0.124          | 0.121          | 0.164          | 0.158          | 0.181          |
| mean | 100 | 0   | rob.   | 0.034         | 0.064         | 0.013         | -0.037         | -0.003         | 0.013          | -0.021         | -0.011         | -0.022         | -0.060         | -0.063         | -0.009         |
| sd   |     |     | rob.   | 0.124         | 0.238         | 0.271         | 0.082          | 0.110          | 0.137          | 0.169          | 0.161          | 0.160          | 0.190          | 0.202          | 0.218          |
| mean | 100 | 5   | trad.  | -0.038        | 0.051         | 0.182         | -0.395         | -0.337         | -0.264         | -0.308         | -0.290         | -0.265         | -0.388         | -0.363         | -0.280         |
| sd   |     |     | trad.  | 0.534         | 1.006         | 1.034         | 0.376          | 0.383          | 0.403          | 0.401          | 0.410          | 0.421          | 0.429          | 0.410          | 0.397          |
| mean | 100 | 5   | rob.   | 0.046         | 0.062         | 0.007         | -0.033         | -0.009         | 0.015          | -0.001         | -0.022         | -0.011         | -0.058         | -0.054         | -0.034         |
| sd   |     |     | rob.   | 0.132         | 0.232         | 0.265         | 0.085          | 0.108          | 0.135          | 0.165          | 0.148          | 0.156          | 0.195          | 0.200          | 0.248          |
| mean | 100 | 10  | trad.  | -0.198        | -0.121        | 0.075         | -0.524         | -0.431         | -0.337         | -0.363         | -0.372         | -0.364         | -0.448         | -0.457         | -0.343         |
| sd   |     |     | trad.  | 0.614         | 0.827         | 0.814         | 0.391          | 0.398          | 0.421          | 0.416          | 0.431          | 0.412          | 0.412          | 0.402          | 0.407          |
| mean | 100 | 10  | rob.   | 0.030         | 0.052         | 0.006         | -0.032         | 0.003          | 0.006          | -0.006         | -0.013         | -0.022         | -0.058         | -0.071         | -0.033         |
| sd   |     |     | rob.   | 0.124         | 0.229         | 0.274         | 0.081          | 0.109          | 0.139          | 0.156          | 0.158          | 0.161          | 0.193          | 0.210          | 0.247          |
| mean | 100 | 20  | trad.  | -0.317        | -0.181        | 0.093         | -0.611         | -0.545         | -0.443         | -0.447         | -0.436         | -0.462         | -0.546         | -0.547         | -0.458         |
| sd   |     |     | trad.  | 0.649         | 0.752         | 0.766         | 0.400          | 0.390          | 0.408          | 0.410          | 0.410          | 0.409          | 0.393          | 0.404          | 0.415          |
| mean | 100 | 20  | rob.   | 0.033         | 0.049         | 0.010         | -0.030         | -0.005         | 0.014          | -0.017         | -0.014         | -0.011         | -0.065         | -0.063         | -0.024         |
| sd   |     |     | rob.   | 0.125         | 0.221         | 0.248         | 0.084          | 0.116          | 0.139          | 0.157          | 0.154          | 0.162          | 0.199          | 0.206          | 0.241          |
| mean | 100 | 40  | trad.  | -0.457        | -0.221        | 0.034         | -0.694         | -0.590         | -0.502         | -0.502         | -0.493         | -0.504         | -0.606         | -0.573         | -0.490         |
| sd   |     |     | trad.  | 0.628         | 0.757         | 0.778         | 0.364          | 0.362          | 0.384          | 0.371          | 0.370          | 0.386          | 0.378          | 0.357          | 0.371          |
| mean | 100 | 40  | rob.   | 0.034         | 0.060         | -0.001        | -0.034         | -0.002         | 0.019          | -0.014         | -0.015         | -0.017         | -0.051         | -0.072         | -0.034         |
| sd   |     |     | rob.   | 0.126         | 0.207         | 0.249         | 0.082          | 0.111          | 0.130          | 0.171          | 0.164          | 0.161          | 0.198          | 0.211          | 0.247          |
| mean | 100 | 50  | trad.  | -0.401        | -0.251        | 0.097         | -0.698         | -0.602         | -0.504         | -0.489         | -0.496         | -0.503         | -0.607         | -0.582         | -0.483         |
| sd   |     |     | trad.  | 0.620         | 0.862         | 0.860         | 0.365          | 0.342          | 0.359          | 0.358          | 0.354          | 0.353          | 0.343          | 0.359          | 0.356          |
| mean | 100 | 50  | rob.   | -0.131        | -0.082        | 0.048         | -0.302         | -0.246         | -0.183         | -0.209         | -0.207         | -0.213         | -0.269         | -0.263         | -0.222         |
| sd   |     |     | rob.   | 0.626         | 0.829         | 0.813         | 0.383          | 0.420          | 0.424          | 0.440          | 0.428          | 0.439          | 0.417          | 0.411          | 0.450          |
| mean | 300 | 0   | trad.  | 0.003         | 0.010         | -0.001        | -0.010         | -0.001         | 0.006          | 0.002          | -0.002         | -0.006         | -0.017         | -0.005         | 0.007          |
| sd   |     |     | trad.  | 0.060         | 0.081         | 0.092         | 0.046          | 0.054          | 0.064          | 0.076          | 0.073          | 0.077          | 0.094          | 0.092          | 0.114          |
| mean | 300 | 0   | rob.   | 0.006         | 0.010         | 0.001         | -0.010         | -0.001         | 0.006          | 0.001          | -0.004         | -0.004         | -0.019         | -0.011         | 0.009          |
| sd   |     |     | rob.   | 0.069         | 0.095         | 0.109         | 0.052          | 0.062          | 0.075          | 0.087          | 0.084          | 0.087          | 0.107          | 0.102          | 0.128          |
| mean | 300 | 5   | trad.  | 0.057         | 0.132         | 0.075         | -0.431         | -0.358         | -0.304         | -0.306         | -0.320         | -0.334         | -0.432         | -0.422         | -0.353         |
| sd   |     |     | trad.  | 0.329         | 0.919         | 0.957         | 0.301          | 0.300          | 0.308          | 0.305          | 0.303          | 0.308          | 0.316          | 0.343          | 0.339          |
| mean | 300 | 5   | rob.   | 0.010         | 0.005         | 0.014         | -0.007         | 0.001          | 0.004          | 0.000          | 0.001          | -0.000         | -0.011         | -0.008         | -0.001         |
| sd   |     |     | rob.   | 0.065         | 0.093         | 0.103         | 0.051          | 0.063          | 0.070          | 0.086          | 0.086          | 0.086          | 0.111          | 0.111          | 0.139          |
| mean | 300 | 10  | trad.  | -0.067        | -0.049        | 0.151         | -0.539         | -0.493         | -0.397         | -0.413         | -0.398         | -0.425         | -0.515         | -0.527         | -0.423         |
| sd   |     |     | trad.  | 0.429         | 0.719         | 0.747         | 0.323          | 0.332          | 0.321          | 0.326          | 0.328          | 0.328          | 0.342          | 0.331          | 0.335          |
| mean | 300 | 10  | rob.   | 0.003         | 0.011         | 0.006         | -0.005         | 0.003          | -0.001         | 0.002          | 0.003          | -0.008         | -0.009         | -0.018         | 0.004          |
| sd   |     |     | rob.   | 0.068         | 0.093         | 0.110         | 0.052          | 0.063          | 0.075          | 0.089          | 0.087          | 0.087          | 0.113          | 0.118          | 0.135          |
| mean | 300 | 20  | trad.  | -0.216        | -0.164        | 0.107         | -0.674         | -0.591         | -0.484         | -0.495         | -0.509         | -0.488         | -0.592         | -0.585         | -0.484         |
| sd   |     |     | trad.  | 0.545         | 0.729         | 0.763         | 0.324          | 0.334          | 0.314          | 0.328          | 0.334          | 0.312          | 0.330          | 0.319          | 0.322          |
| mean | 300 | 20  | rob.   | 0.003         | 0.017         | 0.001         | -0.009         | 0.000          | 0.003          | -0.007         | 0.002          | -0.002         | -0.017         | -0.011         | 0.008          |
| sd   |     |     | rob.   | 0.068         | 0.090         | 0.107         | 0.053          | 0.062          | 0.074          | 0.091          | 0.090          | 0.089          | 0.112          | 0.113          | 0.137          |
| mean | 300 | 40  | trad.  | -0.333        | -0.227        | 0.013         | -0.729         | -0.622         | -0.538         | -0.526         | -0.534         | -0.510         | -0.650         | -0.621         | -0.553         |
| sd   |     |     | trad.  | 0.561         | 0.744         | 0.724         | 0.301          | 0.291          | 0.317          | 0.291          | 0.292          | 0.307          | 0.296          | 0.302          | 0.303          |
| mean | 300 | 40  | rob.   | 0.006         | 0.020         | -0.000        | -0.010         | -0.001         | 0.006          | -0.001         | -0.007         | -0.002         | -0.016         | -0.019         | 0.007          |
| sd   |     |     | rob.   | 0.075         | 0.107         | 0.119         | 0.058          | 0.071          | 0.082          | 0.098          | 0.099          | 0.096          | 0.129          | 0.125          | 0.144          |
| mean | 300 | 50  | trad.  | -0.350        | -0.204        | 0.072         | -0.737         | -0.638         | -0.549         | -0.539         | -0.549         | -0.540         | -0.632         | -0.649         | -0.549         |
| sd   |     |     | trad.  | 0.567         | 0.718         | 0.731         | 0.289          | 0.287          | 0.290          | 0.285          | 0.283          | 0.275          | 0.297          | 0.281          | 0.295          |
| mean | 300 | 50  | rob.   | -0.016        | 0.016         | 0.014         | -0.224         | -0.213         | -0.170         | -0.219         | -0.212         | -0.203         | -0.271         | -0.281         | -0.218         |
| sd   |     |     | rob.   | 0.349         | 0.549         | 0.612         | 0.267          | 0.307          | 0.336          | 0.317          | 0.319          | 0.303          | 0.331          | 0.346          | 0.359          |
| mean | 500 | 0   | trad.  | -0.000        | 0.004         | -0.000        | -0.002         | -0.001         | -0.000         | 0.001          | -0.004         | 0.001          | -0.002         | -0.006         | -0.001         |
| sd   |     |     | trad.  | 0.045         | 0.062         | 0.069         | 0.036          | 0.044          | 0.050          | 0.057          | 0.058          | 0.058          | 0.079          | 0.080          | 0.094          |
| mean | 500 | 0   | rob.   | -0.001        | 0.004         | 0.002         | -0.002         | -0.001         | -0.000         | 0.001          | -0.005         | 0.000          | -0.003         | -0.008         | -0.001         |
| sd   |     |     | rob.   | 0.051         | 0.069         | 0.078         | 0.040          | 0.048          | 0.055          | 0.062          | 0.065          | 0.067          | 0.089          | 0.089          | 0.104          |
| mean | 500 | 5   | trad.  | 0.087         | 0.141         | 0.017         | -0.419         | -0.353         | -0.304         | -0.325         | -0.311         | -0.320         | -0.426         | -0.431         | -0.360         |
| sd   |     |     | trad.  | 0.204         | 0.586         | 0.646         | 0.258          | 0.254          | 0.258          | 0.255          | 0.258          | 0.258          | 0.299          | 0.295          | 0.305          |
| mean | 500 | 5   | rob.   | 0.003         | 0.004         | 0.005         | -0.004         | -0.001         | 0.004          | -0.001         | -0.002         | -0.001         | -0.008         | -0.010         | 0.008          |
| sd   |     |     | rob.   | 0.051         | 0.074         | 0.080         | 0.041          | 0.047          | 0.056          | 0.065          | 0.063          | 0.064          | 0.089          | 0.091          | 0.104          |
| mean | 500 | 10  | trad.  | 0.007         | 0.044         | 0.107         | -0.549         | -0.483         | -0.415         | -0.414         | -0.419         | -0.414         | -0.530         | -0.539         | -0.447         |
| sd   |     |     | trad.  | 0.321         | 0.658         | 0.721         | 0.289          | 0.294          | 0.288          | 0.282          | 0.285          | 0.283          | 0.313          | 0.318          | 0.303          |
| mean | 500 | 10  | rob.   | 0.001         | 0.004         | 0.005         | -0.003         | 0.000          | 0.002          | 0.002          | -0.003         | 0.001          | -0.004         | -0.005         | 0.001          |
| sd   |     |     | rob.   | 0.053         | 0.072         | 0.080         | 0.039          | 0.047          | 0.058          | 0.064          | 0.065          | 0.066          | 0.087          | 0.089          | 0.105          |
| mean | 500 | 20  | trad.  | -0.131        | -0.093        | 0.119         | -0.656         | -0.592         | -0.493         | -0.492         | -0.507         | -0.492         | -0.597         | -0.594         | -0.517         |
| sd   |     |     | trad.  | 0.464         | 0.759         | 0.780         | 0.287          | 0.291          | 0.294          | 0.287          | 0.283          | 0.297          | 0.298          | 0.301          | 0.289          |
| mean | 500 | 20  | rob.   | 0.003         | 0.006         | -0.000        | -0.003         | -0.001         | 0.002          | -0.007         | 0.001          | -0.003         | -0.005         | -0.010         | 0.002          |
| sd   |     |     | rob.   | 0.055         | 0.073         | 0.081         | 0.042          | 0.052          | 0.060          | 0.066          | 0.066          | 0.068          | 0.094          | 0.093          | 0.108          |
| mean | 500 | 40  | trad.  | -0.287        | -0.193        | 0.069         | -0.737         | -0.645         | -0.543         | -0.554         | -0.548         | -0.544         | -0.647         | -0.655         | -0.552         |
| sd   |     |     | trad.  | 0.536         | 0.693         | 0.694         | 0.274          | 0.269          | 0.271          | 0.268          | 0.265          | 0.267          | 0.281          | 0.273          | 0.279          |
| mean | 500 | 40  | rob.   | -0.003        | 0.006         | -0.002        | -0.004         | -0.000         | -0.000         | -0.005         | 0.003          | -0.010         | -0.010         | -0.009         | 0.004          |
| sd   |     |     | rob.   | 0.058         | 0.078         | 0.090         | 0.047          | 0.058          | 0.067          | 0.074          | 0.074          | 0.078          | 0.099          | 0.101          | 0.117          |
| mean | 500 | 50  | trad.  | -0.317        | -0.209        | 0.062         | -0.758         | -0.646         | -0.553         | -0.565         | -0.574         | -0.553         | -0.658         | -0.664         | -0.556         |
| sd   |     |     | trad.  | 0.541         | 0.684         | 0.688         | 0.258          | 0.267          | 0.249          | 0.257          | 0.261          | 0.251          | 0.260          | 0.250          | 0.259          |
| mean | 500 | 50  | rob.   | -0.062        | -0.039        | 0.029         | -0.185         | -0.168         | -0.151         | -0.199         | -0.204         | -0.181         | -0.277         | -0.253         | -0.225         |
| sd   |     |     | rob.   | 0.240         | 0.368         | 0.433         | 0.224          | 0.252          | 0.287          | 0.287          | 0.284          | 0.271          | 0.316          | 0.324          | 0.335          |

**Table 2** Results for traditional and robust PLSc for three common factors and unsystematic outliers in two indicators

|      | n   | out | estim. | $\gamma_{21}$ | $\gamma_{31}$ | $\gamma_{32}$ | $\lambda_{11}$ | $\lambda_{12}$ | $\lambda_{13}$ | $\lambda_{21}$ | $\lambda_{22}$ | $\lambda_{23}$ | $\lambda_{31}$ | $\lambda_{32}$ | $\lambda_{33}$ |
|------|-----|-----|--------|---------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| mean | 100 | 0   | trad.  | 0.027         | 0.047         | 0.007         | -0.027         | -0.000         | 0.010          | -0.009         | -0.012         | -0.002         | -0.034         | -0.034         | 0.005          |
| sd   |     |     | trad.  | 0.096         | 0.150         | 0.179         | 0.069          | 0.088          | 0.101          | 0.120          | 0.126          | 0.121          | 0.156          | 0.149          | 0.172          |
| mean | 100 | 0   | rob.   | 0.036         | 0.066         | 0.014         | -0.034         | -0.003         | 0.018          | -0.018         | -0.013         | -0.004         | -0.059         | -0.057         | -0.018         |
| sd   |     |     | rob.   | 0.125         | 0.233         | 0.275         | 0.086          | 0.109          | 0.123          | 0.145          | 0.157          | 0.149          | 0.197          | 0.189          | 0.223          |
| mean | 100 | 5   | trad.  | 0.061         | 0.076         | -0.021        | -0.057         | -0.030         | -0.250         | -0.274         | -0.037         | -0.042         | -0.037         | -0.044         | -0.001         |
| sd   |     |     | trad.  | 0.115         | 0.186         | 0.219         | 0.095          | 0.110          | 0.222          | 0.226          | 0.143          | 0.137          | 0.153          | 0.157          | 0.196          |
| mean | 100 | 5   | rob.   | 0.033         | 0.071         | -0.002        | -0.037         | -0.001         | 0.017          | -0.025         | -0.018         | -0.018         | -0.062         | -0.063         | -0.008         |
| sd   |     |     | rob.   | 0.128         | 0.213         | 0.265         | 0.081          | 0.111          | 0.134          | 0.167          | 0.159          | 0.164          | 0.199          | 0.189          | 0.222          |
| mean | 100 | 10  | trad.  | 0.073         | 0.084         | -0.035        | -0.061         | -0.027         | -0.370         | -0.386         | -0.045         | -0.047         | -0.034         | -0.035         | -0.021         |
| sd   |     |     | trad.  | 0.124         | 0.223         | 0.263         | 0.093          | 0.102          | 0.212          | 0.215          | 0.137          | 0.137          | 0.160          | 0.154          | 0.207          |
| mean | 100 | 10  | rob.   | 0.040         | 0.077         | -0.017        | -0.040         | -0.003         | 0.007          | -0.029         | -0.020         | -0.016         | -0.048         | -0.057         | -0.035         |
| sd   |     |     | rob.   | 0.125         | 0.218         | 0.260         | 0.084          | 0.109          | 0.133          | 0.163          | 0.164          | 0.163          | 0.179          | 0.186          | 0.247          |
| mean | 100 | 20  | trad.  | 0.065         | 0.073         | -0.012        | -0.055         | -0.024         | -0.477         | -0.490         | -0.047         | -0.048         | -0.033         | -0.038         | -0.004         |
| sd   |     |     | trad.  | 0.121         | 0.197         | 0.232         | 0.086          | 0.094          | 0.208          | 0.213          | 0.143          | 0.139          | 0.153          | 0.159          | 0.197          |
| mean | 100 | 20  | rob.   | 0.032         | 0.071         | 0.011         | -0.035         | 0.001          | 0.004          | -0.034         | -0.018         | -0.022         | -0.057         | -0.057         | -0.005         |
| sd   |     |     | rob.   | 0.127         | 0.223         | 0.259         | 0.082          | 0.104          | 0.136          | 0.163          | 0.167          | 0.167          | 0.191          | 0.187          | 0.212          |
| mean | 100 | 40  | trad.  | 0.073         | 0.072         | -0.019        | -0.054         | -0.022         | -0.585         | -0.596         | -0.048         | -0.045         | -0.030         | -0.043         | -0.005         |
| sd   |     |     | trad.  | 0.121         | 0.221         | 0.264         | 0.079          | 0.088          | 0.203          | 0.199          | 0.132          | 0.132          | 0.148          | 0.157          | 0.190          |
| mean | 100 | 40  | rob.   | 0.044         | 0.071         | -0.000        | -0.042         | -0.004         | -0.039         | -0.073         | -0.027         | -0.026         | -0.054         | -0.066         | -0.017         |
| sd   |     |     | rob.   | 0.126         | 0.221         | 0.269         | 0.088          | 0.105          | 0.168          | 0.188          | 0.159          | 0.161          | 0.188          | 0.207          | 0.221          |
| mean | 100 | 50  | trad.  | 0.077         | 0.078         | -0.025        | -0.055         | -0.016         | -0.612         | -0.608         | -0.053         | -0.051         | -0.038         | -0.032         | 0.008          |
| sd   |     |     | trad.  | 0.132         | 0.218         | 0.262         | 0.084          | 0.087          | 0.200          | 0.197          | 0.138          | 0.137          | 0.153          | 0.156          | 0.170          |
| mean | 100 | 50  | rob.   | 0.094         | 0.094         | -0.025        | -0.081         | -0.032         | -0.237         | -0.268         | -0.066         | -0.065         | -0.065         | -0.060         | -0.007         |
| sd   |     |     | rob.   | 0.157         | 0.313         | 0.364         | 0.122          | 0.128          | 0.263          | 0.261          | 0.172          | 0.172          | 0.201          | 0.202          | 0.222          |
| mean | 300 | 0   | trad.  | 0.001         | 0.008         | 0.003         | -0.004         | 0.002          | -0.001         | -0.001         | -0.003         | -0.002         | -0.009         | -0.014         | 0.006          |
| sd   |     |     | trad.  | 0.059         | 0.078         | 0.092         | 0.046          | 0.054          | 0.063          | 0.076          | 0.071          | 0.075          | 0.097          | 0.099          | 0.121          |
| mean | 300 | 0   | rob.   | 0.003         | 0.008         | 0.005         | -0.005         | 0.003          | -0.001         | -0.003         | -0.004         | -0.000         | -0.013         | -0.016         | 0.009          |
| sd   |     |     | rob.   | 0.069         | 0.090         | 0.108         | 0.050          | 0.061          | 0.073          | 0.086          | 0.080          | 0.087          | 0.109          | 0.107          | 0.134          |
| mean | 300 | 5   | trad.  | 0.018         | 0.012         | -0.001        | -0.020         | -0.010         | -0.271         | -0.280         | -0.011         | -0.015         | -0.010         | -0.011         | 0.001          |
| sd   |     |     | trad.  | 0.068         | 0.088         | 0.102         | 0.058          | 0.065          | 0.126          | 0.123          | 0.083          | 0.083          | 0.093          | 0.099          | 0.121          |
| mean | 300 | 5   | rob.   | 0.006         | 0.008         | 0.007         | -0.009         | 0.002          | 0.001          | -0.006         | -0.000         | -0.003         | -0.012         | -0.014         | -0.001         |
| sd   |     |     | rob.   | 0.067         | 0.093         | 0.108         | 0.050          | 0.064          | 0.071          | 0.084          | 0.084          | 0.084          | 0.111          | 0.115          | 0.134          |
| mean | 300 | 10  | trad.  | 0.016         | 0.012         | 0.000         | -0.018         | -0.012         | -0.381         | -0.390         | -0.014         | -0.016         | -0.015         | -0.008         | 0.007          |
| sd   |     |     | trad.  | 0.068         | 0.092         | 0.107         | 0.056          | 0.058          | 0.123          | 0.122          | 0.079          | 0.080          | 0.098          | 0.103          | 0.113          |
| mean | 300 | 10  | rob.   | 0.003         | 0.008         | 0.005         | -0.006         | 0.003          | -0.003         | -0.011         | -0.003         | -0.003         | -0.022         | -0.016         | 0.015          |
| sd   |     |     | rob.   | 0.065         | 0.096         | 0.108         | 0.051          | 0.064          | 0.076          | 0.089          | 0.081          | 0.085          | 0.110          | 0.115          | 0.127          |
| mean | 300 | 20  | trad.  | 0.014         | 0.016         | -0.003        | -0.015         | -0.009         | -0.496         | -0.492         | -0.014         | -0.013         | -0.008         | -0.008         | 0.003          |
| sd   |     |     | trad.  | 0.068         | 0.088         | 0.105         | 0.049          | 0.050          | 0.120          | 0.121          | 0.072          | 0.079          | 0.095          | 0.097          | 0.117          |
| mean | 300 | 20  | rob.   | 0.002         | 0.015         | -0.002        | -0.009         | -0.002         | -0.010         | -0.014         | -0.002         | -0.002         | -0.013         | -0.014         | 0.003          |
| sd   |     |     | rob.   | 0.068         | 0.097         | 0.112         | 0.053          | 0.064          | 0.078          | 0.090          | 0.087          | 0.091          | 0.113          | 0.116          | 0.141          |
| mean | 300 | 40  | trad.  | 0.018         | 0.017         | -0.003        | -0.019         | -0.004         | -0.588         | -0.591         | -0.012         | -0.016         | -0.013         | -0.013         | 0.011          |
| sd   |     |     | trad.  | 0.067         | 0.088         | 0.104         | 0.049          | 0.048          | 0.121          | 0.123          | 0.075          | 0.073          | 0.090          | 0.098          | 0.111          |
| mean | 300 | 40  | rob.   | 0.011         | 0.016         | -0.001        | -0.017         | -0.003         | -0.048         | -0.067         | -0.004         | -0.010         | -0.019         | -0.014         | 0.002          |
| sd   |     |     | rob.   | 0.077         | 0.107         | 0.120         | 0.061          | 0.068          | 0.097          | 0.113          | 0.101          | 0.098          | 0.113          | 0.121          | 0.145          |
| mean | 300 | 50  | trad.  | 0.010         | 0.001         | 0.003         | -0.012         | -0.004         | -0.550         | -0.552         | -0.007         | -0.011         | -0.008         | -0.005         | 0.001          |
| sd   |     |     | trad.  | 0.052         | 0.069         | 0.077         | 0.037          | 0.040          | 0.094          | 0.092          | 0.056          | 0.057          | 0.083          | 0.081          | 0.094          |
| mean | 300 | 50  | rob.   | 0.002         | 0.001         | 0.004         | -0.007         | 0.001          | -0.024         | -0.032         | -0.001         | -0.005         | -0.010         | -0.011         | 0.004          |
| sd   |     |     | rob.   | 0.055         | 0.079         | 0.085         | 0.043          | 0.052          | 0.065          | 0.076          | 0.071          | 0.070          | 0.096          | 0.093          | 0.113          |
| mean | 500 | 0   | trad.  | -0.001        | 0.004         | 0.001         | -0.001         | -0.002         | 0.002          | -0.003         | 0.000          | 0.002          | -0.009         | -0.002         | 0.002          |
| sd   |     |     | trad.  | 0.045         | 0.061         | 0.070         | 0.036          | 0.043          | 0.051          | 0.056          | 0.057          | 0.058          | 0.082          | 0.080          | 0.090          |
| mean | 500 | 0   | rob.   | -0.001        | 0.005         | 0.002         | -0.002         | -0.003         | 0.003          | -0.003         | 0.000          | -0.000         | -0.009         | -0.005         | 0.004          |
| sd   |     |     | rob.   | 0.050         | 0.069         | 0.079         | 0.041          | 0.048          | 0.056          | 0.063          | 0.063          | 0.066          | 0.092          | 0.086          | 0.100          |
| mean | 500 | 5   | trad.  | 0.006         | 0.009         | -0.003        | -0.011         | -0.006         | -0.286         | -0.288         | -0.004         | -0.007         | -0.008         | -0.005         | 0.006          |
| sd   |     |     | trad.  | 0.054         | 0.069         | 0.075         | 0.045          | 0.046          | 0.096          | 0.094          | 0.066          | 0.063          | 0.084          | 0.081          | 0.093          |
| mean | 500 | 5   | rob.   | 0.000         | 0.004         | 0.003         | -0.005         | -0.002         | -0.001         | -0.006         | -0.001         | -0.001         | -0.009         | -0.005         | 0.005          |
| sd   |     |     | rob.   | 0.051         | 0.070         | 0.078         | 0.040          | 0.045          | 0.056          | 0.067          | 0.069          | 0.064          | 0.094          | 0.089          | 0.108          |
| mean | 500 | 10  | trad.  | 0.009         | 0.009         | -0.005        | -0.009         | -0.004         | -0.392         | -0.393         | -0.006         | -0.008         | -0.005         | -0.007         | 0.004          |
| sd   |     |     | trad.  | 0.056         | 0.069         | 0.080         | 0.044          | 0.043          | 0.093          | 0.094          | 0.061          | 0.061          | 0.080          | 0.080          | 0.097          |
| mean | 500 | 10  | rob.   | 0.001         | 0.006         | -0.001        | -0.003         | 0.001          | -0.006         | -0.006         | -0.000         | -0.003         | -0.002         | -0.007         | -0.002         |
| sd   |     |     | rob.   | 0.054         | 0.071         | 0.079         | 0.041          | 0.049          | 0.055          | 0.066          | 0.064          | 0.065          | 0.087          | 0.090          | 0.107          |
| mean | 500 | 20  | trad.  | 0.007         | 0.005         | 0.002         | -0.011         | -0.005         | -0.491         | -0.491         | -0.009         | -0.009         | -0.006         | -0.002         | -0.002         |
| sd   |     |     | trad.  | 0.054         | 0.067         | 0.078         | 0.040          | 0.038          | 0.092          | 0.093          | 0.062          | 0.060          | 0.081          | 0.079          | 0.093          |
| mean | 500 | 20  | rob.   | -0.002        | 0.003         | 0.003         | -0.005         | 0.002          | -0.016         | -0.013         | -0.002         | -0.002         | -0.009         | -0.001         | -0.003         |
| sd   |     |     | rob.   | 0.053         | 0.071         | 0.077         | 0.041          | 0.049          | 0.061          | 0.069          | 0.070          | 0.068          | 0.094          | 0.091          | 0.106          |
| mean | 500 | 40  | trad.  | 0.010         | 0.008         | -0.001        | -0.008         | -0.008         | -0.585         | -0.593         | -0.011         | -0.008         | -0.003         | -0.009         | 0.003          |
| sd   |     |     | trad.  | 0.052         | 0.068         | 0.079         | 0.038          | 0.038          | 0.091          | 0.099          | 0.057          | 0.055          | 0.081          | 0.079          | 0.092          |
| mean | 500 | 40  | rob.   | 0.004         | 0.007         | 0.001         | -0.005         | -0.003         | -0.060         | -0.071         | -0.008         | 0.000          | -0.008         | -0.012         | 0.004          |
| sd   |     |     | rob.   | 0.055         | 0.081         | 0.091         | 0.047          | 0.056          | 0.078          | 0.084          | 0.072          | 0.075          | 0.100          | 0.096          | 0.119          |
| mean | 500 | 50  | trad.  | 0.013         | 0.003         | 0.003         | -0.012         | -0.005         | -0.618         | -0.619         | -0.009         | -0.010         | -0.010         | -0.006         | 0.008          |
| sd   |     |     | trad.  | 0.052         | 0.069         | 0.081         | 0.038          | 0.038          | 0.098          | 0.095          | 0.056          | 0.056          | 0.079          | 0.081          | 0.091          |
| mean | 500 | 50  | rob.   | 0.011         | 0.005         | 0.004         | -0.011         | -0.002         | -0.171         | -0.194         | -0.005         | -0.009         | -0.018         | -0.008         | 0.007          |
| sd   |     |     | rob.   | 0.067         | 0.089         | 0.099         | 0.053          | 0.061          | 0.104          | 0.113          | 0.080          | 0.081          | 0.102          | 0.105          | 0.125          |

**Table 3** Results for traditional and robust PLS for three composites and unsystematic outliers in all indicators

|      | n   | out | estim. | $\gamma_{21}$ | $\gamma_{31}$ | $\gamma_{32}$ | $w_{11}$ | $w_{12}$ | $w_{13}$ | $w_{21}$ | $w_{22}$ | $w_{23}$ | $w_{31}$ | $w_{32}$ | $w_{33}$ |
|------|-----|-----|--------|---------------|---------------|---------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| mean | 100 | 0   | trad.  | 0.018         | 0.016         | 0.033         | -0.017   | -0.012   | -0.003   | -0.005   | -0.021   | -0.023   | -0.043   | -0.067   | -0.069   |
| sd   |     |     |        | 0.075         | 0.120         | 0.137         | 0.185    | 0.194    | 0.208    | 0.189    | 0.194    | 0.179    | 0.357    | 0.305    | 0.339    |
| mean | 100 | 0   | rob.   | 0.031         | 0.028         | 0.052         | -0.030   | -0.045   | -0.012   | -0.026   | -0.046   | -0.051   | -0.094   | -0.105   | -0.120   |
| sd   |     |     |        | 0.112         | 0.205         | 0.238         | 0.296    | 0.302    | 0.320    | 0.285    | 0.298    | 0.277    | 0.464    | 0.414    | 0.433    |
| mean | 100 | 5   | trad.  | -0.133        | -0.106        | 0.104         | -0.360   | -0.240   | -0.061   | -0.102   | -0.293   | -0.342   | -0.257   | -0.319   | -0.294   |
| sd   |     |     |        | 0.495         | 0.402         | 0.378         | 0.610    | 0.581    | 0.598    | 0.511    | 0.571    | 0.555    | 0.580    | 0.563    | 0.565    |
| mean | 100 | 5   | rob.   | 0.031         | 0.031         | 0.058         | -0.035   | -0.052   | 0.004    | -0.021   | -0.029   | -0.067   | -0.068   | -0.110   | -0.125   |
| sd   |     |     |        | 0.108         | 0.191         | 0.218         | 0.301    | 0.301    | 0.306    | 0.286    | 0.290    | 0.279    | 0.440    | 0.395    | 0.430    |
| mean | 100 | 10  | trad.  | -0.235        | -0.162        | 0.067         | -0.395   | -0.208   | -0.008   | -0.072   | -0.286   | -0.366   | -0.239   | -0.248   | -0.310   |
| sd   |     |     |        | 0.479         | 0.425         | 0.416         | 0.588    | 0.598    | 0.592    | 0.548    | 0.560    | 0.569    | 0.589    | 0.559    | 0.569    |
| mean | 100 | 10  | rob.   | 0.034         | 0.019         | 0.058         | -0.043   | -0.020   | -0.010   | -0.026   | -0.035   | -0.047   | -0.059   | -0.118   | -0.130   |
| sd   |     |     |        | 0.105         | 0.188         | 0.211         | 0.261    | 0.290    | 0.296    | 0.268    | 0.272    | 0.271    | 0.445    | 0.402    | 0.435    |
| mean | 100 | 20  | trad.  | -0.366        | -0.206        | 0.014         | -0.365   | -0.171   | 0.013    | -0.063   | -0.235   | -0.354   | -0.190   | -0.256   | -0.267   |
| sd   |     |     |        | 0.418         | 0.392         | 0.401         | 0.563    | 0.561    | 0.561    | 0.531    | 0.544    | 0.564    | 0.575    | 0.540    | 0.557    |
| mean | 100 | 20  | rob.   | 0.038         | 0.024         | 0.053         | -0.042   | -0.028   | 0.001    | -0.029   | -0.058   | -0.023   | -0.085   | -0.119   | -0.087   |
| sd   |     |     |        | 0.099         | 0.184         | 0.207         | 0.276    | 0.289    | 0.284    | 0.265    | 0.278    | 0.251    | 0.440    | 0.393    | 0.414    |
| mean | 100 | 40  | trad.  | -0.475        | -0.266        | -0.014        | -0.353   | -0.196   | 0.020    | -0.064   | -0.250   | -0.352   | -0.138   | -0.272   | -0.272   |
| sd   |     |     |        | 0.330         | 0.314         | 0.320         | 0.540    | 0.539    | 0.561    | 0.552    | 0.538    | 0.524    | 0.538    | 0.538    | 0.543    |
| mean | 100 | 40  | rob.   | 0.036         | 0.017         | 0.051         | -0.045   | -0.021   | -0.016   | -0.033   | -0.053   | -0.040   | -0.105   | -0.101   | -0.105   |
| sd   |     |     |        | 0.100         | 0.185         | 0.203         | 0.277    | 0.290    | 0.304    | 0.281    | 0.291    | 0.270    | 0.439    | 0.406    | 0.416    |
| mean | 100 | 50  | trad.  | -0.486        | -0.278        | 0.018         | -0.355   | -0.137   | 0.021    | -0.041   | -0.286   | -0.346   | -0.150   | -0.258   | -0.257   |
| sd   |     |     |        | 0.303         | 0.293         | 0.289         | 0.540    | 0.536    | 0.538    | 0.525    | 0.533    | 0.550    | 0.539    | 0.522    | 0.539    |
| mean | 100 | 50  | rob.   | -0.050        | -0.120        | 0.105         | -0.414   | -0.184   | -0.059   | -0.101   | -0.305   | -0.338   | -0.213   | -0.323   | -0.337   |
| sd   |     |     |        | 0.565         | 0.468         | 0.435         | 0.617    | 0.626    | 0.601    | 0.527    | 0.573    | 0.552    | 0.605    | 0.557    | 0.578    |
| mean | 300 | 0   | trad.  | 0.006         | 0.006         | 0.012         | -0.008   | -0.004   | 0.002    | -0.008   | -0.006   | -0.004   | -0.016   | -0.026   | -0.011   |
| sd   |     |     |        | 0.044         | 0.065         | 0.068         | 0.097    | 0.109    | 0.106    | 0.105    | 0.105    | 0.099    | 0.196    | 0.172    | 0.185    |
| mean | 300 | 0   | rob.   | 0.010         | 0.009         | 0.013         | -0.010   | -0.005   | 0.004    | -0.010   | -0.006   | -0.005   | -0.021   | -0.034   | -0.017   |
| sd   |     |     |        | 0.050         | 0.075         | 0.079         | 0.114    | 0.126    | 0.125    | 0.123    | 0.120    | 0.112    | 0.229    | 0.203    | 0.219    |
| mean | 300 | 5   | trad.  | -0.150        | -0.090        | 0.097         | -0.291   | -0.138   | -0.027   | -0.087   | -0.221   | -0.268   | -0.166   | -0.272   | -0.302   |
| sd   |     |     |        | 0.222         | 0.271         | 0.289         | 0.543    | 0.550    | 0.559    | 0.504    | 0.539    | 0.505    | 0.568    | 0.522    | 0.555    |
| mean | 300 | 5   | rob.   | 0.010         | 0.009         | 0.015         | -0.012   | 0.006    | -0.007   | -0.008   | -0.006   | -0.008   | -0.017   | -0.024   | -0.033   |
| sd   |     |     |        | 0.049         | 0.074         | 0.077         | 0.116    | 0.125    | 0.130    | 0.126    | 0.127    | 0.117    | 0.237    | 0.213    | 0.220    |
| mean | 300 | 10  | trad.  | -0.256        | -0.166        | 0.083         | -0.341   | -0.167   | 0.042    | -0.069   | -0.224   | -0.312   | -0.157   | -0.239   | -0.279   |
| sd   |     |     |        | 0.246         | 0.262         | 0.289         | 0.534    | 0.540    | 0.549    | 0.513    | 0.540    | 0.525    | 0.547    | 0.526    | 0.539    |
| mean | 300 | 10  | rob.   | 0.007         | 0.009         | 0.020         | -0.001   | -0.008   | -0.005   | -0.005   | -0.004   | -0.013   | -0.010   | -0.028   | -0.034   |
| sd   |     |     |        | 0.052         | 0.076         | 0.079         | 0.112    | 0.127    | 0.128    | 0.124    | 0.131    | 0.118    | 0.237    | 0.202    | 0.226    |
| mean | 300 | 20  | trad.  | -0.378        | -0.219        | 0.043         | -0.346   | -0.175   | 0.017    | -0.057   | -0.241   | -0.335   | -0.169   | -0.283   | -0.258   |
| sd   |     |     |        | 0.238         | 0.232         | 0.243         | 0.530    | 0.535    | 0.551    | 0.520    | 0.533    | 0.529    | 0.541    | 0.530    | 0.541    |
| mean | 300 | 20  | rob.   | 0.010         | 0.008         | 0.015         | -0.006   | -0.005   | -0.003   | -0.006   | -0.009   | -0.009   | -0.031   | -0.023   | -0.026   |
| sd   |     |     |        | 0.049         | 0.076         | 0.082         | 0.121    | 0.131    | 0.134    | 0.129    | 0.130    | 0.120    | 0.252    | 0.208    | 0.225    |
| mean | 300 | 40  | trad.  | -0.445        | -0.268        | 0.019         | -0.356   | -0.138   | 0.031    | -0.032   | -0.248   | -0.347   | -0.156   | -0.283   | -0.239   |
| sd   |     |     |        | 0.187         | 0.189         | 0.189         | 0.535    | 0.515    | 0.530    | 0.513    | 0.520    | 0.534    | 0.526    | 0.542    | 0.526    |
| mean | 300 | 40  | rob.   | 0.010         | 0.012         | 0.016         | -0.013   | -0.008   | 0.006    | -0.011   | -0.005   | -0.015   | -0.018   | -0.034   | -0.039   |
| sd   |     |     |        | 0.056         | 0.090         | 0.094         | 0.134    | 0.139    | 0.146    | 0.136    | 0.143    | 0.134    | 0.259    | 0.235    | 0.243    |
| mean | 300 | 50  | trad.  | -0.466        | -0.276        | 0.000         | -0.349   | -0.148   | 0.033    | -0.063   | -0.258   | -0.367   | -0.161   | -0.240   | -0.255   |
| sd   |     |     |        | 0.174         | 0.170         | 0.177         | 0.528    | 0.521    | 0.532    | 0.537    | 0.512    | 0.541    | 0.533    | 0.532    | 0.513    |
| mean | 300 | 50  | rob.   | -0.063        | -0.077        | 0.091         | -0.210   | -0.151   | -0.073   | -0.089   | -0.188   | -0.246   | -0.182   | -0.272   | -0.238   |
| sd   |     |     |        | 0.257         | 0.296         | 0.315         | 0.534    | 0.549    | 0.538    | 0.486    | 0.499    | 0.518    | 0.546    | 0.549    | 0.558    |
| mean | 500 | 0   | trad.  | 0.004         | 0.002         | 0.004         | -0.001   | -0.007   | 0.004    | -0.002   | -0.000   | -0.006   | -0.007   | -0.011   | -0.013   |
| sd   |     |     |        | 0.033         | 0.048         | 0.052         | 0.075    | 0.081    | 0.085    | 0.078    | 0.083    | 0.073    | 0.155    | 0.142    | 0.148    |
| mean | 500 | 0   | rob.   | 0.004         | 0.004         | 0.006         | -0.001   | -0.007   | 0.002    | -0.003   | -0.002   | -0.006   | -0.009   | -0.016   | -0.015   |
| sd   |     |     |        | 0.037         | 0.054         | 0.057         | 0.085    | 0.090    | 0.094    | 0.090    | 0.093    | 0.084    | 0.178    | 0.156    | 0.167    |
| mean | 500 | 5   | trad.  | -0.182        | -0.105        | 0.086         | -0.226   | -0.097   | -0.003   | -0.095   | -0.139   | -0.203   | -0.169   | -0.229   | -0.236   |
| sd   |     |     |        | 0.167         | 0.214         | 0.227         | 0.513    | 0.508    | 0.494    | 0.469    | 0.485    | 0.469    | 0.557    | 0.501    | 0.528    |
| mean | 500 | 5   | rob.   | 0.005         | 0.006         | 0.006         | -0.003   | 0.001    | -0.005   | -0.000   | -0.004   | -0.006   | -0.009   | -0.022   | -0.008   |
| sd   |     |     |        | 0.038         | 0.055         | 0.059         | 0.086    | 0.095    | 0.091    | 0.094    | 0.093    | 0.087    | 0.174    | 0.155    | 0.163    |
| mean | 500 | 10  | trad.  | -0.284        | -0.163        | 0.056         | -0.269   | -0.124   | 0.030    | -0.098   | -0.189   | -0.278   | -0.168   | -0.244   | -0.208   |
| sd   |     |     |        | 0.182         | 0.208         | 0.228         | 0.514    | 0.508    | 0.515    | 0.494    | 0.522    | 0.512    | 0.540    | 0.511    | 0.516    |
| mean | 500 | 10  | rob.   | 0.006         | 0.006         | 0.008         | 0.000    | -0.006   | -0.001   | -0.000   | -0.004   | -0.006   | -0.008   | -0.011   | -0.024   |
| sd   |     |     |        | 0.037         | 0.055         | 0.058         | 0.084    | 0.092    | 0.094    | 0.093    | 0.094    | 0.086    | 0.186    | 0.158    | 0.172    |
| mean | 500 | 20  | trad.  | -0.387        | -0.225        | 0.027         | -0.328   | -0.153   | 0.073    | -0.041   | -0.242   | -0.316   | -0.154   | -0.256   | -0.244   |
| sd   |     |     |        | 0.178         | 0.181         | 0.188         | 0.524    | 0.507    | 0.524    | 0.512    | 0.522    | 0.514    | 0.531    | 0.531    | 0.516    |
| mean | 500 | 20  | rob.   | 0.006         | 0.005         | 0.008         | -0.009   | -0.000   | 0.003    | -0.002   | -0.006   | -0.003   | -0.019   | -0.017   | -0.010   |
| sd   |     |     |        | 0.038         | 0.055         | 0.060         | 0.091    | 0.097    | 0.098    | 0.095    | 0.100    | 0.094    | 0.181    | 0.162    | 0.176    |
| mean | 500 | 40  | trad.  | -0.450        | -0.267        | 0.014         | -0.332   | -0.136   | 0.032    | -0.053   | -0.245   | -0.313   | -0.140   | -0.238   | -0.234   |
| sd   |     |     |        | 0.144         | 0.146         | 0.147         | 0.515    | 0.522    | 0.525    | 0.521    | 0.508    | 0.524    | 0.521    | 0.508    | 0.525    |
| mean | 500 | 40  | rob.   | 0.008         | 0.006         | 0.015         | -0.008   | -0.003   | 0.003    | -0.001   | -0.006   | -0.007   | -0.014   | -0.024   | -0.018   |
| sd   |     |     |        | 0.043         | 0.066         | 0.070         | 0.099    | 0.108    | 0.111    | 0.108    | 0.106    | 0.099    | 0.207    | 0.178    | 0.193    |
| mean | 500 | 50  | trad.  | -0.456        | -0.275        | 0.009         | -0.353   | -0.152   | 0.069    | -0.048   | -0.232   | -0.345   | -0.131   | -0.254   | -0.239   |
| sd   |     |     |        | 0.131         | 0.133         | 0.131         | 0.529    | 0.523    | 0.509    | 0.511    | 0.513    | 0.529    | 0.531    | 0.515    | 0.513    |
| mean | 500 | 50  | rob.   | -0.078        | -0.072        | 0.067         | -0.111   | -0.056   | -0.035   | -0.032   | -0.116   | -0.121   | -0.165   | -0.190   | -0.210   |
| sd   |     |     |        | 0.143         | 0.219         | 0.227         | 0.429    | 0.426    | 0.443    | 0.409    | 0.408    | 0.403    | 0.540    | 0.491    | 0.521    |

**Table 4** Results for traditional and robust PLS for three composites and unsystematic outliers in two indicators

|      | n   | out | estim. | $\gamma_{21}$ | $\gamma_{31}$ | $\gamma_{32}$ | $w_{11}$ | $w_{12}$ | $w_{13}$ | $w_{21}$ | $w_{22}$ | $w_{23}$ | $w_{31}$ | $w_{32}$ | $w_{33}$ |
|------|-----|-----|--------|---------------|---------------|---------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| mean | 100 | 0   | trad.  | 0.022         | 0.012         | 0.037         | -0.022   | -0.012   | -0.001   | -0.005   | -0.028   | -0.015   | -0.051   | -0.054   | -0.085   |
| sd   |     |     |        | 0.070         | 0.122         | 0.136         | 0.189    | 0.202    | 0.208    | 0.192    | 0.199    | 0.183    | 0.376    | 0.309    | 0.343    |
| mean | 100 | 0   | rob.   | 0.039         | 0.030         | 0.060         | -0.049   | -0.039   | 0.003    | -0.003   | -0.063   | -0.038   | -0.071   | -0.123   | -0.136   |
| sd   |     |     |        | 0.101         | 0.207         | 0.229         | 0.294    | 0.320    | 0.317    | 0.282    | 0.293    | 0.267    | 0.462    | 0.418    | 0.454    |
| mean | 100 | 5   | trad.  | 0.016         | 0.003         | 0.039         | -0.006   | 0.010    | -0.078   | -0.083   | -0.002   | -0.050   | -0.045   | -0.061   | -0.095   |
| sd   |     |     |        | 0.076         | 0.127         | 0.137         | 0.205    | 0.215    | 0.332    | 0.320    | 0.218    | 0.199    | 0.370    | 0.321    | 0.358    |
| mean | 100 | 5   | rob.   | 0.029         | 0.024         | 0.055         | -0.050   | -0.035   | -0.001   | -0.029   | -0.038   | -0.048   | -0.100   | -0.074   | -0.122   |
| sd   |     |     |        | 0.103         | 0.204         | 0.218         | 0.298    | 0.303    | 0.314    | 0.280    | 0.287    | 0.274    | 0.434    | 0.395    | 0.423    |
| mean | 100 | 10  | trad.  | 0.011         | 0.004         | 0.049         | 0.008    | 0.040    | -0.114   | -0.131   | 0.031    | -0.056   | -0.081   | -0.052   | -0.064   |
| sd   |     |     |        | 0.082         | 0.131         | 0.139         | 0.200    | 0.203    | 0.282    | 0.288    | 0.213    | 0.215    | 0.365    | 0.321    | 0.348    |
| mean | 100 | 10  | rob.   | 0.038         | 0.019         | 0.057         | -0.037   | -0.019   | -0.019   | -0.014   | -0.031   | -0.057   | -0.102   | -0.091   | -0.092   |
| sd   |     |     |        | 0.103         | 0.195         | 0.213         | 0.257    | 0.295    | 0.303    | 0.262    | 0.281    | 0.260    | 0.435    | 0.392    | 0.416    |
| mean | 100 | 20  | trad.  | -0.000        | 0.010         | 0.044         | 0.038    | 0.056    | -0.158   | -0.212   | 0.058    | -0.037   | -0.059   | -0.055   | -0.081   |
| sd   |     |     |        | 0.075         | 0.117         | 0.131         | 0.177    | 0.196    | 0.222    | 0.244    | 0.202    | 0.197    | 0.376    | 0.316    | 0.337    |
| mean | 100 | 20  | rob.   | 0.029         | 0.023         | 0.058         | -0.031   | -0.012   | -0.032   | -0.034   | -0.034   | -0.044   | -0.080   | -0.093   | -0.135   |
| sd   |     |     |        | 0.100         | 0.174         | 0.200         | 0.266    | 0.276    | 0.292    | 0.271    | 0.278    | 0.255    | 0.446    | 0.402    | 0.431    |
| mean | 100 | 40  | trad.  | 0.000         | 0.008         | 0.041         | 0.057    | 0.045    | -0.176   | -0.240   | 0.077    | -0.042   | -0.042   | -0.074   | -0.085   |
| sd   |     |     |        | 0.076         | 0.124         | 0.134         | 0.174    | 0.197    | 0.201    | 0.216    | 0.195    | 0.198    | 0.367    | 0.333    | 0.355    |
| mean | 100 | 40  | rob.   | 0.034         | 0.013         | 0.059         | -0.014   | -0.022   | -0.049   | -0.038   | -0.011   | -0.078   | -0.071   | -0.118   | -0.111   |
| sd   |     |     |        | 0.104         | 0.183         | 0.197         | 0.264    | 0.277    | 0.321    | 0.291    | 0.282    | 0.274    | 0.444    | 0.393    | 0.426    |
| mean | 100 | 50  | trad.  | -0.008        | 0.009         | 0.041         | 0.055    | 0.048    | -0.186   | -0.253   | 0.069    | -0.031   | -0.066   | -0.057   | -0.075   |
| sd   |     |     |        | 0.078         | 0.127         | 0.136         | 0.183    | 0.206    | 0.193    | 0.223    | 0.193    | 0.197    | 0.364    | 0.324    | 0.358    |
| mean | 100 | 50  | rob.   | 0.043         | 0.012         | 0.054         | -0.065   | -0.037   | -0.066   | -0.061   | -0.060   | -0.105   | -0.108   | -0.124   | -0.127   |
| sd   |     |     |        | 0.122         | 0.193         | 0.202         | 0.314    | 0.308    | 0.454    | 0.427    | 0.304    | 0.285    | 0.470    | 0.425    | 0.451    |
| mean | 300 | 0   | trad.  | 0.010         | 0.006         | 0.007         | -0.000   | -0.010   | -0.001   | -0.008   | 0.000    | -0.010   | -0.019   | -0.017   | -0.017   |
| sd   |     |     |        | 0.042         | 0.066         | 0.071         | 0.102    | 0.108    | 0.113    | 0.107    | 0.104    | 0.099    | 0.202    | 0.174    | 0.190    |
| mean | 300 | 0   | rob.   | 0.014         | 0.009         | 0.011         | -0.003   | -0.011   | -0.002   | -0.010   | -0.002   | -0.011   | -0.019   | -0.030   | -0.023   |
| sd   |     |     |        | 0.048         | 0.077         | 0.082         | 0.124    | 0.129    | 0.129    | 0.123    | 0.125    | 0.119    | 0.233    | 0.201    | 0.217    |
| mean | 300 | 5   | trad.  | -0.010        | 0.003         | 0.014         | 0.044    | 0.047    | -0.102   | -0.110   | 0.051    | -0.013   | -0.015   | -0.022   | -0.021   |
| sd   |     |     |        | 0.044         | 0.061         | 0.064         | 0.100    | 0.110    | 0.136    | 0.135    | 0.111    | 0.106    | 0.206    | 0.185    | 0.196    |
| mean | 300 | 5   | rob.   | 0.011         | 0.008         | 0.015         | -0.002   | -0.004   | -0.007   | -0.006   | -0.006   | -0.010   | -0.024   | -0.031   | -0.026   |
| sd   |     |     |        | 0.048         | 0.076         | 0.079         | 0.113    | 0.126    | 0.124    | 0.124    | 0.124    | 0.116    | 0.244    | 0.218    | 0.226    |
| mean | 300 | 10  | trad.  | -0.012        | 0.003         | 0.014         | 0.055    | 0.060    | -0.131   | -0.159   | 0.068    | -0.013   | -0.008   | -0.028   | -0.018   |
| sd   |     |     |        | 0.045         | 0.064         | 0.068         | 0.091    | 0.103    | 0.115    | 0.129    | 0.108    | 0.105    | 0.202    | 0.178    | 0.198    |
| mean | 300 | 10  | rob.   | 0.011         | 0.009         | 0.015         | -0.006   | -0.002   | -0.004   | -0.007   | -0.007   | -0.007   | -0.012   | -0.032   | -0.026   |
| sd   |     |     |        | 0.050         | 0.076         | 0.082         | 0.111    | 0.122    | 0.122    | 0.125    | 0.124    | 0.114    | 0.232    | 0.200    | 0.226    |
| mean | 300 | 20  | trad.  | -0.015        | -0.001        | 0.015         | 0.069    | 0.059    | -0.154   | -0.211   | 0.088    | -0.019   | -0.024   | -0.019   | -0.014   |
| sd   |     |     |        | 0.045         | 0.063         | 0.067         | 0.096    | 0.104    | 0.104    | 0.121    | 0.109    | 0.109    | 0.206    | 0.183    | 0.197    |
| mean | 300 | 20  | rob.   | 0.013         | 0.007         | 0.013         | -0.002   | -0.009   | -0.000   | -0.013   | 0.002    | -0.017   | -0.025   | -0.025   | -0.027   |
| sd   |     |     |        | 0.051         | 0.076         | 0.082         | 0.121    | 0.128    | 0.136    | 0.133    | 0.124    | 0.120    | 0.240    | 0.209    | 0.229    |
| mean | 300 | 40  | trad.  | -0.018        | 0.001         | 0.016         | 0.067    | 0.068    | -0.175   | -0.261   | 0.087    | -0.009   | -0.019   | -0.019   | -0.017   |
| sd   |     |     |        | 0.045         | 0.063         | 0.067         | 0.092    | 0.102    | 0.100    | 0.114    | 0.109    | 0.108    | 0.202    | 0.186    | 0.187    |
| mean | 300 | 40  | rob.   | 0.005         | 0.010         | 0.016         | 0.009    | 0.016    | -0.040   | -0.049   | 0.016    | -0.013   | -0.033   | -0.029   | -0.034   |
| sd   |     |     |        | 0.056         | 0.084         | 0.091         | 0.127    | 0.136    | 0.147    | 0.149    | 0.140    | 0.129    | 0.260    | 0.238    | 0.244    |
| mean | 300 | 50  | trad.  | -0.021        | -0.001        | 0.017         | 0.076    | 0.060    | -0.186   | -0.266   | 0.086    | -0.009   | -0.016   | -0.033   | -0.009   |
| sd   |     |     |        | 0.044         | 0.062         | 0.065         | 0.093    | 0.105    | 0.098    | 0.118    | 0.107    | 0.107    | 0.207    | 0.188    | 0.193    |
| mean | 300 | 50  | rob.   | -0.003        | 0.004         | 0.021         | 0.037    | 0.025    | -0.078   | -0.103   | 0.035    | -0.011   | -0.027   | -0.049   | -0.021   |
| sd   |     |     |        | 0.055         | 0.086         | 0.090         | 0.135    | 0.142    | 0.160    | 0.170    | 0.146    | 0.140    | 0.269    | 0.238    | 0.247    |
| mean | 500 | 0   | trad.  | 0.005         | 0.003         | 0.006         | -0.004   | -0.004   | 0.002    | -0.002   | -0.007   | 0.001    | -0.007   | -0.012   | -0.012   |
| sd   |     |     |        | 0.034         | 0.048         | 0.051         | 0.076    | 0.084    | 0.085    | 0.080    | 0.083    | 0.075    | 0.156    | 0.138    | 0.145    |
| mean | 500 | 0   | rob.   | 0.006         | 0.004         | 0.008         | -0.006   | -0.001   | 0.000    | -0.003   | -0.008   | 0.000    | -0.010   | -0.015   | -0.012   |
| sd   |     |     |        | 0.037         | 0.054         | 0.057         | 0.086    | 0.093    | 0.096    | 0.089    | 0.095    | 0.085    | 0.172    | 0.155    | 0.158    |
| mean | 500 | 5   | trad.  | -0.014        | -0.002        | 0.011         | 0.048    | 0.048    | -0.100   | -0.120   | 0.054    | -0.003   | -0.015   | -0.010   | -0.008   |
| sd   |     |     |        | 0.034         | 0.048         | 0.049         | 0.073    | 0.080    | 0.099    | 0.096    | 0.084    | 0.080    | 0.161    | 0.142    | 0.153    |
| mean | 500 | 5   | rob.   | 0.006         | 0.002         | 0.010         | -0.006   | -0.003   | 0.003    | -0.004   | -0.008   | -0.000   | -0.015   | -0.015   | -0.011   |
| sd   |     |     |        | 0.037         | 0.056         | 0.055         | 0.086    | 0.090    | 0.098    | 0.094    | 0.094    | 0.089    | 0.182    | 0.159    | 0.166    |
| mean | 500 | 10  | trad.  | -0.018        | 0.000         | 0.010         | 0.055    | 0.064    | -0.130   | -0.162   | 0.074    | -0.008   | -0.015   | -0.002   | -0.015   |
| sd   |     |     |        | 0.034         | 0.047         | 0.049         | 0.072    | 0.080    | 0.090    | 0.098    | 0.083    | 0.079    | 0.160    | 0.138    | 0.152    |
| mean | 500 | 10  | rob.   | 0.005         | 0.006         | 0.009         | -0.006   | 0.007    | -0.007   | -0.005   | 0.001    | -0.008   | -0.016   | -0.004   | -0.021   |
| sd   |     |     |        | 0.039         | 0.056         | 0.057         | 0.088    | 0.093    | 0.098    | 0.090    | 0.094    | 0.086    | 0.180    | 0.156    | 0.171    |
| mean | 500 | 20  | trad.  | -0.021        | -0.003        | 0.013         | 0.069    | 0.064    | -0.160   | -0.206   | 0.083    | -0.006   | -0.013   | -0.005   | -0.016   |
| sd   |     |     |        | 0.033         | 0.049         | 0.051         | 0.072    | 0.081    | 0.078    | 0.090    | 0.082    | 0.081    | 0.163    | 0.144    | 0.155    |
| mean | 500 | 20  | rob.   | 0.004         | 0.002         | 0.013         | 0.001    | -0.000   | -0.008   | -0.013   | 0.001    | -0.005   | -0.015   | -0.008   | -0.023   |
| sd   |     |     |        | 0.039         | 0.059         | 0.059         | 0.091    | 0.100    | 0.099    | 0.097    | 0.098    | 0.092    | 0.184    | 0.166    | 0.181    |
| mean | 500 | 40  | trad.  | -0.023        | -0.001        | 0.010         | 0.070    | 0.069    | -0.177   | -0.256   | 0.093    | -0.009   | -0.002   | -0.017   | -0.013   |
| sd   |     |     |        | 0.034         | 0.050         | 0.053         | 0.071    | 0.079    | 0.076    | 0.091    | 0.083    | 0.082    | 0.160    | 0.136    | 0.149    |
| mean | 500 | 40  | rob.   | 0.000         | 0.006         | 0.010         | 0.012    | 0.017    | -0.033   | -0.046   | 0.021    | -0.009   | -0.008   | -0.023   | -0.016   |
| sd   |     |     |        | 0.042         | 0.062         | 0.066         | 0.092    | 0.105    | 0.110    | 0.111    | 0.105    | 0.097    | 0.192    | 0.170    | 0.184    |
| mean | 500 | 50  | trad.  | -0.024        | -0.002        | 0.010         | 0.072    | 0.069    | -0.182   | -0.264   | 0.092    | -0.007   | -0.011   | -0.008   | -0.015   |
| sd   |     |     |        | 0.035         | 0.048         | 0.049         | 0.072    | 0.081    | 0.073    | 0.087    | 0.083    | 0.083    | 0.162    | 0.145    | 0.152    |
| mean | 500 | 50  | rob.   | -0.010        | 0.007         | 0.011         | 0.040    | 0.033    | -0.081   | -0.104   | 0.051    | -0.012   | -0.025   | -0.019   | -0.015   |
| sd   |     |     |        | 0.045         | 0.065         | 0.068         | 0.098    | 0.110    | 0.113    | 0.122    | 0.111    | 0.107    | 0.214    | 0.186    | 0.196    |

Table 5 Results for traditional and robust PLSc for five common factors and unsystematic outliers in all indicators

|      | n   | out | estim. | $\rho_{12}$ | $\gamma_{32}$ | $\gamma_{41}$ | $\gamma_{42}$ | $\gamma_{51}$ | $\gamma_{52}$ | $\gamma_{65}$ | $\lambda_{11}$ | $\lambda_{13}$ | $\lambda_{21}$ | $\lambda_{22}$ | $\lambda_{23}$ | $\lambda_{24}$ | $\lambda_{25}$ | $\lambda_{26}$ | $\lambda_{31}$ | $\lambda_{32}$ | $\lambda_{33}$ | $\lambda_{34}$ | $\lambda_{41}$ | $\lambda_{42}$ | $\lambda_{51}$ | $\lambda_{52}$ | $\lambda_{53}$ | $\lambda_{54}$ | $\lambda_{55}$ | $\lambda_{56}$ |        |
|------|-----|-----|--------|-------------|---------------|---------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------|
| mean | 100 | 0   | trad.  | -0.005      | -0.016        | 0.015         | 0.019         | 0.007         | -0.010        | -0.003        | 0.001          | $\lambda_{22}$ | -0.003         | 0.001          | -0.001         | -0.008         | -0.007         | -0.011         | -0.014         | -0.025         | -0.086         | -0.111         | -0.026         | -0.030         | 0.002          | -0.004         | -0.003         | -0.009         | -0.024         | -0.022         |        |
| sd   |     |     |        | 0.082       | 0.164         | 0.229         | 0.228         | 0.223         | 0.056         | 0.102         | 0.107          | 0.056          | 0.102          | 0.107          | 0.104          | 0.090          | 0.085          | 0.086          | 0.282          | 0.220          | -0.086         | -0.111         | -0.026         | -0.030         | 0.002          | -0.004         | -0.003         | -0.009         | -0.024         | -0.022         |        |
| mean | 100 | 0   | rob.   | -0.010      | -0.054        | 0.025         | -0.009        | -0.004        | -0.045        | -0.000        | 0.000          | -0.005         | 0.000          | 0.000          | -0.005         | 0.000          | 0.002          | -0.002         | -0.012         | -0.056         | -0.145         | -0.191         | -0.013         | -0.041         | -0.002         | 0.002          | -0.009         | -0.010         | -0.048         | -0.068         |        |
| sd   |     |     |        | 0.109       | 0.233         | 0.319         | 0.304         | 0.322         | 0.318         | 0.195         | 0.076          | 0.069          | 0.148          | 0.144          | 0.151          | 0.122          | 0.117          | 0.118          | 0.332          | 0.281          | 0.239          | 0.218          | 0.126          | 0.111          | 0.178          | 0.183          | 0.154          | 0.150          | 0.095          | 0.091          |        |
| mean | 100 | 5   | trad.  | -0.193      | -0.072        | 0.225         | -0.220        | -0.172        | -0.159        | -0.010        | -0.170         | -0.237         | -0.114         | -0.130         | -0.100         | -0.187         | -0.189         | -0.188         | -0.103         | -0.105         | -0.169         | -0.2215        | 0.014          | -0.062         | -0.048         | -0.002         | -0.008         | -0.008         | -0.012         | -0.048         | -0.048 |
| sd   |     |     |        | 0.562       | 0.486         | 0.633         | 0.632         | 0.728         | 0.973         | 0.698         | 0.276          | 0.361          | 0.276          | 0.276          | 0.264          | 0.289          | 0.282          | 0.279          | 0.415          | 0.244          | 0.225          | 0.219          | 0.213          | 0.193          | 0.173          | 0.169          | 0.142          | 0.155          | 0.100          | 0.097          |        |
| mean | 100 | 5   | rob.   | 0.002       | -0.054        | 0.014         | 0.001         | 0.004         | -0.051        | 0.008         | 0.014          | -0.020         | -0.011         | -0.000         | 0.005          | -0.003         | -0.003         | 0.001          | -0.027         | -0.082         | -0.149         | -0.191         | -0.002         | -0.046         | -0.013         | -0.011         | -0.013         | -0.003         | -0.047         | -0.048         |        |
| sd   |     |     |        | 0.107       | 0.243         | 0.306         | 0.288         | 0.302         | 0.308         | 0.187         | 0.078          | 0.066          | 0.152          | 0.154          | 0.152          | 0.121          | 0.118          | 0.120          | 0.344          | 0.294          | 0.246          | 0.233          | 0.128          | 0.113          | 0.182          | 0.188          | 0.151          | 0.149          | 0.093          | 0.091          |        |
| mean | 100 | 10  | trad.  | -0.260      | -0.074        | 0.234         | -0.258        | -0.243        | -0.243        | -0.020        | -0.273         | -0.214         | -0.205         | -0.187         | -0.187         | -0.292         | -0.269         | -0.290         | -0.290         | -0.157         | -0.107         | -0.163         | -0.217         | -0.013         | -0.073         | -0.008         | -0.002         | -0.019         | -0.014         | -0.062         | -0.061 |
| sd   |     |     |        | 1.065       | 0.417         | 0.752         | 0.735         | 0.980         | 1.359         | 1.015         | 0.451          | 0.374          | 0.287          | 0.301          | 0.295          | 0.304          | 0.295          | 0.292          | 0.418          | 0.239          | 0.233          | 0.232          | 0.180          | 0.257          | 0.192          | 0.187          | 0.168          | 0.166          | 0.125          | 0.123          |        |
| mean | 100 | 10  | rob.   | 0.001       | -0.045        | 0.013         | 0.003         | -0.009        | -0.035        | 0.007         | 0.012          | -0.019         | -0.005         | -0.009         | -0.001         | -0.009         | -0.008         | 0.000          | -0.020         | -0.064         | -0.140         | -0.188         | -0.002         | -0.045         | -0.002         | -0.006         | -0.023         | -0.011         | -0.045         | -0.046         |        |
| sd   |     |     |        | 0.108       | 0.225         | 0.316         | 0.299         | 0.309         | 0.310         | 0.178         | 0.076          | 0.071          | 0.150          | 0.146          | 0.143          | 0.120          | 0.121          | 0.121          | 0.341          | 0.291          | 0.235          | 0.217          | 0.122          | 0.111          | 0.181          | 0.184          | 0.151          | 0.157          | 0.093          | 0.092          |        |
| mean | 100 | 20  | trad.  | -0.313      | -0.041        | 0.222         | -0.330        | -0.268        | -0.305        | -0.002        | -0.368         | -0.457         | -0.255         | -0.241         | -0.244         | -0.386         | -0.387         | -0.376         | -0.254         | -0.091         | -0.148         | -0.199         | 0.033          | -0.126         | -0.033         | -0.001         | -0.024         | -0.014         | -0.069         | -0.066         |        |
| sd   |     |     |        | 1.888       | 0.524         | 0.895         | 0.900         | 1.161         | 1.256         | 0.902         | 0.417          | 0.378          | 0.285          | 0.278          | 0.277          | 0.284          | 0.282          | 0.273          | 0.396          | 0.235          | 0.229          | 0.229          | 0.321          | 0.644          | 0.206          | 0.207          | 0.173          | 0.173          | 0.110          | 0.120          |        |
| mean | 100 | 40  | rob.   | 0.007       | -0.038        | 0.005         | 0.013         | 0.025         | -0.075        | -0.005        | 0.014          | -0.018         | -0.009         | -0.002         | -0.005         | -0.009         | -0.006         | -0.003         | -0.018         | -0.083         | -0.143         | -0.196         | -0.011         | -0.040         | -0.001         | -0.011         | -0.007         | -0.019         | -0.049         | -0.046         |        |
| sd   |     |     |        | 0.111       | 0.239         | 0.308         | 0.295         | 0.321         | 0.313         | 0.195         | 0.078          | 0.069          | 0.148          | 0.139          | 0.132          | 0.115          | 0.118          | 0.120          | 0.322          | 0.289          | 0.251          | 0.252          | 0.117          | 0.117          | 0.180          | 0.176          | 0.151          | 0.164          | 0.098          | 0.094          |        |
| mean | 100 | 40  | trad.  | -0.436      | -0.078        | 0.084         | -0.151        | -0.358        | -0.463        | -0.006        | -0.457         | -0.553         | -0.291         | -0.297         | -0.298         | -0.465         | -0.460         | -0.460         | -0.320         | -0.064         | -0.116         | -0.154         | 0.033          | -0.117         | 0.033          | -0.011         | -0.015         | -0.027         | -0.071         | -0.082         |        |
| sd   |     |     |        | 2.446       | 0.645         | 0.708         | 0.704         | 1.111         | 1.271         | 0.610         | 0.417          | 0.447          | 0.251          | 0.247          | 0.255          | 0.255          | 0.267          | 0.255          | 0.342          | 0.231          | 0.189          | 0.182          | 0.510          | 0.414          | 0.216          | 0.218          | 0.183          | 0.179          | 0.117          | 0.129          |        |
| mean | 100 | 40  | rob.   | 0.010       | -0.038        | 0.024         | 0.030         | 0.005         | -0.056        | 0.003         | 0.011          | -0.013         | -0.003         | -0.006         | -0.003         | 0.002          | 0.003          | -0.006         | -0.031         | -0.071         | -0.127         | -0.181         | -0.018         | -0.035         | -0.004         | -0.009         | -0.016         | -0.007         | -0.037         | -0.043         |        |
| sd   |     |     |        | 0.103       | 0.220         | 0.297         | 0.278         | 0.290         | 0.295         | 0.169         | 0.073          | 0.065          | 0.137          | 0.140          | 0.144          | 0.109          | 0.113          | 0.117          | 0.340          | 0.274          | 0.231          | 0.221          | 0.118          | 0.109          | 0.168          | 0.170          | 0.149          | 0.150          | 0.087          | 0.089          |        |
| mean | 100 | 50  | trad.  | -0.456      | -0.080        | 0.087         | -0.433        | -0.772        | -0.002        | -0.149        | -0.484         | -0.573         | -0.297         | -0.314         | -0.306         | -0.492         | -0.486         | -0.488         | -0.331         | -0.038         | -0.118         | -0.159         | 0.002          | -0.134         | 0.001          | 0.007          | -0.027         | -0.021         | -0.075         | -0.076         |        |
| sd   |     |     |        | 4.790       | 0.731         | 0.809         | 0.844         | 14.454        | 14.462        | 2.334         | 0.397          | 0.426          | 0.249          | 0.240          | 0.241          | 0.246          | 0.250          | 0.247          | 0.306          | 0.210          | 0.202          | 0.202          | 0.417          | 0.578          | 0.204          | 0.201          | 0.186          | 0.178          | 0.120          | 0.124          |        |
| mean | 100 | 50  | rob.   | -0.359      | -0.053        | 0.342         | -0.485        | -0.390        | -0.419        | -0.086        | -0.179         | -0.262         | -0.201         | -0.223         | -0.198         | -0.347         | -0.323         | -0.362         | -0.206         | -0.143         | -0.241         | -0.290         | -0.107         | -0.029         | -0.029         | -0.063         | -0.056         | -0.117         | -0.107         | -0.107         |        |
| sd   |     |     |        | 0.910       | 0.712         | 2.953         | 2.990         | 2.423         | 2.532         | 1.343         | 0.528          | 0.416          | 0.399          | 0.406          | 0.411          | 0.410          | 0.416          | 0.403          | 0.518          | 0.268          | 0.277          | 0.282          | 0.340          | 0.398          | 0.272          | 0.267          | 0.230          | 0.238          | 0.198          | 0.190          |        |
| mean | 300 | 0   | trad.  | -0.002      | -0.007        | 0.012         | 0.012         | -0.008        | -0.015        | -0.038        | -0.000         | -0.000         | -0.005         | 0.000          | -0.001         | -0.003         | -0.002         | 0.003          | 0.004          | 0.001          | -0.006         | -0.051         | 0.031          | -0.028         | -0.033         | 0.001          | 0.001          | -0.003         | -0.008         | -0.005         |        |
| sd   |     |     |        | 0.052       | 0.079         | 0.123         | 0.126         | 0.116         | 0.113         | 0.061         | 0.036          | 0.036          | 0.062          | 0.061          | 0.061          | 0.051          | 0.050          | 0.048          | 0.177          | 0.130          | 0.104          | 0.085          | 0.053          | 0.057          | 0.077          | 0.076          | 0.068          | 0.070          | 0.044          | 0.044          |        |
| mean | 300 | 0   | rob.   | 0.001       | -0.004        | -0.023        | 0.019         | -0.003        | -0.026        | -0.035        | -0.000         | -0.000         | -0.000         | -0.003         | -0.002         | -0.005         | -0.005         | -0.006         | 0.007          | -0.003         | -0.029         | -0.054         | -0.032         | -0.029         | -0.003         | 0.001          | -0.006         | -0.006         | -0.008         | -0.005         |        |
| sd   |     |     |        | 0.056       | 0.097         | 0.154         | 0.153         | 0.142         | 0.140         | 0.070         | 0.042          | 0.040          | 0.069          | 0.067          | 0.072          | 0.056          | 0.056          | 0.058          | 0.186          | 0.156          | 0.114          | 0.093          | 0.064          | 0.066          | 0.066          | 0.088          | 0.089          | 0.078          | 0.048          | 0.049          |        |
| mean | 300 | 5   | trad.  | -0.090      | -0.037        | 0.024         | -0.063        | -0.017        | 0.006         | -0.031        | -0.250         | -0.285         | -0.141         | -0.142         | -0.139         | -0.206         | -0.214         | -0.210         | -0.136         | -0.024         | -0.044         | -0.070         | -0.026         | -0.028         | -0.002         | -0.004         | 0.000          | 0.002          | -0.014         | -0.015         |        |
| sd   |     |     |        | 0.240       | 0.817         | 0.453         | 0.413         | 0.497         | 0.452         | 0.116         | 0.179          | 0.178          | 0.131          | 0.123          | 0.127          | 0.129          | 0.129          | 0.128          | 0.233          | 0.144          | 0.125          | 0.116          | 0.067          | 0.071          | 0.095          | 0.093          | 0.082          | 0.084          | 0.053          | 0.051          |        |
| mean | 300 | 5   | rob.   | 0.002       | -0.004        | -0.010        | 0.014         | 0.002         | -0.025        | -0.031        | -0.000         | -0.002         | -0.003         | -0.001         | -0.004         | -0.005         | -0.003         | -0.005         | -0.002         | -0.010         | -0.034         | -0.057         | -0.029         | -0.031         | -0.001         | -0.003         | -0.004         | 0.000          | -0.010         | -0.012         |        |
| sd   |     |     |        | 0.059       | 0.096         | 0.150         | 0.147         | 0.140         | 0.140         | 0.071         | 0.043          | 0.042          | 0.071          | 0.071          | 0.072          | 0.057          | 0.058          | 0.060          | 0.201          | 0.156          | 0.127          | 0.097          | 0.062          | 0.064          | 0.088          | 0.088          | 0.079          | 0.079          | 0.049          | 0.049          |        |
| mean | 300 | 10  | trad.  | -0.206      | -0.018        | 0.105         | -0.122        | -0.134        | 0.103         | -0.041        | -0.357         | -0.387         | -0.196         | -0.190         | -0.187         | -0.285         | -0.290         | -0.283         | -0.207         | -0.033         | -0.050         | -0.071         | -0.016         | -0.042         | 0.001          | -0.002         | 0.001          | -0.001         | -0.019         | -0.017         |        |
| sd   |     |     |        | 0.342       | 0.173         | 0.302         | 0.371         | 0.492         | 0.440         | 0.127         | 0.269          | 0.208          | 0.137          | 0.129          | 0.130          | 0.140          | 0.138          | 0.135          | 0.250          | 0.147          | 0.129          | 0.123          | 0.078          | 0.087          | 0.104          | 0.109          | 0.088          | 0.091          | 0.057          | 0.056          |        |
| mean | 300 | 10  | rob.   | 0.004       | -0.010        | -0.017        | 0.020         | -0.000        | -0.020        | -0.035        | 0.002          | -0.002         | -0.003         | -0.005         | -0.005         | -0.005         | -0.004         | -0.002         | 0.001          | -0.008         | -0.034         | -0.053         | -0.030         | -0.031         | 0.000          | -0.005         | -0.008         | -0.004         | -0.008         | -0.008         |        |
| sd   |     |     |        | 0.056       | 0.095         | 0.150         | 0.153         | 0.143         | 0.143         | 0.070         | 0.042          | 0.042          | 0.072          | 0.070          | 0.072          | 0.058          | 0.060          | 0.057          | 0.201          | 0.147          | 0.116          | 0.091          | 0.064          | 0.066          | 0.092          | 0.081          | 0.081          | 0.077          | 0.051          | 0.049          |        |
| mean | 300 | 20  | trad.  | -0.273      | -0.039        | 0.105         | -0.159        | -0.159        | -0.161        | -0.048        | -0.413         | -0.488         | -0.243         | -0.239         | -0.244         | -0.372         | -0.370         | -0.365         | -0.289         | -0.016         | -0.044         | -0.061         | -0.004         | -0.056         | 0.000          | -0.002         | -0.003         | -0.003         | -0.021         | -0.022         |        |
| sd   |     |     |        | 0.494       | 0.193         | 0.469         | 0.419         | 0.502         | 0.468         | 0.150         | 0.244          | 0.263          | 0.137          | 0.134          | 0.138          | 0.141          | 0.144          | 0.108          | 0.223          | 0.133          | 0.108          | 0.098          | 0.100          | 0.108          | 0.118          | 0.121          | 0.102          | 0.102          | 0.063          | 0.064          |        |
| mean | 300 | 20  | rob.   | 0.005       | -0.011        | -0.026        | 0.020         | 0.001         | -0.026        | -0.037        | 0.000          | 0.002          | 0.004          | -0.003         | -0.004         | -0.005         | -0.006         | -0.004         | 0.001          | -0.009         | -0.034         | -0.065         | -0.032         | -0.034         | 0.001          | -0.002         | -0.005         | -0.005         | -0.010         | -0.008         |        |
| sd   |     |     |        | 0.059       | 0.101         | 0.153         | 0.153         | 0.137         | 0.137         | 0.074         | 0.044          | 0.042          | 0.071          | 0.075          | 0.072          | 0.057          | 0.063          | 0.060          | 0.202          | 0.162          | 0.125          | 0.104          | 0.065          | 0.068          | 0.095          | 0.091          | 0.080          | 0.082          | 0.049          | 0.047          |        |
| mean | 300 | 40  | trad.  | -0.454      | -0.057        |               |               |               |               |               |                |                |                |                |                |                |                |                |                |                |                |                |                |                |                |                |                |                |                |                |        |

Table 6 Results for traditional and robust PLSc for five common factors and unsystematic outliers in two indicators

|      | n   | out | estim. | $\rho_{12}$ | $\gamma_{12}$ | $\gamma_{42}$ | $\gamma_{51}$ | $\gamma_{52}$ | $\gamma_{53}$ | $\lambda_{11}$ | $\lambda_{13}$ | $\lambda_{21}$ | $\lambda_{22}$ | $\lambda_{23}$ | $\lambda_{24}$ | $\lambda_{25}$ | $\lambda_{26}$ | $\lambda_{31}$ | $\lambda_{32}$ | $\lambda_{33}$ | $\lambda_{34}$ | $\lambda_{41}$ | $\lambda_{42}$ | $\lambda_{51}$ | $\lambda_{52}$ | $\lambda_{53}$ | $\lambda_{54}$ | $\lambda_{55}$ | $\lambda_{56}$ |        |        |
|------|-----|-----|--------|-------------|---------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------|--------|
| sd   | 100 | 0   | rob.   | 0.082       | 0.159         | 0.222         | 0.220         | 0.219         | 0.061         | 0.054          | 0.105          | 0.108          | 0.110          | 0.086          | 0.000          | 0.088          | 0.287          | 0.231          | 0.195          | 0.134          | 0.130          | 0.117          | 0.090          | 0.091          | 0.134          | 0.130          | 0.117          | 0.117          | 0.065          | 0.071  |        |
| mean | 100 | 0   | rob.   | 0.012       | -0.046        | -0.018        | 0.021         | -0.059        | 0.012         | 0.017          | -0.005         | -0.008         | -0.012         | -0.002         | -0.010         | -0.013         | 0.125          | -0.030         | -0.143         | 0.008          | -0.009         | -0.014         | -0.008         | -0.042         | 0.008          | -0.009         | -0.014         | -0.016         | -0.048         | -0.048 |        |
| sd   | 100 | 5   | trad.  | 0.110       | 0.237         | 0.341         | 0.320         | 0.344         | 0.355         | 0.193          | 0.077          | 0.146          | 0.157          | 0.122          | 0.123          | 0.123          | 0.125          | 0.344          | 0.292          | 0.242          | 0.235          | 0.174          | 0.114          | 0.177          | 0.177          | 0.179          | 0.156          | 0.163          | 0.096          | 0.083  |        |
| mean | 100 | 5   | trad.  | 0.008       | -0.029        | -0.006        | 0.020         | 0.049         | -0.084        | -0.024         | -0.011         | -0.007         | -0.006         | -0.009         | -0.011         | -0.003         | -0.003         | -0.034         | -0.029         | -0.086         | -0.126         | -0.020         | -0.037         | -0.002         | -0.002         | -0.001         | -0.011         | -0.003         | -0.024         | -0.026 |        |
| sd   | 100 | 5   | rob.   | 0.111       | 0.161         | 0.302         | 0.279         | 0.311         | 0.298         | 0.123          | 0.100          | 0.112          | 0.108          | 0.092          | 0.089          | 0.088          | 0.293          | 0.230          | 0.187          | 0.174          | 0.094          | 0.095          | 0.133          | 0.133          | 0.133          | 0.134          | 0.115          | 0.119          | 0.067          | 0.067  |        |
| mean | 100 | 5   | rob.   | 0.007       | -0.036        | -0.000        | 0.012         | -0.064        | 0.008         | 0.016          | -0.008         | 0.006          | -0.010         | -0.001         | -0.003         | -0.003         | -0.003         | -0.032         | -0.069         | -0.147         | -0.198         | 0.004          | -0.039         | 0.002          | -0.007         | -0.017         | -0.017         | -0.045         | -0.047         | -0.047 |        |
| sd   | 100 | 5   | trad.  | 0.108       | 0.243         | 0.311         | 0.294         | 0.329         | 0.334         | 0.193          | 0.076          | 0.147          | 0.153          | 0.116          | 0.120          | 0.126          | 0.334          | 0.293          | 0.247          | 0.235          | 0.173          | 0.185          | 0.114          | 0.173          | 0.173          | 0.185          | 0.162          | 0.156          | 0.089          | 0.083  |        |
| mean | 100 | 10  | trad.  | 0.015       | -0.022        | 0.011         | 0.008         | 0.042         | -0.083        | -0.016         | -0.018         | -0.003         | 0.002          | -0.008         | -0.004         | -0.004         | -0.014         | -0.039         | -0.083         | -0.123         | -0.021         | -0.038         | -0.002         | -0.038         | -0.002         | -0.008         | -0.008         | -0.005         | -0.023         | -0.023 |        |
| sd   | 100 | 10  | rob.   | 0.114       | 0.162         | 0.344         | 0.318         | 0.357         | 0.340         | 0.130          | 0.113          | 0.129          | 0.134          | 0.112          | 0.093          | 0.094          | 0.091          | 0.287          | 0.222          | 0.190          | 0.164          | 0.092          | 0.092          | 0.131          | 0.133          | 0.114          | 0.114          | 0.064          | 0.068          | 0.068  |        |
| mean | 100 | 10  | rob.   | 0.007       | -0.029        | 0.008         | -0.004        | 0.002         | -0.051        | 0.008          | 0.017          | 0.005          | 0.004          | -0.001         | -0.013         | 0.003          | 0.003          | -0.010         | -0.064         | -0.147         | -0.193         | -0.009         | -0.042         | -0.009         | -0.000         | -0.007         | -0.008         | -0.045         | -0.055         | -0.055 |        |
| sd   | 100 | 10  | trad.  | 0.108       | 0.234         | 0.309         | 0.295         | 0.313         | 0.316         | 0.188          | 0.078          | 0.146          | 0.147          | 0.123          | 0.123          | 0.115          | 0.334          | 0.284          | 0.238          | 0.228          | 0.216          | 0.117          | 0.113          | 0.177          | 0.176          | 0.152          | 0.154          | 0.091          | 0.094          | 0.094  |        |
| mean | 100 | 20  | trad.  | 0.026       | -0.025        | 0.020         | -0.002        | 0.062         | -0.020        | -0.035         | -0.591         | -0.279         | -0.009         | -0.005         | -0.007         | -0.009         | -0.014         | -0.006         | -0.028         | -0.074         | -0.116         | -0.019         | -0.033         | 0.004          | -0.010         | -0.002         | -0.011         | -0.026         | -0.025         | -0.025 | -0.025 |
| sd   | 100 | 20  | rob.   | 0.122       | 0.159         | 0.371         | 0.343         | 0.434         | 0.423         | 0.138          | 0.123          | 0.134          | 0.109          | 0.112          | 0.088          | 0.092          | 0.095          | 0.268          | 0.227          | 0.181          | 0.154          | 0.096          | 0.094          | 0.129          | 0.131          | 0.109          | 0.111          | 0.066          | 0.071          | 0.071  |        |
| mean | 100 | 20  | rob.   | 0.004       | -0.045        | 0.006         | 0.005         | -0.050        | -0.007        | 0.009          | -0.014         | -0.001         | -0.001         | -0.006         | -0.003         | -0.003         | -0.003         | -0.040         | -0.057         | -0.134         | -0.191         | -0.021         | -0.027         | -0.004         | -0.005         | -0.013         | -0.043         | -0.043         | -0.039         | -0.039 |        |
| sd   | 100 | 40  | trad.  | 0.110       | 0.229         | 0.300         | 0.280         | 0.328         | 0.330         | 0.188          | 0.080          | 0.148          | 0.140          | 0.148          | 0.117          | 0.114          | 0.350          | 0.274          | 0.226          | 0.229          | 0.229          | 0.118          | 0.107          | 0.182          | 0.179          | 0.146          | 0.147          | 0.089          | 0.089          | 0.089  |        |
| mean | 100 | 40  | trad.  | 0.025       | -0.018        | 0.045         | -0.028        | 0.057         | -0.098        | -0.015         | -0.036         | -0.075         | -0.003         | -0.008         | -0.007         | -0.007         | -0.012         | -0.018         | -0.036         | -0.092         | -0.114         | -0.023         | -0.031         | -0.002         | -0.001         | -0.007         | -0.008         | -0.024         | -0.030         | -0.030 |        |
| sd   | 100 | 40  | rob.   | 0.127       | 0.163         | 0.404         | 0.375         | 0.419         | 0.398         | 0.132          | 0.126          | 0.156          | 0.129          | 0.112          | 0.095          | 0.088          | 0.281          | 0.240          | 0.189          | 0.160          | 0.099          | 0.092          | 0.134          | 0.137          | 0.117          | 0.117          | 0.070          | 0.069          | 0.069          | 0.069  |        |
| mean | 100 | 40  | rob.   | 0.005       | -0.045        | -0.004        | 0.023         | 0.018         | -0.066        | 0.001          | -0.020         | -0.283         | -0.177         | -0.012         | -0.003         | -0.011         | -0.004         | 0.000          | -0.011         | -0.065         | -0.140         | -0.181         | -0.009         | -0.044         | -0.001         | -0.009         | -0.021         | -0.015         | -0.044         | -0.044 |        |
| sd   | 100 | 40  | rob.   | 0.125       | 0.230         | 0.378         | 0.345         | 0.368         | 0.351         | 0.177          | 0.113          | 0.138          | 0.134          | 0.144          | 0.117          | 0.118          | 0.317          | 0.278          | 0.245          | 0.216          | 0.117          | 0.113          | 0.177          | 0.177          | 0.176          | 0.152          | 0.154          | 0.091          | 0.094          | 0.094  |        |
| mean | 100 | 50  | trad.  | 0.010       | -0.021        | 0.030         | -0.020        | 0.041         | -0.078        | -0.019         | -0.028         | -0.759         | -0.351         | -0.005         | -0.006         | -0.010         | -0.002         | -0.036         | -0.079         | -0.124         | -0.022         | -0.033         | -0.008         | -0.000         | -0.002         | -0.014         | -0.002         | -0.028         | -0.029         | -0.029 | -0.029 |
| sd   | 100 | 50  | rob.   | 0.127       | 0.163         | 0.373         | 0.349         | 0.434         | 0.409         | 0.136          | 0.130          | 0.126          | 0.109          | 0.111          | 0.092          | 0.091          | 0.092          | 0.281          | 0.247          | 0.182          | 0.168          | 0.095          | 0.094          | 0.132          | 0.142          | 0.122          | 0.118          | 0.071          | 0.070          | 0.070  |        |
| mean | 100 | 50  | rob.   | -0.005      | -0.041        | 0.025         | -0.008        | -0.031        | -0.037        | -0.008         | -0.039         | -0.001         | -0.006         | -0.004         | -0.003         | -0.005         | -0.003         | -0.040         | -0.071         | -0.134         | -0.174         | -0.007         | -0.045         | -0.004         | -0.003         | -0.016         | -0.008         | -0.049         | -0.049         | -0.049 |        |
| sd   | 300 | 0   | trad.  | 0.154       | 0.248         | 0.436         | 0.391         | 0.459         | 0.430         | 0.203          | 0.143          | 0.148          | 0.150          | 0.156          | 0.121          | 0.129          | 0.334          | 0.282          | 0.228          | 0.210          | 0.175          | 0.171          | 0.114          | 0.175          | 0.171          | 0.154          | 0.149          | 0.093          | 0.089          | 0.089  |        |
| mean | 300 | 0   | trad.  | 0.002       | -0.014        | -0.013        | 0.013         | -0.007        | -0.016        | -0.042         | -0.001         | 0.003          | -0.003         | -0.005         | -0.002         | -0.005         | -0.005         | -0.002         | -0.011         | -0.019         | -0.039         | -0.029         | -0.029         | -0.005         | 0.000          | -0.006         | 0.001          | -0.007         | -0.006         | -0.006 | -0.006 |
| sd   | 300 | 0   | rob.   | 0.051       | 0.077         | 0.122         | 0.125         | 0.112         | 0.110         | 0.059          | 0.038          | 0.036          | 0.059          | 0.063          | 0.061          | 0.049          | 0.050          | 0.170          | 0.136          | 0.103          | 0.078          | 0.056          | 0.056          | 0.077          | 0.081          | 0.067          | 0.067          | 0.044          | 0.042          | 0.042  |        |
| mean | 300 | 0   | rob.   | 0.006       | -0.007        | -0.018        | 0.019         | -0.000        | -0.031        | -0.037         | 0.002          | -0.001         | -0.006         | -0.002         | -0.006         | -0.004         | -0.004         | -0.004         | -0.001         | -0.008         | -0.032         | -0.049         | -0.026         | -0.029         | -0.005         | -0.003         | -0.005         | -0.000         | -0.011         | -0.008 | -0.008 |
| sd   | 300 | 5   | trad.  | 0.056       | 0.092         | 0.145         | 0.144         | 0.143         | 0.144         | 0.070          | 0.042          | 0.072          | 0.072          | 0.070          | 0.056          | 0.058          | 0.057          | 0.196          | 0.154          | 0.111          | 0.094          | 0.064          | 0.067          | 0.088          | 0.090          | 0.081          | 0.075          | 0.048          | 0.047          | 0.047  |        |
| mean | 300 | 5   | trad.  | 0.005       | -0.007        | -0.017        | 0.016         | 0.010         | -0.039        | -0.043         | -0.001         | -0.364         | -0.160         | -0.004         | -0.004         | -0.005         | -0.005         | -0.005         | -0.002         | -0.020         | -0.043         | -0.029         | -0.030         | -0.001         | -0.007         | -0.003         | -0.004         | -0.009         | -0.009         | -0.009 | -0.009 |
| sd   | 300 | 5   | rob.   | 0.071       | 0.080         | 0.164         | 0.156         | 0.177         | 0.164         | 0.065          | 0.070          | 0.062          | 0.065          | 0.065          | 0.051          | 0.053          | 0.052          | 0.173          | 0.136          | 0.105          | 0.085          | 0.055          | 0.060          | 0.078          | 0.081          | 0.067          | 0.067          | 0.043          | 0.046          | 0.046  |        |
| mean | 300 | 10  | trad.  | 0.007       | -0.008        | -0.023        | 0.025         | 0.031         | -0.055        | -0.041         | -0.001         | -0.498         | -0.224         | -0.005         | -0.003         | -0.005         | -0.005         | -0.001         | -0.004         | -0.118         | -0.094         | -0.046         | -0.032         | -0.029         | -0.001         | -0.002         | -0.006         | -0.004         | -0.006         | -0.006 | -0.006 |
| sd   | 300 | 10  | rob.   | 0.087       | 0.081         | 0.199         | 0.192         | 0.208         | 0.201         | 0.066          | 0.087          | 0.064          | 0.062          | 0.062          | 0.054          | 0.053          | 0.054          | 0.165          | 0.135          | 0.102          | 0.084          | 0.053          | 0.058          | 0.078          | 0.082          | 0.070          | 0.072          | 0.042          | 0.042          | 0.042  | 0.042  |
| mean | 300 | 10  | rob.   | 0.001       | -0.009        | -0.015        | 0.018         | -0.018        | -0.018        | -0.036         | 0.001          | -0.008         | -0.006         | -0.004         | -0.003         | -0.006         | -0.003         | 0.008          | -0.008         | -0.008         | -0.056         | -0.029         | -0.031         | -0.001         | -0.001         | -0.002         | 0.000          | -0.006         | -0.010         | -0.012 | -0.012 |
| sd   | 300 | 20  | trad.  | 0.057       | 0.094         | 0.156         | 0.153         | 0.136         | 0.136         | 0.072          | 0.043          | 0.074          | 0.075          | 0.072          | 0.059          | 0.058          | 0.059          | 0.195          | 0.157          | 0.119          | 0.095          | 0.061          | 0.069          | 0.096          | 0.091          | 0.078          | 0.079          | 0.051          | 0.049          | 0.049  | 0.049  |
| mean | 300 | 20  | trad.  | 0.023       | -0.007        | -0.007        | 0.009         | 0.062         | -0.086        | -0.069         | -0.021         | -0.626         | -0.286         | -0.002         | -0.003         | -0.004         | -0.005         | -0.005         | -0.005         | -0.026         | -0.043         | -0.032         | -0.030         | -0.031         | -0.032         | -0.001         | -0.001         | -0.002         | -0.006         | -0.006 | -0.007 |
| sd   | 300 | 20  | rob.   | 0.099       | 0.083         | 0.240         | 0.228         | 0.284         | 0.273         | 0.069          | 0.105          | 0.074          | 0.064          | 0.065          | 0.052          | 0.054          | 0.054          | 0.182          | 0.139          | 0.104          | 0.084          | 0.058          | 0.060          | 0.080          | 0.081          | 0.065          | 0.068          | 0.044          | 0.044          | 0.044  | 0.044  |
| mean | 300 | 20  | rob.   | 0.006       | -0.013        | -0.026        | 0.029         | -0.000        | -0.028        | -0.036         | -0.001         | -0.020         | -0.021         | -0.003         | 0.001          | -0.004         | -0.002         | -0.005         | -0.007         | -0.006         | -0.037         | -0.058         | -0.029         | -0.031         | -0.005         | -0.002         | -0.001         | -0.004         | -0.011         | -0.009 | -0.009 |
| sd   | 300 | 20  | rob.   | 0.061       | 0.094         | 0.159         | 0.160         | 0.152         | 0.149         | 0.071          | 0.044          | 0.046          | 0.077          | 0.071          | 0.057          | 0.058          | 0.063          | 0.211          | 0.158          | 0.129          | 0.098          | 0.063          | 0.071          | 0.091          | 0.091          | 0.088          | 0.079          | 0.083          | 0.049          | 0.050  | 0.050  |
| mean | 300 | 40  | trad.  | 0.038       | -0.010        | 0.014         | -0.004        | 0.099         | -0.124        | -0.043         | -0.029         | -0.731         | -0.333         | -0.002         | -0.005         | -0.002         | 0.000          | -0.000         | -0.000         | -0.026         | -0.042         | -0.031         | -0.028         | 0.001          | -0.002         | -0.003         | -0.004         | -0.006         | -0.007         | -0.007 | -0.007 |
| sd   | 300 | 40  | rob.   | 0.111       | 0.082         | 0.296         | 0.282         | 0.384         | 0.373         | 0.073          | 0.116          | 0.075          | 0.072          | 0.064          | 0.050          | 0.051          | 0.052          | 0.171          | 0.131          | 0.104          | 0.081          | 0.056          | 0.060          | 0.079          | 0.080          | 0.068          | 0.070          | 0.044          | 0.043          | 0      |        |

Table 7 Results for traditional and robust PLS for five composites and unsystematic outliers in all indicators

|      | n   | out | estim.. | $\rho_{12}$ | $\gamma_{32}$ | $\gamma_{41}$ | $\gamma_{42}$ | $\gamma_{51}$ | $w_{12}$ | $w_{21}$ | $w_{22}$ | $w_{23}$ | $w_{24}$ | $w_{25}$ | $w_{26}$ | $w_{31}$ | $w_{32}$ | $w_{33}$ | $w_{34}$ | $w_{41}$ | $w_{42}$ | $w_{51}$ | $w_{52}$ | $w_{53}$ | $w_{54}$ | $w_{55}$ | $w_{56}$ |        |        |        |        |        |
|------|-----|-----|---------|-------------|---------------|---------------|---------------|---------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------|--------|--------|--------|--------|
| mean | 100 | 0   | trad.   | 0.005       | -0.072        | -0.005        | 0.010         | -0.068        | 0.029    | -0.057   | -0.011   | -0.006   | 0.001    | 0.001    | -0.006   | 0.000    | -0.004   | 0.000    | -0.004   | -0.100   | -0.021   | -0.081   | -0.126   | -0.050   | -0.011   | 0.006    | -0.012   | -0.020 | -0.029 | -0.014 | -0.008 | -0.004 |
|      | 100 | 0   | rob.    | 0.051       | -0.146        | -0.401        | 0.088         | 0.116         | 0.103    | 0.112    | 0.116    | 0.075    | 0.075    | 0.072    | 0.078    | 0.078    | 0.078    | 0.078    | 0.353    | 0.413    | 0.531    | 0.598    | 0.095    | 0.110    | 0.178    | 0.163    | 0.165    | 0.165  | 0.165  | 0.165  | -0.008 |        |
| sd   | 100 | 0   | trad.   | -0.011      | -0.114        | -0.007        | 0.019         | -0.118        | 0.054    | -0.069   | -0.013   | -0.007   | 0.001    | -0.004   | -0.004   | -0.010   | -0.005   | -0.100   | -0.076   | -0.136   | -0.179   | -0.110   | -0.017   | 0.006    | -0.023   | -0.046   | -0.051   | -0.036 | -0.035 | -0.012 | -0.012 |        |
|      | 100 | 5   | trad.   | 0.071       | 0.230         | 0.153         | 0.134         | 0.179         | 0.172    | 0.178    | 0.166    | 0.172    | 0.118    | 0.122    | 0.123    | 0.123    | 0.123    | 0.123    | 0.439    | 0.544    | 0.669    | 0.797    | 0.143    | 0.164    | 0.276    | 0.242    | 0.252    | 0.244  | 0.255  | 0.262  | 0.262  |        |
| mean | 100 | 5   | trad.   | -0.172      | -0.093        | -0.047        | -0.141        | -0.147        | 0.210    | -0.115   | -0.260   | -0.258   | 0.030    | -0.031   | -0.034   | 0.015    | 0.044    | -0.031   | -0.021   | -0.115   | -0.199   | -0.172   | -0.025   | -0.027   | -0.038   | -0.078   | -0.061   | -0.070 | -0.029 | -0.017 | -0.017 |        |
|      | 100 | 5   | rob.    | 0.332       | 0.334         | 0.237         | 0.229         | 0.193         | 0.202    | 0.179    | 0.390    | 0.345    | 0.306    | 0.286    | 0.305    | 0.316    | 0.324    | 0.314    | 0.602    | 0.398    | 0.488    | 0.549    | 0.208    | 0.246    | 0.285    | 0.264    | 0.267    | 0.254  | 0.279  | 0.284  | 0.284  |        |
| mean | 100 | 5   | rob.    | -0.012      | -0.121        | 0.003         | 0.010         | -0.132        | 0.060    | -0.068   | -0.005   | -0.019   | -0.006   | -0.020   | -0.001   | -0.002   | -0.006   | -0.002   | -0.054   | -0.117   | -0.233   | -0.092   | -0.007   | 0.007    | 0.034    | 0.163    | 0.244    | 0.246  | -0.026 | -0.013 | 0.013  |        |
|      | 100 | 10  | trad.   | 0.071       | 0.239         | 0.155         | 0.139         | 0.173         | 0.175    | 0.185    | 0.168    | 0.165    | 0.120    | 0.116    | 0.111    | 0.118    | 0.121    | 0.119    | 0.437    | 0.561    | 0.680    | 0.780    | 0.134    | 0.163    | 0.273    | 0.244    | 0.246    | 0.236  | 0.260  | 0.254  | 0.254  |        |
| mean | 100 | 10  | trad.   | -0.319      | -0.109        | 0.020         | -0.289        | -0.220        | 0.349    | -0.118   | -0.426   | -0.391   | 0.011    | -0.100   | -0.085   | -0.037   | 0.021    | -0.011   | -0.048   | -0.134   | -0.244   | -0.150   | -0.078   | -0.037   | -0.040   | -0.098   | -0.120   | -0.096 | -0.051 | -0.041 | -0.041 |        |
|      | 100 | 20  | trad.   | -0.445      | 0.356         | 0.224         | 0.237         | 0.188         | 0.222    | 0.195    | 0.484    | 0.465    | 0.369    | 0.385    | 0.378    | 0.387    | 0.648    | 0.382    | 0.461    | 0.526    | 0.328    | 0.354    | 0.327    | 0.326    | 0.333    | 0.315    | 0.325    | 0.325  | 0.332  | 0.332  |        |        |
| mean | 100 | 10  | rob.    | 0.009       | -0.106        | 0.005         | 0.011         | -0.135        | 0.066    | -0.077   | -0.016   | -0.011   | 0.000    | -0.008   | -0.006   | -0.001   | -0.106   | -0.050   | -0.092   | -0.197   | -0.164   | -0.011   | -0.001   | -0.025   | -0.051   | -0.044   | -0.023   | -0.019 | -0.023 | -0.019 | -0.023 |        |
|      | 100 | 20  | rob.    | 0.072       | 0.234         | 0.148         | 0.132         | 0.168         | 0.177    | 0.196    | 0.164    | 0.162    | 0.118    | 0.114    | 0.110    | 0.118    | 0.121    | 0.123    | 0.455    | 0.558    | 0.657    | 0.776    | 0.136    | 0.167    | 0.277    | 0.253    | 0.254    | 0.255  | 0.251  | 0.253  | 0.253  |        |
| mean | 100 | 20  | trad.   | -0.507      | -0.076        | 0.062         | -0.418        | -0.254        | 0.467    | -0.074   | -0.547   | -0.482   | -0.011   | -0.138   | -0.155   | -0.062   | 0.009    | -0.020   | -0.067   | -0.112   | -0.216   | -0.155   | -0.155   | -0.052   | -0.051   | -0.146   | -0.130   | -0.122 | -0.069 | -0.048 | -0.048 |        |
|      | 100 | 30  | trad.   | -0.456      | 0.324         | 0.187         | 0.201         | 0.165         | 0.206    | 0.182    | 0.562    | 0.526    | 0.402    | 0.393    | 0.401    | 0.394    | 0.400    | 0.394    | 0.592    | 0.444    | 0.518    | 0.583    | 0.444    | 0.446    | 0.357    | 0.352    | 0.367    | 0.351  | 0.346  | 0.371  | 0.371  |        |
| mean | 100 | 20  | rob.    | 0.008       | -0.114        | 0.005         | 0.005         | -0.019        | 0.059    | -0.064   | -0.014   | -0.011   | -0.000   | -0.009   | -0.008   | -0.007   | 0.001    | -0.103   | -0.056   | -0.085   | -0.248   | -0.095   | -0.042   | -0.003   | -0.021   | -0.056   | -0.038   | -0.037 | -0.014 | -0.029 | -0.029 |        |
|      | 100 | 40  | rob.    | 0.071       | 0.216         | 0.137         | 0.123         | 0.166         | 0.157    | 0.185    | 0.160    | 0.157    | 0.112    | 0.109    | 0.110    | 0.120    | 0.117    | 0.119    | 0.427    | 0.545    | 0.668    | 0.788    | 0.134    | 0.161    | 0.255    | 0.238    | 0.244    | 0.242  | 0.254  | 0.243  | 0.243  |        |
| mean | 100 | 40  | trad.   | -0.623      | -0.068        | 0.057         | -0.513        | -0.249        | 0.559    | -0.048   | -0.579   | -0.555   | -0.022   | -0.205   | -0.215   | -0.132   | -0.048   | -0.045   | -0.119   | -0.113   | -0.191   | -0.124   | -0.253   | -0.118   | -0.073   | -0.139   | -0.142   | -0.145 | -0.076 | -0.037 | -0.037 |        |
|      | 100 | 50  | trad.   | -0.374      | 0.274         | 0.150         | 0.169         | 0.161         | 0.204    | 0.167    | 0.563    | 0.574    | 0.410    | 0.388    | 0.394    | 0.394    | 0.405    | 0.398    | 0.530    | 0.441    | 0.570    | 0.609    | 0.564    | 0.576    | 0.390    | 0.371    | 0.366    | 0.371  | 0.371  | 0.366  | 0.366  |        |
| mean | 100 | 40  | rob.    | -0.008      | -0.096        | 0.000         | 0.011         | -0.105        | 0.039    | -0.082   | -0.011   | -0.006   | -0.003   | -0.009   | -0.000   | -0.009   | -0.008   | -0.008   | -0.055   | -0.098   | -0.203   | -0.101   | -0.006   | -0.006   | -0.026   | -0.035   | -0.034   | -0.034 | -0.018 | -0.008 | -0.008 |        |
|      | 100 | 50  | rob.    | 0.066       | 0.212         | 0.136         | 0.119         | 0.153         | 0.149    | 0.169    | 0.151    | 0.149    | 0.101    | 0.102    | 0.104    | 0.106    | 0.107    | 0.112    | 0.407    | 0.543    | 0.644    | 0.734    | 0.124    | 0.152    | 0.227    | 0.224    | 0.224    | 0.224  | 0.229  | 0.225  | 0.225  |        |
| mean | 100 | 50  | trad.   | -0.664      | -0.027        | 0.044         | -0.560        | -0.249        | 0.592    | -0.034   | -0.587   | -0.554   | -0.059   | -0.245   | -0.213   | -0.153   | -0.050   | -0.053   | -0.156   | -0.125   | -0.180   | -0.086   | -0.328   | -0.139   | -0.071   | -0.166   | -0.141   | -0.116 | -0.081 | -0.042 | -0.042 |        |
|      | 100 | 50  | rob.    | 0.332       | 0.270         | 0.152         | 0.188         | 0.167         | 0.214    | 0.163    | 0.590    | 0.551    | 0.403    | 0.411    | 0.401    | 0.400    | 0.404    | 0.396    | 0.493    | 0.465    | 0.571    | 0.645    | 0.618    | 0.622    | 0.391    | 0.389    | 0.363    | 0.364  | 0.371  | 0.382  | 0.382  |        |
| mean | 100 | 50  | rob.    | -0.245      | -0.115        | -0.030        | -0.313        | -0.180        | 0.389    | -0.141   | -0.324   | -0.369   | 0.402    | -0.107   | -0.126   | -0.068   | -0.035   | -0.097   | -0.000   | -0.193   | -0.355   | -0.183   | -0.190   | -0.119   | -0.101   | -0.197   | -0.164   | -0.152 | -0.097 | -0.046 | -0.046 |        |
|      | 100 | 50  | rob.    | 0.576       | 0.496         | 0.324         | 0.342         | 0.243         | 0.333    | 0.255    | 0.502    | 0.546    | 0.415    | 0.419    | 0.408    | 0.451    | 0.429    | 0.433    | 0.721    | 0.424    | 0.492    | 0.575    | 0.501    | 0.524    | 0.441    | 0.410    | 0.396    | 0.401  | 0.396  | 0.415  | 0.415  |        |
| mean | 300 | 0   | trad.   | 0.001       | -0.025        | -0.004        | -0.006        | -0.037        | 0.007    | -0.049   | -0.001   | -0.001   | 0.000    | -0.001   | -0.001   | -0.002   | -0.000   | -0.002   | -0.102   | -0.010   | -0.009   | -0.044   | -0.012   | 0.000    | -0.004   | -0.001   | -0.003   | -0.009 | -0.009 | 0.000  | -0.005 |        |
|      | 300 | 0   | rob.    | 0.030       | 0.064         | 0.060         | 0.052         | 0.062         | 0.055    | 0.047    | 0.066    | 0.065    | 0.041    | 0.041    | 0.041    | 0.043    | 0.044    | 0.042    | 0.194    | 0.244    | 0.286    | 0.346    | 0.056    | 0.067    | 0.096    | 0.086    | 0.090    | 0.089  | 0.089  | 0.089  | 0.089  |        |
| mean | 300 | 0   | rob.    | -0.002      | -0.032        | -0.006        | 0.008         | -0.045        | 0.012    | -0.050   | -0.001   | -0.002   | -0.004   | -0.001   | -0.001   | -0.002   | -0.004   | -0.001   | -0.021   | -0.018   | -0.050   | -0.024   | 0.001    | -0.005   | -0.001   | -0.005   | -0.013   | -0.012 | 0.000  | -0.004 | -0.004 |        |
|      | 300 | 5   | trad.   | 0.034       | 0.077         | 0.068         | 0.059         | 0.072         | 0.064    | 0.075    | 0.076    | 0.047    | 0.047    | 0.046    | 0.046    | 0.050    | 0.049    | 0.050    | 0.236    | 0.284    | 0.335    | 0.403    | 0.061    | 0.074    | 0.111    | 0.104    | 0.106    | 0.103  | 0.105  | 0.105  | 0.105  |        |
| mean | 300 | 5   | trad.   | -0.331      | -0.025        | 0.038         | -0.176        | -0.203        | 0.258    | -0.054   | -0.247   | -0.249   | 0.080    | 0.004    | 0.008    | 0.047    | 0.087    | 0.025    | -0.069   | -0.042   | -0.004   | -0.004   | -0.001   | -0.009   | -0.012   | -0.008   | -0.012   | -0.006 | -0.002 | -0.008 | -0.008 |        |
|      | 300 | 5   | rob.    | 0.172       | 0.116         | 0.115         | 0.082         | 0.098         | 0.073    | 0.077    |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |        |        |        |        |        |

Table 8 Results for traditional and robust PLS for five composites and unsystematic outliers in two indicators

|      | n   | out | estim. | $\rho_{12}$ | $\gamma_{32}$ | $\gamma_{41}$ | $\gamma_{42}$ | $\gamma_{51}$ | $\gamma_{52}$ | $\gamma_{53}$ | $w_{11}$ | $w_{12}$ | $w_{21}$ | $w_{22}$ | $w_{23}$ | $w_{24}$ | $w_{25}$ | $w_{26}$ | $w_{31}$ | $w_{32}$ | $w_{33}$ | $w_{34}$ | $w_{41}$ | $w_{42}$ | $w_{51}$ | $w_{52}$ | $w_{53}$ | $w_{54}$ | $w_{55}$ | $w_{56}$ |       |
|------|-----|-----|--------|-------------|---------------|---------------|---------------|---------------|---------------|---------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------|
| mean | 100 | 0   | trad.  | 0.007       | -0.075        | -0.001        | 0.009         | -0.078        | 0.027         | -0.060        | -0.002   | -0.006   | -0.001   | -0.007   | -0.007   | -0.003   | 0.002    | -0.101   | -0.019   | -0.051   | -0.096   | -0.093   | -0.004   | -0.003   | -0.007   | -0.025   | -0.022   | -0.011   | -0.020   | -0.007   |       |
| sd   |     |     |        | 0.050       | 0.137         | 0.105         | 0.090         | 0.112         | 0.101         | 0.109         | 0.113    | 0.115    | 0.077    | 0.074    | 0.076    | 0.079    | 0.078    | 0.078    | 0.330    | 0.423    | 0.514    | 0.608    | 0.094    | 0.113    | 0.179    | 0.167    | 0.166    | -0.011   | 0.166    | 0.165    |       |
| mean | 100 | 0   | rob.   | 0.009       | -0.120        | -0.005        | 0.017         | -0.127        | 0.055         | -0.076        | -0.003   | -0.009   | -0.019   | -0.013   | -0.013   | -0.005   | 0.021    | -0.100   | -0.038   | -0.085   | -0.202   | -0.133   | -0.010   | -0.007   | -0.017   | -0.056   | -0.042   | -0.039   | -0.038   | -0.010   |       |
| sd   |     |     |        | 0.074       | 0.227         | 0.156         | 0.135         | 0.177         | 0.172         | 0.195         | 0.157    | 0.163    | 0.123    | 0.117    | 0.116    | 0.125    | 0.127    | 0.121    | 0.417    | 0.540    | 0.669    | 0.770    | 0.141    | 0.169    | 0.265    | 0.255    | 0.246    | 0.248    | 0.261    | 0.258    |       |
| mean | 100 | 5   | trad.  | -0.031      | -0.066        | 0.089         | -0.097        | -0.161        | 0.118         | -0.058        | -0.010   | -0.047   | -0.047   | -0.134   | 0.055    | 0.063    | 0.054    | -0.047   | -0.035   | -0.083   | -0.141   | -0.030   | 0.102    | -0.007   | -0.011   | -0.025   | -0.023   | -0.013   | -0.014   | -0.009   |       |
| sd   |     |     |        | 0.057       | 0.143         | 0.101         | 0.092         | 0.115         | 0.107         | 0.110         | 0.114    | 0.114    | 0.132    | 0.110    | 0.087    | 0.096    | 0.095    | 0.090    | 0.344    | 0.434    | 0.521    | 0.599    | 0.102    | 0.124    | 0.178    | 0.168    | 0.170    | 0.169    | 0.175    | 0.177    |       |
| mean | 100 | 5   | rob.   | 0.011       | -0.103        | 0.005         | 0.009         | -0.129        | 0.058         | -0.085        | -0.013   | -0.010   | -0.010   | -0.015   | -0.001   | -0.002   | -0.002   | -0.103   | -0.068   | -0.095   | -0.238   | -0.105   | -0.011   | -0.006   | -0.025   | -0.058   | -0.052   | -0.043   | -0.024   | -0.018   |       |
| sd   |     |     |        | 0.070       | 0.242         | 0.145         | 0.125         | 0.169         | 0.174         | 0.195         | 0.156    | 0.157    | 0.118    | 0.119    | 0.116    | 0.125    | 0.131    | 0.125    | 0.448    | 0.562    | 0.672    | 0.767    | 0.140    | 0.164    | 0.270    | 0.253    | 0.265    | 0.261    | 0.260    | 0.265    |       |
| mean | 100 | 10  | trad.  | -0.047      | -0.064        | 0.119         | -0.122        | -0.188        | 0.149         | -0.056        | -0.007   | -0.009   | -0.083   | -0.205   | 0.070    | 0.093    | 0.077    | -0.031   | -0.034   | -0.048   | -0.117   | -0.080   | -0.006   | -0.006   | -0.005   | -0.026   | -0.026   | -0.031   | -0.014   | 0.001    |       |
| sd   |     |     |        | 0.060       | 0.141         | 0.106         | 0.097         | 0.113         | 0.118         | 0.118         | 0.116    | 0.117    | 0.108    | 0.107    | 0.093    | 0.094    | 0.097    | 0.102    | 0.348    | 0.436    | 0.510    | 0.584    | 0.094    | 0.115    | 0.190    | 0.170    | 0.184    | 0.179    | 0.189    | 0.185    |       |
| mean | 100 | 10  | rob.   | 0.009       | -0.115        | 0.006         | 0.006         | -0.123        | 0.060         | -0.075        | -0.016   | -0.011   | -0.001   | -0.015   | -0.011   | 0.001    | -0.005   | -0.098   | -0.081   | -0.078   | -0.200   | -0.152   | -0.009   | -0.003   | -0.026   | -0.052   | -0.047   | -0.055   | -0.025   | 0.003    |       |
| sd   |     |     |        | 0.072       | 0.231         | 0.150         | 0.134         | 0.172         | 0.173         | 0.188         | 0.163    | 0.165    | 0.115    | 0.117    | 0.114    | 0.126    | 0.125    | 0.125    | 0.443    | 0.546    | 0.677    | 0.787    | 0.133    | 0.159    | 0.266    | 0.248    | 0.259    | 0.257    | 0.266    | 0.255    |       |
| mean | 100 | 20  | trad.  | -0.053      | -0.079        | 0.139         | -0.140        | -0.204        | 0.165         | -0.054        | -0.010   | -0.125   | -0.125   | -0.274   | 0.094    | 0.102    | 0.093    | -0.031   | -0.035   | -0.087   | -0.104   | -0.053   | -0.004   | -0.004   | -0.022   | -0.028   | -0.026   | -0.021   | -0.011   | 0.006    |       |
| sd   |     |     |        | 0.059       | 0.143         | 0.104         | 0.093         | 0.110         | 0.107         | 0.114         | 0.118    | 0.118    | 0.099    | 0.095    | 0.091    | 0.100    | 0.099    | 0.099    | 0.352    | 0.429    | 0.527    | 0.606    | 0.102    | 0.120    | 0.187    | 0.173    | 0.184    | 0.172    | 0.180    | 0.180    |       |
| mean | 100 | 20  | rob.   | 0.007       | -0.109        | 0.010         | 0.006         | -0.134        | 0.069         | -0.064        | -0.011   | -0.006   | -0.010   | -0.017   | 0.002    | -0.003   | 0.002    | -0.098   | -0.070   | -0.135   | -0.199   | -0.080   | -0.006   | -0.008   | -0.033   | -0.052   | -0.041   | -0.057   | -0.024   | 0.009    |       |
| sd   |     |     |        | 0.070       | 0.216         | 0.152         | 0.130         | 0.162         | 0.166         | 0.171         | 0.161    | 0.157    | 0.115    | 0.112    | 0.114    | 0.117    | 0.116    | 0.121    | 0.425    | 0.540    | 0.669    | 0.765    | 0.130    | 0.155    | 0.252    | 0.250    | 0.239    | 0.241    | 0.259    | 0.258    |       |
| mean | 100 | 40  | trad.  | -0.063      | -0.067        | 0.151         | -0.155        | -0.210        | 0.174         | -0.048        | -0.014   | -0.140   | -0.139   | -0.333   | 0.103    | 0.109    | 0.100    | -0.012   | -0.041   | -0.073   | -0.097   | -0.085   | -0.005   | -0.006   | -0.006   | -0.031   | -0.024   | -0.026   | -0.012   | -0.012   |       |
| sd   |     |     |        | 0.060       | 0.140         | 0.102         | 0.095         | 0.113         | 0.114         | 0.111         | 0.120    | 0.119    | 0.092    | 0.093    | 0.092    | 0.103    | 0.102    | 0.106    | 0.344    | 0.442    | 0.520    | 0.615    | 0.106    | 0.127    | 0.198    | 0.176    | 0.184    | 0.178    | 0.184    | 0.185    |       |
| mean | 100 | 50  | rob.   | -0.031      | -0.099        | 0.088         | -0.094        | -0.204        | 0.140         | -0.060        | -0.016   | -0.021   | -0.059   | -0.143   | 0.051    | 0.061    | 0.053    | -0.043   | -0.054   | -0.113   | -0.163   | -0.122   | -0.013   | -0.004   | -0.014   | -0.059   | -0.049   | -0.050   | -0.030   | -0.016   |       |
| sd   |     |     |        | 0.082       | 0.227         | 0.145         | 0.133         | 0.170         | 0.168         | 0.178         | 0.156    | 0.161    | 0.208    | 0.194    | 0.132    | 0.141    | 0.141    | 0.146    | 0.427    | 0.508    | 0.659    | 0.749    | 0.148    | 0.172    | 0.268    | 0.249    | 0.256    | 0.244    | 0.254    | 0.260    |       |
| mean | 100 | 50  | trad.  | -0.064      | -0.082        | 0.146         | -0.159        | -0.207        | 0.174         | -0.054        | -0.002   | -0.006   | -0.167   | -0.343   | 0.101    | 0.111    | 0.107    | 0.104    | 0.104    | 0.351    | 0.430    | 0.519    | 0.607    | 0.100    | 0.118    | 0.195    | 0.175    | 0.184    | 0.176    | 0.181    | 0.188 |
| sd   |     |     |        | 0.062       | 0.146         | 0.102         | 0.089         | 0.108         | 0.105         | 0.117         | 0.119    | 0.112    | 0.094    | 0.091    | 0.093    | 0.103    | 0.104    | 0.104    | 0.351    | 0.430    | 0.519    | 0.607    | 0.100    | 0.118    | 0.195    | 0.175    | 0.184    | 0.176    | 0.184    | 0.185    |       |
| mean | 100 | 50  | rob.   | -0.050      | -0.101        | 0.147         | -0.140        | -0.237        | 0.178         | -0.065        | -0.007   | -0.018   | -0.140   | -0.290   | 0.085    | 0.100    | 0.094    | -0.019   | -0.084   | -0.115   | -0.260   | -0.072   | -0.010   | -0.007   | -0.026   | -0.069   | -0.037   | -0.055   | -0.024   | -0.015   |       |
| sd   |     |     |        | 0.085       | 0.241         | 0.147         | 0.136         | 0.171         | 0.169         | 0.202         | 0.167    | 0.162    | 0.172    | 0.175    | 0.134    | 0.152    | 0.159    | 0.159    | 0.457    | 0.557    | 0.658    | 0.752    | 0.149    | 0.171    | 0.283    | 0.272    | 0.270    | 0.256    | 0.271    | 0.272    |       |
| mean | 300 | 0   | trad.  | 0.002       | -0.025        | -0.003        | 0.004         | -0.036        | 0.009         | -0.049        | 0.000    | 0.002    | -0.002   | -0.000   | -0.001   | -0.000   | 0.001    | -0.101   | -0.013   | -0.005   | -0.019   | -0.037   | -0.001   | -0.001   | -0.003   | -0.010   | -0.006   | -0.001   | -0.002   | -0.004   |       |
| sd   |     |     |        | 0.030       | 0.065         | 0.058         | 0.050         | 0.064         | 0.057         | 0.045         | 0.065    | 0.064    | 0.041    | 0.040    | 0.041    | 0.042    | 0.041    | 0.042    | 0.195    | 0.237    | 0.282    | 0.342    | 0.056    | 0.066    | 0.095    | 0.086    | 0.097    | 0.091    | 0.091    | 0.091    |       |
| mean | 300 | 0   | rob.   | 0.003       | -0.033        | -0.002        | 0.004         | -0.043        | 0.012         | -0.051        | -0.002   | 0.001    | -0.002   | -0.001   | -0.002   | 0.000    | 0.001    | -0.100   | -0.017   | -0.017   | -0.032   | -0.001   | -0.001   | -0.001   | -0.006   | -0.010   | -0.009   | -0.005   | -0.004   | -0.003   |       |
| sd   |     |     |        | 0.033       | 0.075         | 0.066         | 0.057         | 0.073         | 0.066         | 0.054         | 0.074    | 0.073    | 0.046    | 0.047    | 0.048    | 0.049    | 0.047    | 0.048    | 0.229    | 0.277    | 0.325    | 0.396    | 0.063    | 0.075    | 0.111    | 0.102    | 0.101    | 0.105    | 0.108    | 0.105    |       |
| mean | 300 | 5   | trad.  | -0.045      | -0.022        | 0.103         | -0.111        | -0.139        | 0.120         | -0.047        | 0.000    | -0.056   | -0.056   | -0.144   | 0.063    | 0.072    | 0.066    | -0.045   | -0.001   | -0.019   | -0.022   | -0.028   | -0.002   | -0.002   | -0.002   | -0.014   | -0.005   | -0.001   | -0.009   | 0.002    |       |
| sd   |     |     |        | 0.033       | 0.067         | 0.060         | 0.054         | 0.064         | 0.058         | 0.048         | 0.067    | 0.066    | 0.067    | 0.058    | 0.049    | 0.052    | 0.053    | 0.057    | 0.190    | 0.228    | 0.277    | 0.330    | 0.057    | 0.070    | 0.103    | 0.098    | 0.096    | 0.096    | 0.098    | 0.097    |       |
| mean | 300 | 5   | rob.   | 0.001       | -0.031        | -0.000        | 0.001         | -0.042        | 0.013         | -0.050        | -0.001   | 0.002    | -0.002   | -0.001   | -0.002   | -0.001   | 0.002    | -0.099   | -0.012   | -0.003   | -0.029   | -0.050   | -0.004   | 0.000    | -0.002   | -0.017   | -0.009   | 0.001    | -0.008   | -0.001   |       |
| sd   |     |     |        | 0.033       | 0.078         | 0.067         | 0.059         | 0.075         | 0.067         | 0.058         | 0.071    | 0.074    | 0.048    | 0.048    | 0.048    | 0.047    | 0.050    | 0.050    | 0.229    | 0.277    | 0.328    | 0.381    | 0.063    | 0.074    | 0.112    | 0.102    | 0.103    | 0.103    | 0.107    | 0.108    |       |
| mean | 300 | 10  | trad.  | -0.055      | -0.020        | 0.134         | -0.143        | -0.167        | 0.147         | -0.045        | -0.003   | -0.000   | -0.088   | -0.209   | 0.086    | 0.092    | 0.083    | -0.026   | -0.008   | -0.002   | -0.002   | -0.019   | -0.038   | -0.002   | -0.002   | -0.014   | -0.005   | -0.001   | -0.009   | 0.002    |       |
| sd   |     |     |        | 0.033       | 0.065         | 0.057         | 0.051         | 0.063         | 0.057         | 0.048         | 0.065    | 0.066    | 0.059    | 0.053    | 0.049    | 0.054    | 0.055    | 0.057    | 0.191    | 0.230    | 0.274    | 0.325    | 0.057    | 0.068    | 0.099    | 0.095    | 0.096    | 0.096    | 0.099    | 0.096    |       |
| mean | 300 | 10  | rob.   | 0.001       | -0.028        | 0.005         | -0.003        | -0.048        | 0.016         | -0.047        | -0.001   | -0.001   | 0.003    | -0.005   | 0.003    | 0.000    | 0.002    | -0.099   | -0.012   | -0.003   | -0.029   | -0.050   | -0.004   | 0.000    | -0.002   | -0.017   | -0.009   | 0.001    | -0.008   | -0.001   |       |
| sd   |     |     |        | 0.034       | 0.078         | 0.069         | 0.059         | 0.073         | 0.064         | 0.057         | 0.076    | 0.074    | 0.047    | 0.048    | 0.047    | 0.050    | 0.049    | 0.049    | 0.228    | 0.267    | 0.315    | 0.373    | 0.063    | 0.075    | 0.112    | 0.108    | 0.108    | 0.100    | 0.107    | 0.108    |       |
| mean | 300 | 20  | trad.  | -0.063      | -0.026        | 0.146         | -0.154        | -0.181        | 0.162         | -0.048        | -0.001   | -0.128   | -0.128   | -0.272   | 0.100    | 0.104    | 0.097    | -0.014   | -0.023   | -0.018   | -0.022   | -0.021   | -0.002   | -0.003   | -0.008   | -0.003   | -0.010   | -0.003   | -0.005   | -0.006   |       |
| sd   |     |     |        | 0.036       | 0.063         | 0.055         | 0.053         | 0.060         | 0.056         | 0.047         | 0.067    | 0.069    | 0.065    | 0.051    | 0.050    | 0.055    | 0.055    | 0.057    | 0.199    | 0.238    | 0.288    | 0.334    | 0.056    | 0.068    | 0.100    | 0.094    | 0.097    | 0.093    | 0.101    | 0.101    |       |
| mean | 300 | 20  | rob.   | -0.003      | -0.036        | 0.011         | -0.008        | -0.056        | 0.024         | -0.049        | 0.002    | -0.002   | -0.006   | -0.012   | 0.005    | 0.006    | 0.008    | -0.095   | -0.027   | -0.028   | -0.022   | -0.040   | -0.001   | -0.003   | -0.010   | -0.009   | -0.009   | -0.005   | -0.003   | -0.002   |       |
| sd   |     |     |        | 0.036       | 0.079         | 0.069         | 0.061         | 0.075         | 0.069         | 0.057         | 0.078    | 0.080    | 0.051    | 0.050    | 0.049    | 0.052    | 0.053    | 0.053    | 0.232    | 0.290    | 0.334    | 0.389    | 0.062    | 0.074    | 0.119    | 0.108    | 0.109    | 0.104    | 0.110    | 0.110    |       |
| mean | 300 | 40  | trad.  | -0.071      | -0.014        | 0.154         | -0.164        | -0.186        | 0.167</       |               |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |       |

## 2.2 Systematic outliers

This section shows the complete results for systematic outliers.



**Table 10** Results for traditional and robust PLS<sub>c</sub> for three common factors and systematic outliers in two indicators

|      | n   | out | estim. | $\gamma_{21}$ | $\gamma_{31}$ | $\gamma_{32}$ | $\lambda_{11}$ | $\lambda_{12}$ | $\lambda_{13}$ | $\lambda_{21}$ | $\lambda_{22}$ | $\lambda_{23}$ | $\lambda_{31}$ | $\lambda_{32}$ | $\lambda_{33}$ |
|------|-----|-----|--------|---------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| mean | 100 | 0   | trad.  | 0.023         | 0.059         | -0.013        | -0.026         | -0.001         | 0.015          | -0.013         | 0.003          | -0.013         | -0.034         | -0.033         | -0.001         |
| sd   |     |     | trad.  | 0.094         | 0.155         | 0.184         | 0.068          | 0.087          | 0.101          | 0.127          | 0.120          | 0.127          | 0.142          | 0.145          | 0.188          |
| mean | 100 | 0   | rob.   | 0.038         | 0.080         | -0.018        | -0.035         | -0.006         | 0.025          | -0.018         | -0.009         | -0.017         | -0.051         | -0.054         | -0.015         |
| sd   |     |     | rob.   | 0.120         | 0.249         | 0.278         | 0.087          | 0.115          | 0.127          | 0.169          | 0.153          | 0.166          | 0.186          | 0.186          | 0.218          |
| mean | 100 | 5   | trad.  | 0.123         | 0.080         | -0.044        | -0.128         | -0.104         | 0.027          | -0.007         | -0.101         | -0.100         | -0.039         | -0.040         | -0.012         |
| sd   |     |     | trad.  | 0.095         | 0.199         | 0.229         | 0.086          | 0.104          | 0.121          | 0.130          | 0.127          | 0.121          | 0.161          | 0.169          | 0.205          |
| mean | 100 | 5   | rob.   | 0.035         | 0.055         | 0.017         | -0.034         | -0.005         | 0.019          | -0.017         | -0.009         | -0.011         | -0.053         | -0.061         | -0.010         |
| sd   |     |     | rob.   | 0.121         | 0.221         | 0.261         | 0.083          | 0.111          | 0.136          | 0.149          | 0.156          | 0.158          | 0.185          | 0.181          | 0.227          |
| mean | 100 | 10  | trad.  | 0.200         | 0.131         | -0.101        | -0.196         | -0.160         | 0.031          | -0.005         | -0.161         | -0.158         | -0.040         | -0.046         | 0.003          |
| sd   |     |     | trad.  | 0.098         | 0.302         | 0.334         | 0.100          | 0.110          | 0.135          | 0.143          | 0.131          | 0.131          | 0.166          | 0.166          | 0.188          |
| mean | 100 | 10  | rob.   | 0.046         | 0.044         | 0.035         | -0.032         | -0.006         | 0.019          | -0.007         | -0.017         | -0.020         | -0.056         | -0.059         | -0.013         |
| sd   |     |     | rob.   | 0.122         | 0.232         | 0.263         | 0.084          | 0.116          | 0.132          | 0.152          | 0.155          | 0.154          | 0.188          | 0.183          | 0.218          |
| mean | 100 | 20  | trad.  | 0.302         | 0.344         | -0.325        | -0.271         | -0.229         | 0.024          | -0.019         | -0.222         | -0.221         | -0.046         | -0.040         | -0.012         |
| sd   |     |     | trad.  | 0.099         | 0.657         | 0.696         | 0.126          | 0.129          | 0.162          | 0.160          | 0.132          | 0.136          | 0.169          | 0.164          | 0.209          |
| mean | 100 | 20  | rob.   | 0.064         | 0.068         | 0.015         | -0.040         | -0.009         | 0.037          | 0.020          | -0.030         | -0.022         | -0.051         | -0.039         | -0.012         |
| sd   |     |     | rob.   | 0.116         | 0.206         | 0.252         | 0.086          | 0.106          | 0.129          | 0.143          | 0.152          | 0.148          | 0.165          | 0.166          | 0.221          |
| mean | 100 | 40  | trad.  | 0.336         | 0.473         | -0.424        | -0.271         | -0.230         | -0.081         | -0.116         | -0.207         | -0.202         | -0.039         | -0.042         | -0.008         |
| sd   |     |     | trad.  | 0.118         | 1.139         | 1.158         | 0.159          | 0.157          | 0.263          | 0.253          | 0.155          | 0.147          | 0.169          | 0.168          | 0.205          |
| mean | 100 | 40  | rob.   | 0.296         | 0.355         | -0.264        | -0.218         | -0.176         | -0.055         | -0.087         | -0.159         | -0.149         | -0.050         | -0.056         | -0.023         |
| sd   |     |     | rob.   | 0.130         | 0.804         | 0.839         | 0.164          | 0.163          | 0.270          | 0.268          | 0.170          | 0.169          | 0.194          | 0.197          | 0.234          |
| mean | 100 | 50  | trad.  | 0.321         | 0.527         | -0.445        | -0.250         | -0.202         | -0.156         | -0.182         | -0.181         | -0.185         | -0.044         | -0.036         | -0.006         |
| sd   |     |     | trad.  | 0.131         | 1.019         | 1.053         | 0.164          | 0.163          | 0.298          | 0.295          | 0.157          | 0.155          | 0.173          | 0.165          | 0.198          |
| mean | 100 | 50  | rob.   | 0.308         | 0.373         | -0.243        | -0.224         | -0.172         | -0.188         | -0.211         | -0.156         | -0.159         | -0.057         | -0.047         | -0.011         |
| sd   |     |     | rob.   | 0.131         | 0.934         | 0.972         | 0.174          | 0.173          | 0.333          | 0.330          | 0.175          | 0.172          | 0.184          | 0.179          | 0.224          |
| mean | 300 | 0   | trad.  | -0.001        | 0.008         | 0.003         | -0.007         | -0.000         | 0.002          | -0.004         | -0.001         | -0.006         | -0.009         | -0.009         | 0.002          |
| sd   |     |     | trad.  | 0.060         | 0.082         | 0.091         | 0.044          | 0.054          | 0.066          | 0.075          | 0.072          | 0.076          | 0.096          | 0.097          | 0.112          |
| mean | 300 | 0   | rob.   | -0.003        | 0.010         | 0.004         | -0.007         | -0.001         | 0.003          | -0.006         | -0.003         | -0.008         | -0.015         | -0.012         | 0.006          |
| sd   |     |     | rob.   | 0.068         | 0.090         | 0.105         | 0.050          | 0.064          | 0.074          | 0.085          | 0.082          | 0.088          | 0.106          | 0.111          | 0.128          |
| mean | 300 | 5   | trad.  | 0.105         | 0.044         | -0.053        | -0.124         | -0.106         | 0.039          | 0.017          | -0.103         | -0.107         | -0.013         | -0.011         | 0.003          |
| sd   |     |     | trad.  | 0.058         | 0.100         | 0.113         | 0.053          | 0.062          | 0.066          | 0.076          | 0.075          | 0.074          | 0.099          | 0.104          | 0.125          |
| mean | 300 | 5   | rob.   | 0.010         | 0.010         | 0.002         | -0.007         | -0.002         | 0.007          | 0.002          | -0.002         | -0.004         | -0.016         | -0.015         | 0.005          |
| sd   |     |     | rob.   | 0.067         | 0.093         | 0.105         | 0.051          | 0.063          | 0.073          | 0.091          | 0.087          | 0.087          | 0.107          | 0.114          | 0.137          |
| mean | 300 | 10  | trad.  | 0.186         | 0.090         | -0.114        | -0.212         | -0.185         | 0.060          | 0.024          | -0.179         | -0.178         | -0.011         | -0.009         | 0.003          |
| sd   |     |     | trad.  | 0.057         | 0.131         | 0.144         | 0.068          | 0.071          | 0.078          | 0.080          | 0.078          | 0.078          | 0.107          | 0.106          | 0.130          |
| mean | 300 | 10  | rob.   | 0.011         | 0.011         | 0.002         | -0.014         | -0.005         | 0.012          | 0.006          | -0.011         | -0.009         | -0.015         | -0.013         | 0.007          |
| sd   |     |     | rob.   | 0.067         | 0.095         | 0.109         | 0.053          | 0.063          | 0.073          | 0.086          | 0.084          | 0.087          | 0.112          | 0.110          | 0.137          |
| mean | 300 | 20  | trad.  | 0.312         | 0.286         | -0.333        | -0.322         | -0.283         | 0.076          | 0.027          | -0.260         | -0.261         | -0.012         | -0.010         | -0.001         |
| sd   |     |     | trad.  | 0.064         | 0.409         | 0.419         | 0.088          | 0.088          | 0.091          | 0.093          | 0.087          | 0.087          | 0.109          | 0.115          | 0.139          |
| mean | 300 | 20  | rob.   | 0.033         | 0.014         | -0.001        | -0.022         | -0.013         | 0.029          | 0.028          | -0.018         | -0.016         | -0.013         | -0.010         | 0.001          |
| sd   |     |     | rob.   | 0.068         | 0.098         | 0.110         | 0.054          | 0.067          | 0.079          | 0.086          | 0.087          | 0.086          | 0.112          | 0.106          | 0.133          |
| mean | 300 | 40  | trad.  | 0.408         | 1.011         | -1.062        | -0.407         | -0.357         | 0.068          | 0.021          | -0.317         | -0.319         | -0.021         | -0.026         | 0.006          |
| sd   |     |     | trad.  | 0.065         | 1.334         | 1.341         | 0.128          | 0.120          | 0.135          | 0.134          | 0.110          | 0.108          | 0.123          | 0.132          | 0.156          |
| mean | 300 | 40  | rob.   | 0.285         | 0.490         | -0.503        | -0.270         | -0.233         | 0.090          | 0.062          | -0.213         | -0.216         | -0.020         | -0.023         | 0.004          |
| sd   |     |     | rob.   | 0.154         | 0.924         | 0.942         | 0.187          | 0.172          | 0.129          | 0.134          | 0.158          | 0.157          | 0.128          | 0.125          | 0.158          |
| mean | 300 | 50  | trad.  | 0.393         | 1.036         | -1.077        | -0.385         | -0.336         | 0.004          | -0.036         | -0.302         | -0.297         | -0.022         | -0.019         | 0.003          |
| sd   |     |     | trad.  | 0.096         | 1.292         | 1.311         | 0.171          | 0.162          | 0.213          | 0.211          | 0.142          | 0.145          | 0.133          | 0.123          | 0.149          |
| mean | 300 | 50  | rob.   | 0.378         | 0.830         | -0.862        | -0.373         | -0.324         | -0.009         | -0.044         | -0.291         | -0.286         | -0.027         | -0.028         | 0.001          |
| sd   |     |     | rob.   | 0.102         | 1.349         | 1.366         | 0.183          | 0.173          | 0.246          | 0.243          | 0.152          | 0.156          | 0.151          | 0.139          | 0.169          |
| mean | 500 | 0   | trad.  | 0.002         | 0.005         | 0.000         | -0.002         | -0.000         | 0.004          | 0.001          | -0.001         | 0.002          | -0.009         | -0.000         | 0.001          |
| sd   |     |     | trad.  | 0.047         | 0.066         | 0.070         | 0.037          | 0.044          | 0.051          | 0.059          | 0.056          | 0.056          | 0.083          | 0.078          | 0.093          |
| mean | 500 | 0   | rob.   | 0.002         | 0.006         | -0.001        | -0.003         | -0.000         | 0.003          | 0.001          | -0.003         | 0.004          | -0.009         | -0.003         | 0.002          |
| sd   |     |     | rob.   | 0.053         | 0.072         | 0.077         | 0.041          | 0.049          | 0.056          | 0.066          | 0.062          | 0.063          | 0.091          | 0.086          | 0.106          |
| mean | 500 | 5   | trad.  | 0.104         | 0.035         | -0.049        | -0.126         | -0.110         | 0.041          | 0.016          | -0.106         | -0.106         | -0.003         | -0.004         | -0.003         |
| sd   |     |     | trad.  | 0.046         | 0.078         | 0.086         | 0.043          | 0.049          | 0.052          | 0.057          | 0.055          | 0.060          | 0.084          | 0.083          | 0.098          |
| mean | 500 | 5   | rob.   | 0.004         | 0.004         | 0.001         | -0.005         | -0.002         | 0.005          | -0.000         | -0.002         | -0.004         | -0.005         | -0.003         | -0.004         |
| sd   |     |     | rob.   | 0.050         | 0.070         | 0.078         | 0.039          | 0.050          | 0.056          | 0.065          | 0.062          | 0.066          | 0.089          | 0.089          | 0.107          |
| mean | 500 | 10  | trad.  | 0.184         | 0.089         | -0.114        | -0.209         | -0.184         | 0.062          | 0.026          | -0.175         | -0.175         | -0.008         | -0.005         | 0.003          |
| sd   |     |     | trad.  | 0.045         | 0.097         | 0.107         | 0.050          | 0.057          | 0.060          | 0.061          | 0.063          | 0.060          | 0.089          | 0.087          | 0.100          |
| mean | 500 | 10  | rob.   | 0.010         | 0.009         | -0.000        | -0.009         | -0.005         | 0.012          | 0.010          | -0.007         | -0.007         | -0.007         | -0.007         | 0.004          |
| sd   |     |     | rob.   | 0.050         | 0.074         | 0.082         | 0.041          | 0.049          | 0.056          | 0.064          | 0.066          | 0.065          | 0.091          | 0.090          | 0.109          |
| mean | 500 | 20  | trad.  | 0.310         | 0.253         | -0.305        | -0.319         | -0.281         | 0.079          | 0.029          | -0.264         | -0.263         | -0.006         | -0.010         | 0.004          |
| sd   |     |     | trad.  | 0.048         | 0.232         | 0.241         | 0.069          | 0.071          | 0.074          | 0.074          | 0.068          | 0.068          | 0.093          | 0.093          | 0.107          |
| mean | 500 | 20  | rob.   | 0.028         | 0.012         | -0.003        | -0.016         | -0.012         | 0.028          | 0.028          | -0.018         | -0.016         | -0.010         | -0.009         | 0.005          |
| sd   |     |     | rob.   | 0.053         | 0.074         | 0.083         | 0.042          | 0.048          | 0.055          | 0.066          | 0.066          | 0.070          | 0.093          | 0.095          | 0.106          |
| mean | 500 | 40  | trad.  | 0.430         | 1.278         | -1.366        | -0.451         | -0.399         | 0.107          | 0.054          | -0.357         | -0.357         | -0.014         | -0.010         | -0.000         |
| sd   |     |     | trad.  | 0.044         | 1.248         | 1.242         | 0.102          | 0.096          | 0.093          | 0.092          | 0.087          | 0.086          | 0.111          | 0.105          | 0.130          |
| mean | 500 | 40  | rob.   | 0.269         | 0.523         | -0.560        | -0.264         | -0.231         | 0.121          | 0.097          | -0.216         | -0.214         | -0.011         | -0.007         | -0.005         |
| sd   |     |     | rob.   | 0.164         | 0.903         | 0.929         | 0.196          | 0.176          | 0.077          | 0.087          | 0.156          | 0.156          | 0.107          | 0.111          | 0.131          |
| mean | 500 | 50  | trad.  | 0.427         | 1.359         | -1.447        | -0.463         | -0.410         | 0.083          | 0.037          | -0.360         | -0.361         | -0.021         | -0.016         | 0.010          |
| sd   |     |     | trad.  | 0.064         | 1.406         | 1.401         | 0.146          | 0.137          | 0.155          | 0.151          | 0.119          | 0.120          | 0.117          | 0.117          | 0.132          |
| mean | 500 | 50  | rob.   | 0.417         | 1.132         | -1.216        | -0.460         | -0.406         | 0.084          | 0.040          | -0.356         | -0.357         | -0.025         | -0.018         | 0.006          |
| sd   |     |     | rob.   | 0.071         | 1.278         | 1.276         | 0.156          | 0.147          | 0.175          | 0.169          | 0.128          | 0.130          | 0.130          | 0.124          | 0.149          |

**Table 11** Results for traditional and robust PLS for three composites and systematic outliers in all indicators

|      | n   | out | estim. | $\gamma_{21}$ | $\gamma_{31}$ | $\gamma_{32}$ | $w_{11}$ | $w_{12}$ | $w_{13}$ | $w_{21}$ | $w_{22}$ | $w_{23}$ | $w_{31}$ | $w_{32}$ | $w_{33}$ |
|------|-----|-----|--------|---------------|---------------|---------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| mean | 100 | 0   | trad.  | 0.021         | 0.016         | 0.030         | -0.004   | -0.024   | -0.005   | -0.011   | -0.016   | -0.027   | -0.047   | -0.057   | -0.074   |
| sd   |     |     |        | 0.071         | 0.124         | 0.138         | 0.185    | 0.197    | 0.199    | 0.202    | 0.194    | 0.182    | 0.356    | 0.303    | 0.348    |
| mean | 100 | 0   | rob.   | 0.034         | 0.020         | 0.057         | -0.030   | -0.053   | 0.004    | -0.033   | -0.038   | -0.051   | -0.079   | -0.128   | -0.121   |
| sd   |     |     |        | 0.097         | 0.211         | 0.232         | 0.291    | 0.301    | 0.306    | 0.295    | 0.296    | 0.278    | 0.465    | 0.414    | 0.447    |
| mean | 100 | 5   | trad.  | 0.254         | 0.137         | 0.301         | -0.148   | -0.017   | 0.084    | 0.080    | -0.142   | -0.120   | -0.062   | -0.056   | -0.092   |
| sd   |     |     |        | 0.034         | 0.103         | 0.105         | 0.124    | 0.125    | 0.124    | 0.098    | 0.118    | 0.105    | 0.150    | 0.123    | 0.140    |
| mean | 100 | 5   | rob.   | 0.037         | 0.022         | 0.057         | -0.064   | -0.000   | -0.014   | -0.025   | -0.037   | -0.068   | -0.104   | -0.111   | -0.089   |
| sd   |     |     |        | 0.096         | 0.203         | 0.227         | 0.300    | 0.296    | 0.297    | 0.291    | 0.298    | 0.289    | 0.444    | 0.402    | 0.428    |
| mean | 100 | 10  | trad.  | 0.331         | 0.158         | 0.375         | -0.166   | -0.037   | 0.093    | 0.070    | -0.162   | -0.156   | -0.068   | -0.080   | -0.117   |
| sd   |     |     |        | 0.024         | 0.109         | 0.110         | 0.108    | 0.111    | 0.114    | 0.084    | 0.104    | 0.092    | 0.126    | 0.104    | 0.114    |
| mean | 100 | 10  | rob.   | 0.029         | 0.025         | 0.047         | -0.048   | -0.021   | -0.011   | -0.020   | -0.054   | -0.048   | -0.060   | -0.141   | -0.119   |
| sd   |     |     |        | 0.103         | 0.189         | 0.225         | 0.282    | 0.304    | 0.315    | 0.290    | 0.283    | 0.278    | 0.455    | 0.399    | 0.442    |
| mean | 100 | 20  | trad.  | 0.388         | 0.171         | 0.429         | -0.195   | -0.044   | 0.104    | 0.062    | -0.177   | -0.183   | -0.082   | -0.097   | -0.128   |
| sd   |     |     |        | 0.016         | 0.104         | 0.105         | 0.096    | 0.095    | 0.100    | 0.074    | 0.089    | 0.081    | 0.102    | 0.090    | 0.094    |
| mean | 100 | 20  | rob.   | 0.033         | 0.017         | 0.066         | -0.025   | -0.029   | -0.017   | -0.023   | -0.049   | -0.031   | -0.091   | -0.111   | -0.088   |
| sd   |     |     |        | 0.098         | 0.170         | 0.194         | 0.263    | 0.274    | 0.282    | 0.263    | 0.278    | 0.251    | 0.428    | 0.398    | 0.408    |
| mean | 100 | 40  | trad.  | 0.420         | 0.183         | 0.455         | -0.220   | -0.045   | 0.119    | 0.057    | -0.173   | -0.211   | -0.076   | -0.113   | -0.143   |
| sd   |     |     |        | 0.011         | 0.103         | 0.104         | 0.078    | 0.081    | 0.080    | 0.067    | 0.079    | 0.074    | 0.087    | 0.081    | 0.083    |
| mean | 100 | 40  | rob.   | 0.282         | 0.129         | 0.309         | -0.163   | -0.037   | 0.071    | 0.025    | -0.127   | -0.158   | -0.076   | -0.126   | -0.145   |
| sd   |     |     |        | 0.200         | 0.191         | 0.258         | 0.212    | 0.213    | 0.224    | 0.193    | 0.215    | 0.209    | 0.290    | 0.272    | 0.298    |
| mean | 100 | 50  | trad.  | 0.425         | 0.181         | 0.463         | -0.222   | -0.048   | 0.125    | 0.054    | -0.169   | -0.215   | -0.072   | -0.120   | -0.141   |
| sd   |     |     |        | 0.011         | 0.103         | 0.103         | 0.077    | 0.074    | 0.077    | 0.069    | 0.072    | 0.069    | 0.081    | 0.073    | 0.080    |
| mean | 100 | 50  | rob.   | 0.432         | 0.186         | 0.465         | -0.225   | -0.050   | 0.124    | 0.055    | -0.174   | -0.218   | -0.072   | -0.122   | -0.146   |
| sd   |     |     |        | 0.014         | 0.156         | 0.156         | 0.110    | 0.110    | 0.113    | 0.098    | 0.108    | 0.103    | 0.116    | 0.104    | 0.114    |
| mean | 300 | 0   | trad.  | 0.006         | 0.005         | 0.015         | -0.006   | -0.003   | 0.000    | -0.002   | -0.002   | -0.010   | -0.009   | -0.020   | -0.025   |
| sd   |     |     |        | 0.045         | 0.063         | 0.068         | 0.100    | 0.110    | 0.111    | 0.105    | 0.111    | 0.104    | 0.201    | 0.177    | 0.194    |
| mean | 300 | 0   | rob.   | 0.008         | 0.007         | 0.017         | -0.006   | -0.006   | -0.000   | -0.004   | -0.005   | -0.010   | -0.009   | -0.025   | -0.035   |
| sd   |     |     |        | 0.052         | 0.073         | 0.081         | 0.112    | 0.127    | 0.130    | 0.124    | 0.127    | 0.119    | 0.224    | 0.203    | 0.227    |
| mean | 300 | 5   | trad.  | 0.248         | 0.132         | 0.296         | -0.137   | -0.023   | 0.084    | 0.079    | -0.137   | -0.118   | -0.059   | -0.049   | -0.091   |
| sd   |     |     |        | 0.021         | 0.061         | 0.062         | 0.070    | 0.072    | 0.072    | 0.055    | 0.072    | 0.065    | 0.084    | 0.070    | 0.081    |
| mean | 300 | 5   | rob.   | 0.010         | 0.009         | 0.012         | -0.006   | -0.006   | -0.002   | -0.008   | -0.002   | -0.014   | -0.027   | -0.021   | -0.026   |
| sd   |     |     |        | 0.052         | 0.072         | 0.081         | 0.116    | 0.128    | 0.130    | 0.123    | 0.132    | 0.123    | 0.239    | 0.208    | 0.220    |
| mean | 300 | 10  | trad.  | 0.326         | 0.156         | 0.373         | -0.166   | -0.041   | 0.099    | 0.072    | -0.160   | -0.156   | -0.077   | -0.074   | -0.106   |
| sd   |     |     |        | 0.014         | 0.061         | 0.061         | 0.061    | 0.063    | 0.067    | 0.047    | 0.057    | 0.052    | 0.068    | 0.059    | 0.062    |
| mean | 300 | 10  | rob.   | 0.012         | 0.007         | 0.016         | -0.006   | -0.006   | -0.001   | -0.003   | -0.003   | -0.014   | -0.033   | -0.030   | -0.013   |
| sd   |     |     |        | 0.050         | 0.078         | 0.083         | 0.114    | 0.123    | 0.134    | 0.125    | 0.127    | 0.114    | 0.242    | 0.213    | 0.217    |
| mean | 300 | 20  | trad.  | 0.385         | 0.168         | 0.429         | -0.193   | -0.044   | 0.105    | 0.065    | -0.177   | -0.184   | -0.078   | -0.096   | -0.131   |
| sd   |     |     |        | 0.009         | 0.061         | 0.061         | 0.051    | 0.052    | 0.054    | 0.042    | 0.049    | 0.044    | 0.059    | 0.050    | 0.054    |
| mean | 300 | 20  | rob.   | 0.010         | 0.007         | 0.019         | -0.002   | -0.005   | -0.007   | -0.002   | -0.011   | -0.008   | -0.010   | -0.029   | -0.037   |
| sd   |     |     |        | 0.052         | 0.078         | 0.083         | 0.117    | 0.125    | 0.129    | 0.124    | 0.131    | 0.121    | 0.242    | 0.204    | 0.222    |
| mean | 300 | 40  | trad.  | 0.419         | 0.177         | 0.458         | -0.218   | -0.045   | 0.118    | 0.057    | -0.172   | -0.209   | -0.075   | -0.113   | -0.142   |
| sd   |     |     |        | 0.007         | 0.060         | 0.060         | 0.046    | 0.045    | 0.044    | 0.039    | 0.044    | 0.040    | 0.047    | 0.045    | 0.050    |
| mean | 300 | 40  | rob.   | 0.037         | 0.025         | 0.044         | -0.025   | -0.000   | -0.000   | 0.004    | -0.021   | -0.023   | -0.036   | -0.027   | -0.038   |
| sd   |     |     |        | 0.095         | 0.093         | 0.123         | 0.136    | 0.137    | 0.142    | 0.131    | 0.142    | 0.132    | 0.253    | 0.215    | 0.237    |
| mean | 300 | 50  | trad.  | 0.422         | 0.182         | 0.459         | -0.222   | -0.047   | 0.125    | 0.055    | -0.168   | -0.214   | -0.068   | -0.121   | -0.143   |
| sd   |     |     |        | 0.007         | 0.058         | 0.058         | 0.043    | 0.042    | 0.041    | 0.040    | 0.042    | 0.040    | 0.047    | 0.045    | 0.045    |
| mean | 300 | 50  | rob.   | 0.425         | 0.181         | 0.465         | -0.221   | -0.048   | 0.124    | 0.054    | -0.169   | -0.216   | -0.069   | -0.122   | -0.144   |
| sd   |     |     |        | 0.007         | 0.066         | 0.066         | 0.050    | 0.049    | 0.048    | 0.046    | 0.049    | 0.046    | 0.054    | 0.051    | 0.050    |
| mean | 500 | 0   | trad.  | 0.004         | 0.004         | 0.008         | -0.004   | 0.001    | -0.003   | -0.003   | -0.002   | -0.004   | -0.019   | -0.012   | -0.001   |
| sd   |     |     |        | 0.034         | 0.049         | 0.050         | 0.074    | 0.080    | 0.081    | 0.082    | 0.081    | 0.072    | 0.162    | 0.141    | 0.151    |
| mean | 500 | 0   | rob.   | 0.005         | 0.006         | 0.008         | -0.007   | 0.002    | -0.002   | -0.004   | -0.001   | -0.007   | -0.024   | -0.013   | -0.003   |
| sd   |     |     |        | 0.037         | 0.054         | 0.059         | 0.085    | 0.091    | 0.092    | 0.091    | 0.093    | 0.082    | 0.177    | 0.158    | 0.167    |
| mean | 500 | 5   | trad.  | 0.247         | 0.130         | 0.296         | -0.134   | -0.023   | 0.082    | 0.079    | -0.136   | -0.117   | -0.054   | -0.053   | -0.090   |
| sd   |     |     |        | 0.016         | 0.046         | 0.048         | 0.053    | 0.054    | 0.054    | 0.045    | 0.054    | 0.047    | 0.067    | 0.054    | 0.062    |
| mean | 500 | 5   | rob.   | 0.007         | 0.006         | 0.008         | -0.005   | 0.002    | -0.006   | -0.005   | -0.003   | -0.006   | -0.004   | -0.022   | -0.015   |
| sd   |     |     |        | 0.037         | 0.053         | 0.060         | 0.085    | 0.090    | 0.093    | 0.094    | 0.091    | 0.084    | 0.175    | 0.159    | 0.167    |
| mean | 500 | 10  | trad.  | 0.325         | 0.155         | 0.373         | -0.169   | -0.034   | 0.097    | 0.072    | -0.161   | -0.153   | -0.072   | -0.076   | -0.110   |
| sd   |     |     |        | 0.012         | 0.047         | 0.048         | 0.047    | 0.049    | 0.048    | 0.037    | 0.043    | 0.040    | 0.053    | 0.045    | 0.050    |
| mean | 500 | 10  | rob.   | 0.005         | 0.006         | 0.009         | -0.005   | -0.002   | -0.000   | -0.001   | -0.005   | -0.004   | -0.011   | -0.016   | -0.013   |
| sd   |     |     |        | 0.038         | 0.057         | 0.060         | 0.087    | 0.095    | 0.095    | 0.095    | 0.092    | 0.086    | 0.174    | 0.156    | 0.165    |
| mean | 500 | 20  | trad.  | 0.385         | 0.171         | 0.425         | -0.193   | -0.044   | 0.105    | 0.063    | -0.175   | -0.184   | -0.079   | -0.095   | -0.131   |
| sd   |     |     |        | 0.007         | 0.048         | 0.048         | 0.041    | 0.042    | 0.040    | 0.033    | 0.040    | 0.035    | 0.045    | 0.040    | 0.042    |
| mean | 500 | 20  | rob.   | 0.008         | 0.006         | 0.006         | -0.001   | -0.007   | -0.002   | -0.003   | -0.003   | -0.008   | -0.004   | -0.019   | -0.022   |
| sd   |     |     |        | 0.038         | 0.058         | 0.061         | 0.091    | 0.100    | 0.101    | 0.095    | 0.099    | 0.091    | 0.185    | 0.163    | 0.170    |
| mean | 500 | 40  | trad.  | 0.418         | 0.180         | 0.455         | -0.215   | -0.047   | 0.118    | 0.054    | -0.171   | -0.208   | -0.075   | -0.114   | -0.140   |
| sd   |     |     |        | 0.005         | 0.045         | 0.045         | 0.034    | 0.034    | 0.035    | 0.032    | 0.035    | 0.032    | 0.036    | 0.036    | 0.037    |
| mean | 500 | 40  | rob.   | 0.019         | 0.016         | 0.022         | -0.011   | 0.000    | -0.003   | -0.000   | -0.008   | -0.014   | -0.007   | -0.019   | -0.032   |
| sd   |     |     |        | 0.052         | 0.070         | 0.076         | 0.100    | 0.103    | 0.110    | 0.107    | 0.108    | 0.101    | 0.195    | 0.175    | 0.185    |
| mean | 500 | 50  | trad.  | 0.422         | 0.181         | 0.461         | -0.222   | -0.049   | 0.128    | 0.057    | -0.169   | -0.216   | -0.069   | -0.120   | -0.143   |
| sd   |     |     |        | 0.005         | 0.045         | 0.045         | 0.033    | 0.033    | 0.033    | 0.031    | 0.033    | 0.031    | 0.036    | 0.034    | 0.035    |
| mean | 500 | 50  | rob.   | 0.423         | 0.180         | 0.464         | -0.223   | -0.049   | 0.128    | 0.059    | -0.170   | -0.218   | -0.068   | -0.121   | -0.143   |
| sd   |     |     |        | 0.007         | 0.049         | 0.048         | 0.036    | 0.036    | 0.036    | 0.033    | 0.035    | 0.034    | 0.039    | 0.036    | 0.038    |

**Table 12** Results for traditional and robust PLS for three composites and systematic outliers in two indicators

|      | n   | out | estim. | $\gamma_{21}$ | $\gamma_{31}$ | $\gamma_{32}$ | $w_{11}$ | $w_{12}$ | $w_{13}$ | $w_{21}$ | $w_{22}$ | $w_{23}$ | $w_{31}$ | $w_{32}$ | $w_{33}$ |
|------|-----|-----|--------|---------------|---------------|---------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| mean | 100 | 0   | trad.  | 0.020         | 0.019         | 0.032         | -0.008   | -0.018   | -0.016   | -0.021   | -0.018   | -0.015   | -0.055   | -0.083   | -0.049   |
| sd   |     |     |        | 0.072         | 0.122         | 0.136         | 0.184    | 0.207    | 0.212    | 0.194    | 0.201    | 0.180    | 0.358    | 0.321    | 0.333    |
| mean | 100 | 0   | rob.   | 0.036         | 0.025         | 0.056         | -0.056   | -0.036   | -0.005   | -0.026   | -0.054   | -0.052   | -0.081   | -0.131   | -0.105   |
| sd   |     |     |        | 0.107         | 0.213         | 0.223         | 0.312    | 0.317    | 0.325    | 0.293    | 0.306    | 0.296    | 0.451    | 0.423    | 0.421    |
| mean | 100 | 5   | trad.  | 0.060         | 0.006         | 0.026         | -0.148   | -0.123   | 0.241    | 0.174    | -0.123   | -0.096   | -0.055   | -0.072   | -0.117   |
| sd   |     |     |        | 0.066         | 0.137         | 0.144         | 0.245    | 0.230    | 0.331    | 0.320    | 0.237    | 0.206    | 0.401    | 0.349    | 0.375    |
| mean | 100 | 5   | rob.   | 0.033         | 0.026         | 0.054         | -0.059   | -0.030   | 0.012    | -0.022   | -0.054   | -0.043   | -0.068   | -0.116   | -0.125   |
| sd   |     |     |        | 0.111         | 0.198         | 0.222         | 0.295    | 0.295    | 0.314    | 0.280    | 0.289    | 0.284    | 0.457    | 0.406    | 0.432    |
| mean | 100 | 10  | trad.  | 0.130         | -0.043        | 0.024         | -0.344   | -0.264   | 0.484    | 0.385    | -0.282   | -0.239   | -0.120   | -0.153   | -0.157   |
| sd   |     |     |        | 0.063         | 0.166         | 0.163         | 0.289    | 0.234    | 0.394    | 0.379    | 0.250    | 0.214    | 0.486    | 0.445    | 0.459    |
| mean | 100 | 10  | rob.   | 0.034         | 0.026         | 0.057         | -0.049   | -0.040   | 0.013    | 0.009    | -0.055   | -0.059   | -0.078   | -0.116   | -0.106   |
| sd   |     |     |        | 0.109         | 0.195         | 0.207         | 0.265    | 0.294    | 0.317    | 0.297    | 0.287    | 0.266    | 0.446    | 0.404    | 0.427    |
| mean | 100 | 20  | trad.  | 0.230         | -0.120        | 0.030         | -0.536   | -0.395   | 0.686    | 0.573    | -0.435   | -0.406   | -0.230   | -0.230   | -0.263   |
| sd   |     |     |        | 0.047         | 0.197         | 0.179         | 0.225    | 0.191    | 0.313    | 0.308    | 0.200    | 0.175    | 0.564    | 0.521    | 0.554    |
| mean | 100 | 20  | rob.   | 0.054         | 0.020         | 0.042         | -0.085   | -0.077   | 0.094    | 0.070    | -0.079   | -0.081   | -0.084   | -0.086   | -0.132   |
| sd   |     |     |        | 0.105         | 0.188         | 0.197         | 0.268    | 0.285    | 0.333    | 0.301    | 0.287    | 0.257    | 0.441    | 0.398    | 0.432    |
| mean | 100 | 40  | trad.  | 0.299         | -0.152        | 0.036         | -0.584   | -0.422   | 0.752    | 0.647    | -0.486   | -0.491   | -0.271   | -0.325   | -0.312   |
| sd   |     |     |        | 0.033         | 0.209         | 0.201         | 0.162    | 0.140    | 0.202    | 0.201    | 0.142    | 0.135    | 0.619    | 0.550    | 0.597    |
| mean | 100 | 40  | rob.   | 0.308         | -0.121        | 0.053         | -0.555   | -0.397   | 0.685    | 0.583    | -0.457   | -0.465   | -0.243   | -0.319   | -0.332   |
| sd   |     |     |        | 0.060         | 0.341         | 0.335         | 0.237    | 0.198    | 0.336    | 0.324    | 0.208    | 0.195    | 0.634    | 0.553    | 0.627    |
| mean | 100 | 50  | trad.  | 0.307         | -0.151        | 0.027         | -0.589   | -0.416   | 0.746    | 0.645    | -0.490   | -0.514   | -0.291   | -0.351   | -0.336   |
| sd   |     |     |        | 0.029         | 0.211         | 0.206         | 0.161    | 0.136    | 0.230    | 0.232    | 0.136    | 0.129    | 0.619    | 0.575    | 0.609    |
| mean | 100 | 50  | rob.   | 0.321         | -0.109        | 0.040         | -0.566   | -0.400   | 0.683    | 0.588    | -0.472   | -0.503   | -0.282   | -0.339   | -0.314   |
| sd   |     |     |        | 0.046         | 0.332         | 0.326         | 0.214    | 0.190    | 0.363    | 0.363    | 0.194    | 0.180    | 0.637    | 0.582    | 0.620    |
| mean | 300 | 0   | trad.  | 0.008         | 0.008         | 0.007         | -0.001   | -0.001   | -0.009   | -0.003   | 0.000    | -0.012   | -0.008   | -0.025   | -0.020   |
| sd   |     |     |        | 0.042         | 0.064         | 0.066         | 0.096    | 0.103    | 0.113    | 0.108    | 0.109    | 0.099    | 0.200    | 0.177    | 0.191    |
| mean | 300 | 0   | rob.   | 0.011         | 0.011         | 0.011         | -0.001   | -0.007   | -0.007   | -0.004   | 0.000    | -0.017   | -0.014   | -0.032   | -0.026   |
| sd   |     |     |        | 0.049         | 0.075         | 0.077         | 0.113    | 0.120    | 0.129    | 0.125    | 0.129    | 0.116    | 0.228    | 0.211    | 0.222    |
| mean | 300 | 5   | trad.  | 0.040         | -0.005        | -0.002        | -0.115   | -0.100   | 0.264    | 0.211    | -0.091   | -0.064   | -0.024   | -0.026   | -0.019   |
| sd   |     |     |        | 0.040         | 0.069         | 0.073         | 0.126    | 0.117    | 0.173    | 0.162    | 0.129    | 0.101    | 0.219    | 0.199    | 0.213    |
| mean | 300 | 5   | rob.   | 0.012         | 0.007         | 0.014         | -0.004   | -0.011   | 0.002    | 0.013    | -0.010   | -0.016   | -0.025   | -0.032   | -0.017   |
| sd   |     |     |        | 0.047         | 0.075         | 0.082         | 0.113    | 0.122    | 0.128    | 0.125    | 0.127    | 0.114    | 0.229    | 0.213    | 0.215    |
| mean | 300 | 10  | trad.  | 0.115         | -0.055        | -0.015        | -0.322   | -0.255   | 0.566    | 0.475    | -0.266   | -0.210   | -0.049   | -0.055   | -0.070   |
| sd   |     |     |        | 0.036         | 0.102         | 0.083         | 0.172    | 0.142    | 0.188    | 0.169    | 0.154    | 0.130    | 0.328    | 0.291    | 0.321    |
| mean | 300 | 10  | rob.   | 0.017         | 0.013         | 0.009         | -0.014   | -0.012   | 0.016    | 0.027    | -0.014   | -0.022   | -0.013   | -0.027   | -0.036   |
| sd   |     |     |        | 0.049         | 0.075         | 0.079         | 0.114    | 0.120    | 0.130    | 0.123    | 0.125    | 0.117    | 0.236    | 0.210    | 0.226    |
| mean | 300 | 20  | trad.  | 0.228         | -0.153        | -0.007        | -0.547   | -0.409   | 0.766    | 0.652    | -0.451   | -0.409   | -0.151   | -0.200   | -0.172   |
| sd   |     |     |        | 0.025         | 0.118         | 0.105         | 0.124    | 0.104    | 0.119    | 0.114    | 0.108    | 0.099    | 0.506    | 0.477    | 0.482    |
| mean | 300 | 20  | rob.   | 0.027         | 0.008         | 0.010         | -0.039   | -0.034   | 0.070    | 0.066    | -0.032   | -0.031   | -0.024   | -0.027   | -0.032   |
| sd   |     |     |        | 0.050         | 0.079         | 0.084         | 0.118    | 0.129    | 0.150    | 0.142    | 0.132    | 0.122    | 0.247    | 0.220    | 0.236    |
| mean | 300 | 40  | trad.  | 0.295         | -0.195        | 0.007         | -0.602   | -0.432   | 0.795    | 0.687    | -0.500   | -0.501   | -0.235   | -0.296   | -0.316   |
| sd   |     |     |        | 0.016         | 0.120         | 0.114         | 0.087    | 0.073    | 0.022    | 0.018    | 0.073    | 0.075    | 0.581    | 0.552    | 0.587    |
| mean | 300 | 40  | rob.   | 0.290         | -0.171        | 0.008         | -0.573   | -0.412   | 0.759    | 0.658    | -0.475   | -0.479   | -0.217   | -0.284   | -0.293   |
| sd   |     |     |        | 0.057         | 0.146         | 0.134         | 0.147    | 0.116    | 0.151    | 0.125    | 0.122    | 0.124    | 0.575    | 0.540    | 0.579    |
| mean | 300 | 50  | trad.  | 0.301         | -0.200        | 0.010         | -0.599   | -0.424   | 0.791    | 0.686    | -0.496   | -0.516   | -0.243   | -0.338   | -0.311   |
| sd   |     |     |        | 0.016         | 0.117         | 0.115         | 0.090    | 0.072    | 0.066    | 0.065    | 0.077    | 0.071    | 0.580    | 0.568    | 0.575    |
| mean | 300 | 50  | rob.   | 0.310         | -0.194        | 0.011         | -0.603   | -0.426   | 0.790    | 0.686    | -0.499   | -0.522   | -0.241   | -0.356   | -0.325   |
| sd   |     |     |        | 0.018         | 0.138         | 0.132         | 0.100    | 0.081    | 0.067    | 0.066    | 0.086    | 0.080    | 0.587    | 0.567    | 0.591    |
| mean | 500 | 0   | trad.  | 0.004         | 0.000         | 0.009         | -0.002   | -0.003   | 0.001    | -0.007   | 0.002    | -0.007   | -0.006   | -0.010   | -0.015   |
| sd   |     |     |        | 0.033         | 0.048         | 0.051         | 0.076    | 0.083    | 0.083    | 0.083    | 0.083    | 0.077    | 0.154    | 0.139    | 0.146    |
| mean | 500 | 0   | rob.   | 0.005         | 0.000         | 0.010         | 0.000    | -0.004   | -0.003   | -0.004   | -0.000   | -0.009   | -0.005   | -0.013   | -0.022   |
| sd   |     |     |        | 0.038         | 0.056         | 0.057         | 0.087    | 0.093    | 0.094    | 0.094    | 0.093    | 0.087    | 0.175    | 0.157    | 0.168    |
| mean | 500 | 5   | trad.  | 0.036         | -0.007        | -0.005        | -0.113   | -0.095   | 0.268    | 0.215    | -0.080   | -0.061   | -0.011   | -0.015   | -0.012   |
| sd   |     |     |        | 0.032         | 0.052         | 0.054         | 0.094    | 0.091    | 0.129    | 0.122    | 0.092    | 0.079    | 0.181    | 0.149    | 0.158    |
| mean | 500 | 5   | rob.   | 0.007         | 0.006         | 0.008         | -0.010   | -0.004   | 0.008    | 0.009    | 0.001    | -0.014   | -0.010   | -0.019   | -0.011   |
| sd   |     |     |        | 0.038         | 0.054         | 0.060         | 0.089    | 0.090    | 0.097    | 0.090    | 0.092    | 0.088    | 0.180    | 0.154    | 0.164    |
| mean | 500 | 10  | trad.  | 0.112         | -0.064        | -0.022        | -0.327   | -0.260   | 0.592    | 0.502    | -0.274   | -0.206   | -0.032   | -0.031   | -0.032   |
| sd   |     |     |        | 0.027         | 0.077         | 0.061         | 0.125    | 0.107    | 0.128    | 0.109    | 0.111    | 0.095    | 0.256    | 0.239    | 0.230    |
| mean | 500 | 10  | rob.   | 0.009         | 0.003         | 0.010         | -0.013   | -0.011   | 0.020    | 0.030    | -0.015   | -0.013   | -0.023   | -0.010   | -0.005   |
| sd   |     |     |        | 0.037         | 0.057         | 0.059         | 0.089    | 0.092    | 0.097    | 0.093    | 0.094    | 0.089    | 0.180    | 0.155    | 0.160    |
| mean | 500 | 20  | trad.  | 0.227         | -0.155        | -0.022        | -0.548   | -0.414   | 0.780    | 0.665    | -0.458   | -0.409   | -0.111   | -0.150   | -0.133   |
| sd   |     |     |        | 0.018         | 0.091         | 0.079         | 0.094    | 0.077    | 0.041    | 0.033    | 0.080    | 0.075    | 0.460    | 0.419    | 0.450    |
| mean | 500 | 20  | rob.   | 0.021         | 0.005         | 0.006         | -0.037   | -0.032   | 0.073    | 0.076    | -0.037   | -0.024   | -0.012   | -0.016   | -0.015   |
| sd   |     |     |        | 0.038         | 0.057         | 0.060         | 0.091    | 0.093    | 0.109    | 0.104    | 0.094    | 0.086    | 0.191    | 0.160    | 0.176    |
| mean | 500 | 40  | trad.  | 0.295         | -0.207        | -0.003        | -0.601   | -0.431   | 0.799    | 0.691    | -0.499   | -0.497   | -0.185   | -0.245   | -0.245   |
| sd   |     |     |        | 0.013         | 0.093         | 0.088         | 0.067    | 0.056    | 0.015    | 0.013    | 0.056    | 0.054    | 0.548    | 0.516    | 0.542    |
| mean | 500 | 40  | rob.   | 0.293         | -0.194        | 0.001         | -0.584   | -0.421   | 0.779    | 0.674    | -0.483   | -0.483   | -0.194   | -0.243   | -0.244   |
| sd   |     |     |        | 0.043         | 0.111         | 0.097         | 0.113    | 0.085    | 0.099    | 0.085    | 0.096    | 0.095    | 0.545    | 0.513    | 0.547    |
| mean | 500 | 50  | trad.  | 0.301         | -0.215        | -0.000        | -0.603   | -0.427   | 0.798    | 0.693    | -0.502   | -0.518   | -0.245   | -0.281   | -0.262   |
| sd   |     |     |        | 0.012         | 0.094         | 0.089         | 0.065    | 0.054    | 0.012    | 0.011    | 0.056    | 0.054    | 0.568    | 0.541    | 0.572    |
| mean | 500 | 50  | rob.   | 0.308         | -0.212        | 0.002         | -0.605   | -0.428   | 0.798    | 0.693    | -0.503   | -0.521   | -0.262   | -0.289   | -0.269   |
| sd   |     |     |        | 0.013         | 0.104         | 0.102         | 0.069    | 0.058    | 0.013    | 0.012    | 0.060    | 0.059    | 0.580    | 0.546    | 0.582    |

**Table 13** Results for traditional and robust PLS for five common factors and systematic outliers in all indicators

|      | n   | out | estim. | $\rho_{12}$ | $\gamma_{32}$ | $\gamma_{41}$ | $\gamma_{42}$ | $\gamma_{51}$ | $\gamma_{52}$ | $\gamma_{63}$ | $\lambda_{11}$ | $\lambda_{13}$ | $\lambda_{21}$ | $\lambda_{22}$ | $\lambda_{23}$ | $\lambda_{24}$ | $\lambda_{25}$ | $\lambda_{26}$ | $\lambda_{31}$ | $\lambda_{32}$ | $\lambda_{33}$ | $\lambda_{34}$ | $\lambda_{41}$ | $\lambda_{42}$ | $\lambda_{51}$ | $\lambda_{52}$ | $\lambda_{53}$ | $\lambda_{54}$ | $\lambda_{55}$ | $\lambda_{56}$ |        |
|------|-----|-----|--------|-------------|---------------|---------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------|
| mean | 100 | 0   | trad.  | 0.011       | -0.030        | -0.028        | 0.030         | 0.028         | -0.062        | -0.023        | 0.002          | -0.007         | -0.005         | 0.001          | -0.010         | -0.008         | -0.007         | -0.011         | -0.016         | -0.037         | -0.093         | -0.121         | -0.026         | -0.036         | 0.001          | 0.002          | -0.008         | -0.012         | -0.030         | -0.028         |        |
| sd   | 100 | 0   | trad.  | 0.085       | 0.161         | 0.231         | 0.223         | 0.233         | 0.230         | 0.127         | 0.061          | 0.057          | 0.102          | 0.108          | 0.110          | 0.085          | 0.088          | 0.085          | 0.284          | 0.238          | 0.183          | 0.162          | 0.094          | 0.091          | 0.138          | 0.136          | -0.008         | -0.012         | -0.030         | -0.028         |        |
| mean | 100 | 0   | rob.   | 0.010       | -0.054        | 0.025         | -0.009        | -0.004        | -0.045        | -0.000        | 0.016          | -0.018         | 0.000          | 0.000          | -0.005         | 0.000          | 0.002          | -0.002         | -0.012         | -0.056         | -0.145         | -0.191         | -0.013         | -0.041         | -0.002         | -0.009         | -0.010         | -0.048         | -0.046         | -0.046         |        |
| sd   | 100 | 5   | trad.  | 0.109       | 0.233         | 0.319         | 0.304         | 0.322         | 0.318         | 0.195         | 0.076          | 0.069          | 0.148          | 0.144          | 0.151          | 0.122          | 0.117          | 0.118          | 0.332          | 0.281          | 0.239          | 0.218          | 0.126          | 0.111          | 0.178          | 0.183          | 0.154          | 0.150          | 0.095          | 0.091          |        |
| mean | 100 | 5   | trad.  | 0.041       | 0.139         | 0.113         | -0.400        | -0.035        | 0.148         | 0.139         | 0.078          | 0.020          | 0.260          | 0.261          | 0.261          | 0.181          | 0.181          | 0.180          | 0.046          | -0.216         | -0.372         | -0.285         | -0.377         | 0.006          | -0.065         | 0.002          | -0.006         | -0.007         | -0.011         | -0.052         |        |
| sd   | 100 | 5   | trad.  | 0.051       | 0.140         | 0.315         | 0.318         | 0.303         | 0.396         | 0.212         | 0.036          | 0.034          | 0.069          | 0.068          | 0.069          | 0.054          | 0.054          | 0.055          | 0.528          | 0.240          | 0.218          | 0.285          | 0.420          | 0.118          | 0.178          | 0.170          | 0.150          | 0.133          | 0.096          | 0.093          |        |
| mean | 100 | 5   | rob.   | 0.008       | -0.049        | -0.004        | 0.016         | 0.017         | -0.057        | 0.003         | 0.015          | -0.017         | -0.009         | 0.004          | 0.001          | 0.002          | 0.001          | -0.001         | -0.001         | -0.027         | -0.079         | -0.140         | -0.194         | -0.015         | -0.039         | -0.002         | -0.014         | -0.016         | -0.048         | -0.048         |        |
| sd   | 100 | 5   | rob.   | 0.111       | 0.245         | 0.315         | 0.307         | 0.309         | 0.314         | 0.191         | 0.077          | 0.068          | 0.149          | 0.153          | 0.142          | 0.117          | 0.119          | 0.119          | 0.331          | 0.302          | 0.245          | 0.229          | 0.120          | 0.114          | 0.179          | 0.180          | 0.158          | 0.160          | 0.096          | 0.092          |        |
| mean | 100 | 10  | trad.  | 0.020       | 0.370         | 0.174         | -0.547        | -0.011        | 0.021         | 0.265         | 0.105          | 0.034          | 0.362          | 0.364          | 0.365          | 0.237          | 0.233          | 0.235          | 0.197          | -0.378         | -0.524         | -0.605         | 0.021          | -0.073         | 0.004          | -0.009         | -0.025         | -0.023         | -0.082         | -0.076         |        |
| sd   | 100 | 10  | trad.  | 0.027       | 0.551         | 0.445         | 0.422         | 0.452         | 0.793         | 0.520         | 0.026          | 0.024          | 0.048          | 0.048          | 0.048          | 0.040          | 0.040          | 0.041          | 0.040          | 0.248          | -0.264         | -0.419         | -0.304         | 0.132          | 0.143          | 0.211          | 0.230          | 0.185          | 0.135          | 0.130          |        |
| mean | 100 | 10  | rob.   | 0.026       | -0.032        | 0.009         | 0.001         | 0.004         | -0.043        | 0.007         | 0.015          | 0.018          | 0.004          | -0.009         | -0.009         | 0.000          | -0.003         | -0.002         | -0.002         | -0.064         | -0.149         | -0.194         | -0.014         | -0.042         | 0.003          | -0.005         | -0.014         | -0.020         | -0.041         | -0.047         |        |
| sd   | 100 | 10  | rob.   | 0.109       | 0.223         | 0.319         | 0.307         | 0.308         | 0.303         | 0.176         | 0.078          | 0.070          | 0.147          | 0.146          | 0.147          | 0.113          | 0.114          | 0.119          | 0.335          | 0.289          | 0.247          | 0.232          | 0.120          | 0.111          | 0.179          | 0.177          | 0.152          | 0.144          | 0.087          | 0.090          |        |
| mean | 100 | 20  | trad.  | 0.240       | 0.634         | 0.312         | -0.761        | 0.031         | -0.152        | 0.126         | 0.043          | 0.444          | 0.445          | 0.446          | 0.279          | 0.280          | 0.281          | 0.332          | -0.516         | -0.699         | -0.790         | 0.038          | -0.107         | -0.057         | -0.055         | -0.102         | -0.092         | -0.166         | -0.136         | -0.236         |        |
| sd   | 100 | 20  | trad.  | 0.018       | 0.512         | 0.563         | 0.567         | 0.626         | 1.140         | 0.798         | 0.018          | 0.018          | 0.032          | 0.033          | 0.033          | 0.028          | 0.027          | 0.028          | 0.494          | 0.217          | 0.241          | 0.252          | 0.163          | 0.152          | 0.311          | 0.301          | 0.286          | 0.295          | 0.237          | 0.236          |        |
| mean | 100 | 20  | rob.   | 0.011       | -0.032        | -0.012        | 0.014         | -0.014        | -0.027        | 0.016         | 0.010          | -0.013         | 0.011          | 0.012          | 0.012          | 0.004          | 0.005          | 0.001          | -0.019         | -0.082         | -0.152         | -0.195         | -0.015         | -0.039         | -0.011         | -0.004         | -0.005         | -0.016         | -0.044         | -0.048         |        |
| sd   | 100 | 20  | rob.   | 0.113       | 0.253         | 0.334         | 0.321         | 0.314         | 0.317         | 0.184         | 0.076          | 0.065          | 0.159          | 0.159          | 0.160          | 0.123          | 0.124          | 0.126          | 0.354          | 0.284          | 0.240          | 0.230          | 0.119          | 0.111          | 0.179          | 0.177          | 0.153          | 0.153          | 0.097          | 0.092          |        |
| mean | 100 | 40  | trad.  | 0.265       | 0.750         | 0.369         | -0.892        | 0.041         | -0.063        | 0.270         | 0.135          | 0.042          | 0.490          | 0.490          | 0.490          | 0.307          | 0.307          | 0.307          | 0.301          | -0.588         | -0.778         | -0.878         | 0.058          | -0.127         | -0.106         | -0.136         | -0.180         | -0.174         | -0.257         | -0.254         |        |
| sd   | 100 | 40  | trad.  | 0.013       | 0.474         | 0.956         | 0.952         | 1.201         | 1.839         | 1.152         | 0.015          | 0.015          | 0.022          | 0.022          | 0.022          | 0.020          | 0.021          | 0.020          | 0.465          | 0.137          | 0.214          | 0.222          | 0.171          | 0.167          | 0.350          | 0.362          | 0.344          | 0.342          | 0.311          | 0.265          |        |
| mean | 100 | 40  | rob.   | 0.263       | 0.582         | 0.330         | -0.855        | -0.101        | 0.131         | 0.318         | 0.142          | 0.051          | 0.495          | 0.495          | 0.496          | 0.312          | 0.313          | 0.313          | 0.248          | -0.496         | -0.672         | -0.761         | 0.073          | -0.144         | -0.142         | -0.131         | -0.183         | -0.177         | -0.254         | -0.262         |        |
| sd   | 100 | 40  | rob.   | 0.016       | 0.623         | 1.172         | 1.165         | 1.351         | 1.746         | 0.997         | 0.020          | 0.019          | 0.033          | 0.032          | 0.032          | 0.028          | 0.029          | 0.029          | 0.642          | 0.250          | 0.277          | 0.292          | 0.230          | 0.231          | 0.363          | 0.380          | 0.339          | 0.346          | 0.296          | 0.310          |        |
| mean | 100 | 50  | trad.  | 0.271       | 0.791         | 0.329         | -0.888        | 0.186         | -0.348        | 0.415         | 0.130          | 0.037          | 0.495          | 0.495          | 0.495          | 0.307          | 0.307          | 0.306          | 0.431          | -0.593         | -0.789         | -0.886         | 0.062          | -0.142         | -0.174         | -0.149         | -0.215         | -0.193         | -0.290         | -0.302         |        |
| sd   | 100 | 50  | trad.  | 0.012       | 0.412         | 1.352         | 1.353         | 3.452         | 9.797         | 6.783         | 0.015          | 0.015          | 0.022          | 0.022          | 0.021          | 0.020          | 0.020          | 0.412          | 0.188          | 0.240          | 0.252          | 0.167          | 0.197          | 0.390          | 0.390          | 0.358          | 0.347          | 0.333          | 0.328          | 0.328          |        |
| mean | 100 | 50  | rob.   | 0.269       | 0.622         | 0.293         | -0.844        | -0.011        | 0.165         | 0.239         | 0.137          | 0.044          | 0.501          | 0.502          | 0.503          | 0.315          | 0.313          | 0.312          | 0.283          | -0.504         | -0.686         | -0.770         | 0.030          | -0.158         | -0.168         | -0.158         | -0.158         | -0.185         | -0.286         | -0.291         |        |
| sd   | 100 | 50  | rob.   | 0.069       | 0.594         | 1.552         | 1.539         | 2.543         | 2.832         | 1.089         | 0.020          | 0.020          | 0.030          | 0.029          | 0.030          | 0.028          | 0.027          | 0.027          | 0.616          | 0.251          | 0.280          | 0.292          | 0.226          | 0.248          | 0.382          | 0.388          | 0.354          | 0.353          | 0.285          | 0.316          |        |
| mean | 300 | 0   | trad.  | 0.004       | -0.003        | -0.008        | 0.009         | -0.004        | -0.017        | -0.039        | 0.001          | -0.000         | -0.001         | -0.002         | -0.002         | -0.003         | -0.002         | -0.002         | -0.002         | 0.009          | -0.015         | -0.019         | -0.038         | -0.032         | -0.029         | -0.006         | -0.002         | 0.000          | -0.007         | -0.005         |        |
| sd   | 300 | 0   | trad.  | 0.050       | 0.079         | 0.132         | 0.131         | 0.112         | 0.112         | 0.062         | 0.037          | 0.037          | 0.061          | 0.060          | 0.062          | 0.050          | 0.051          | 0.050          | 0.166          | 0.137          | 0.100          | 0.081          | 0.054          | 0.058          | 0.077          | 0.079          | 0.068          | 0.070          | 0.043          | 0.044          |        |
| mean | 300 | 0   | rob.   | 0.001       | -0.006        | -0.015        | 0.020         | -0.002        | -0.024        | -0.036        | 0.002          | -0.002         | -0.004         | -0.003         | -0.002         | -0.002         | -0.004         | -0.001         | -0.001         | 0.000          | -0.013         | -0.030         | -0.054         | -0.030         | -0.032         | -0.005         | -0.004         | -0.003         | -0.008         | -0.008         |        |
| sd   | 300 | 0   | rob.   | 0.057       | 0.092         | 0.150         | 0.148         | 0.143         | 0.143         | 0.070         | 0.043          | 0.041          | 0.072          | 0.071          | 0.068          | 0.057          | 0.058          | 0.058          | 0.197          | 0.154          | 0.121          | 0.101          | 0.063          | 0.068          | 0.088          | 0.092          | 0.081          | 0.077          | 0.048          | 0.048          |        |
| mean | 300 | 5   | trad.  | 0.150       | 0.253         | 0.116         | -0.422        | -0.037        | 0.115         | 0.107         | 0.076          | 0.022          | 0.262          | 0.260          | 0.263          | 0.181          | 0.181          | 0.179          | 0.226          | -0.284         | -0.392         | -0.448         | -0.017         | -0.039         | 0.005          | 0.004          | 0.003          | -0.003         | -0.023         | -0.020         |        |
| sd   | 300 | 5   | trad.  | 0.023       | 0.355         | 0.176         | 0.176         | 0.165         | 0.295         | 0.171         | 0.020          | 0.020          | 0.041          | 0.041          | 0.040          | 0.032          | 0.040          | 0.033          | 0.033          | 0.451          | 0.286          | 0.306          | 0.076          | 0.088          | 0.113          | 0.112          | 0.098          | 0.098          | 0.063          | 0.062          |        |
| mean | 300 | 5   | rob.   | 0.056       | 0.092         | 0.147         | 0.151         | 0.144         | 0.145         | 0.071         | 0.040          | 0.040          | 0.072          | 0.074          | 0.069          | 0.057          | 0.056          | 0.057          | 0.198          | 0.157          | 0.121          | 0.103          | 0.063          | 0.068          | 0.090          | 0.088          | 0.078          | 0.078          | 0.048          | 0.050          |        |
| mean | 300 | 10  | trad.  | 0.199       | 0.725         | 0.191         | -0.584        | 0.013         | -0.248        | 0.295         | 0.104          | 0.034          | 0.369          | 0.367          | 0.369          | 0.230          | 0.231          | 0.231          | 0.231          | 0.411          | -0.610         | -0.809         | -0.908         | -0.009         | -0.045         | -0.004         | -0.003         | -0.012         | -0.011         | -0.048         | -0.051 |
| sd   | 300 | 10  | trad.  | 0.016       | 0.273         | 0.219         | 0.217         | 0.259         | 0.590         | 0.443         | 0.016          | 0.015          | 0.026          | 0.027          | 0.027          | 0.023          | 0.022          | 0.022          | 0.239          | 0.133          | 0.109          | 0.164          | 0.091          | 0.102          | 0.177          | 0.177          | 0.148          | 0.144          | 0.091          | 0.091          |        |
| mean | 300 | 10  | rob.   | 0.002       | -0.008        | -0.016        | 0.017         | -0.005        | -0.019        | -0.037        | 0.002          | -0.002         | -0.003         | 0.001          | -0.001         | -0.002         | -0.002         | -0.003         | 0.001          | -0.004         | -0.032         | -0.054         | -0.034         | -0.029         | -0.034         | 0.002          | -0.004         | -0.001         | -0.010         | -0.010         |        |
| sd   | 300 | 10  | rob.   | 0.057       | 0.093         | 0.151         | 0.150         | 0.133         | 0.130         | 0.072         | 0.042          | 0.041          | 0.071          | 0.072          | 0.070          | 0.059          | 0.057          | 0.056          | 0.189          | 0.158          | 0.117          | 0.093          | 0.065          | 0.065          | 0.092          | 0.092          | 0.077          | 0.081          | 0.051          | 0.050          |        |
| mean | 300 | 20  | trad.  | 0.239       | 0.869         | 0.271         | -0.749        | 0.061         | -0.555        | 0.541         | 0.125          | 0.042          | 0.446          | 0.445          | 0.445          | 0.277          | 0.279          | 0.279          | 0.490          | -0.623         | -0.837         | -0.939         | 0.011          | -0.066         | 0.002          | -0.017         | -0.031         | -0.042         | -0.090         | -0.089         |        |
| sd   | 300 | 20  | trad.  | 0.011       | 0.097         | 0.289         | 0.288         | 0.352         | 0.852         | 0.675         | 0.011          | 0.010          | 0.017          | 0.018          | 0.017          | 0.015          | 0.015          | 0.015          | 0.088          | 0.061          | 0.056          | 0.055          | 0.108          | 0.120          | 0.233          | 0.237          | 0.195          | 0.213          | 0.134          | 0.129          |        |
| mean | 300 | 20  | rob.   | 0.004       | -0.014        | -0.020        | 0.025         | -0.000        | -0.027        | -0.036        | 0.002          | -0.002         | -0.002         | -0.002         | -0.002         | 0.001          | -0.005         | -0.006         | -0.006         | -0.035         | -0.068         | -0.103         | -0.059         | -0.026         | -0.034         | -0.004         | -0.004         | -0.002         | -0.013         | -0.009         |        |
| sd   | 300 | 20  | rob.   | 0.060       | 0.093         | 0.157         | 0.154         | 0.150         | 0.149         | 0.073         | 0.043          | 0.042          | 0.073          | 0.075          | 0.071          | 0.058          | 0.061          | 0.061          | 0.203          | 0.154          | 0.121          | 0.095          | 0.065          | 0.065          | 0.092          | 0.090          | 0.079          | 0.081          | 0.051          | 0.050          |        |
| mean | 300 | 40  | trad.  | 0.266       | 0.920         | 0.333         | -0.879        | 0.094         | -0.610        | 0.582         | 0.134          | 0.042          | 0.489          | 0.489          | 0.490          | 0.305          | 0.305          | 0.305          | 0.523          | -0.625         | -0.831         | -0.933         | 0.036          | -0.087         | -0.079         | -0.076         | -0.105         | -0             |                |                |        |

**Table 14** Results for traditional and robust PLSc for five common factors and systematic outliers in two indicators

|      | n   | out | estim. | $\rho_{12}$ | $\gamma_{32}$ | $\gamma_{42}$ | $\gamma_{51}$ | $\gamma_{62}$ | $\gamma_{63}$ | $\lambda_{11}$ | $\lambda_{13}$ | $\lambda_{21}$ | $\lambda_{22}$ | $\lambda_{23}$ | $\lambda_{24}$ | $\lambda_{25}$ | $\lambda_{26}$ | $\lambda_{31}$ | $\lambda_{32}$ | $\lambda_{33}$ | $\lambda_{34}$ | $\lambda_{41}$ | $\lambda_{42}$ | $\lambda_{51}$ | $\lambda_{52}$ | $\lambda_{53}$ | $\lambda_{54}$ | $\lambda_{55}$ | $\lambda_{56}$ |        |
|------|-----|-----|--------|-------------|---------------|---------------|---------------|---------------|---------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|--------|
| mean | 100 | 0   | trad.  | 0.004       | -0.025        | -0.029        | 0.038         | 0.018         | -0.051        | -0.018         | 0.008          | -0.009         | -0.007         | -0.004         | 0.000          | -0.008         | -0.004         | -0.012         | 0.005          | -0.036         | -0.091         | -0.127         | -0.023         | -0.037         | 0.000          | 0.000          | 0.000          | -0.005         | -0.025         | -0.030 |
| sd   | 100 | 0   | trad.  | 0.087       | 0.155         | 0.233         | 0.229         | 0.229         | 0.044         | 0.118          | 0.059          | 0.054          | 0.106          | 0.110          | 0.107          | 0.086          | 0.083          | 0.084          | 0.287          | 0.240          | 0.177          | 0.164          | 0.092          | 0.090          | 0.140          | 0.134          | 0.114          | 0.120          | 0.071          | -0.030 |
| mean | 100 | 0   | rob.   | 0.002       | -0.044        | 0.024         | -0.015        | -0.005        | -0.044        | 0.010          | 0.016          | -0.017         | 0.001          | 0.003          | 0.002          | -0.005         | -0.012         | -0.007         | -0.026         | -0.078         | -0.148         | -0.201         | -0.004         | -0.044         | -0.012         | -0.010         | -0.009         | -0.011         | -0.049         | -0.048 |
| sd   | 100 | 5   | trad.  | 0.112       | 0.241         | 0.315         | 0.306         | 0.339         | 0.335         | 0.185          | 0.080          | 0.070          | 0.150          | 0.149          | 0.147          | 0.119          | 0.125          | 0.120          | 0.339          | 0.291          | 0.254          | 0.235          | 0.217          | 0.118          | 0.186          | 0.185          | 0.154          | 0.146          | 0.092          | 0.090  |
| mean | 100 | 5   | trad.  | 0.061       | -0.026        | -0.140        | 0.120         | 0.178         | -0.195        | -0.032         | -0.045         | -0.168         | 0.017          | -0.017         | -0.009         | -0.032         | -0.027         | -0.028         | -0.011         | -0.040         | -0.182         | -0.169         | 0.095          | -0.034         | 0.031          | 0.007          | -0.005         | -0.009         | -0.029         | -0.029 |
| sd   | 100 | 5   | trad.  | 0.091       | 0.159         | 0.329         | 0.303         | 0.349         | 0.340         | 0.132          | 0.087          | 0.100          | 0.107          | 0.106          | 0.105          | 0.091          | 0.093          | 0.093          | 0.278          | 0.236          | 0.182          | 0.169          | 0.095          | 0.094          | 0.139          | 0.137          | 0.115          | 0.114          | 0.070          | 0.070  |
| mean | 100 | 5   | rob.   | 0.011       | -0.042        | -0.013        | 0.020         | 0.024         | -0.071        | -0.003         | 0.012          | -0.019         | 0.011          | 0.003          | 0.000          | -0.008         | -0.013         | -0.012         | -0.008         | -0.078         | -0.157         | -0.187         | -0.005         | -0.045         | -0.001         | -0.013         | -0.016         | -0.007         | -0.048         | -0.047 |
| sd   | 100 | 5   | rob.   | 0.109       | 0.238         | 0.329         | 0.308         | 0.334         | 0.331         | 0.195          | 0.081          | 0.072          | 0.150          | 0.146          | 0.147          | 0.120          | 0.119          | 0.116          | 0.330          | 0.295          | 0.250          | 0.230          | 0.130          | 0.116          | 0.182          | 0.187          | 0.155          | 0.152          | 0.091          | 0.094  |
| mean | 100 | 10  | trad.  | 0.088       | -0.032        | -0.179        | 0.154         | 0.261         | -0.272        | -0.032         | -0.062         | -0.273         | -0.002         | -0.023         | -0.022         | -0.031         | -0.032         | -0.032         | -0.012         | -0.035         | -0.276         | -0.117         | -0.024         | -0.032         | 0.000          | -0.002         | -0.003         | -0.000         | -0.028         | -0.027 |
| sd   | 100 | 10  | trad.  | 0.096       | 0.159         | 0.386         | 0.365         | 0.414         | 0.394         | 0.148          | 0.101          | 0.118          | 0.120          | 0.106          | 0.109          | 0.091          | 0.090          | 0.091          | 0.274          | 0.228          | 0.186          | 0.165          | 0.097          | 0.096          | 0.136          | 0.136          | 0.116          | 0.119          | 0.071          | 0.071  |
| mean | 100 | 10  | rob.   | 0.013       | -0.044        | -0.014        | 0.026         | 0.034         | -0.072        | -0.001         | 0.002          | -0.023         | 0.018          | -0.007         | -0.014         | -0.014         | -0.005         | -0.013         | -0.029         | -0.083         | -0.157         | -0.196         | 0.001          | -0.048         | -0.006         | -0.008         | -0.013         | -0.005         | -0.048         | -0.049 |
| sd   | 100 | 10  | rob.   | 0.115       | 0.251         | 0.334         | 0.311         | 0.317         | 0.317         | 0.191          | 0.082          | 0.078          | 0.147          | 0.150          | 0.156          | 0.120          | 0.125          | 0.123          | 0.332          | 0.288          | 0.255          | 0.239          | 0.126          | 0.113          | 0.190          | 0.183          | 0.160          | 0.163          | 0.095          | 0.094  |
| mean | 100 | 20  | trad.  | 0.096       | -0.029        | -0.217        | 0.192         | 0.301         | -0.318        | -0.029         | -0.063         | -0.414         | -0.050         | -0.022         | -0.016         | -0.030         | -0.028         | -0.024         | -0.002         | -0.046         | -0.099         | -0.127         | -0.035         | -0.004         | 0.007          | 0.002          | -0.002         | -0.014         | 0.030          | -0.029 |
| sd   | 100 | 20  | trad.  | 0.107       | 0.164         | 0.460         | 0.430         | 0.545         | 0.524         | 0.155          | 0.110          | 0.136          | 0.141          | 0.107          | 0.106          | 0.090          | 0.087          | 0.089          | 0.295          | 0.245          | 0.197          | 0.169          | 0.090          | 0.095          | 0.139          | 0.140          | 0.115          | 0.124          | 0.072          | 0.071  |
| mean | 100 | 20  | rob.   | 0.039       | -0.060        | -0.022        | 0.030         | 0.049         | -0.108        | -0.036         | -0.056         | -0.224         | -0.005         | -0.002         | -0.010         | -0.019         | -0.017         | -0.017         | -0.019         | -0.074         | -0.138         | -0.181         | -0.038         | -0.038         | 0.000          | -0.006         | -0.004         | -0.018         | -0.050         | -0.045 |
| sd   | 100 | 20  | rob.   | 0.143       | 0.242         | 0.570         | 0.541         | 0.709         | 0.692         | 0.247          | 0.140          | 0.255          | 0.245          | 0.151          | 0.145          | 0.123          | 0.121          | 0.129          | 0.335          | 0.293          | 0.248          | 0.231          | 0.121          | 0.115          | 0.179          | 0.189          | 0.151          | 0.153          | 0.093          | 0.091  |
| mean | 300 | 0   | trad.  | -0.000      | -0.007        | -0.020        | 0.022         | -0.007        | -0.015        | -0.043         | 0.001          | -0.002         | -0.005         | -0.000         | -0.003         | -0.002         | -0.005         | 0.001          | -0.006         | -0.006         | -0.018         | -0.040         | -0.027         | -0.029         | 0.003          | -0.008         | -0.004         | -0.000         | -0.005         | -0.007 |
| sd   | 300 | 0   | trad.  | 0.050       | 0.079         | 0.130         | 0.132         | 0.113         | 0.112         | 0.062          | 0.038          | 0.036          | 0.063          | 0.063          | 0.065          | 0.050          | 0.052          | 0.049          | 0.170          | 0.131          | 0.102          | 0.083          | 0.053          | 0.060          | 0.079          | 0.080          | 0.068          | 0.068          | 0.044          | 0.044  |
| mean | 300 | 0   | rob.   | 0.003       | -0.011        | -0.018        | 0.017         | -0.010        | -0.017        | -0.037         | 0.001          | -0.000         | -0.001         | 0.001          | -0.003         | -0.005         | -0.003         | -0.004         | -0.012         | -0.006         | -0.072         | -0.155         | -0.211         | 0.001          | -0.043         | -0.006         | -0.008         | -0.009         | -0.049         | -0.044 |
| sd   | 300 | 0   | rob.   | 0.059       | 0.095         | 0.147         | 0.146         | 0.141         | 0.139         | 0.071          | 0.042          | 0.039          | 0.070          | 0.069          | 0.071          | 0.059          | 0.056          | 0.056          | 0.206          | 0.155          | 0.120          | 0.099          | 0.064          | 0.066          | 0.088          | 0.093          | 0.076          | 0.080          | 0.048          | 0.049  |
| mean | 300 | 5   | trad.  | 0.077       | -0.009        | -0.165        | 0.138         | 0.177         | -0.181        | -0.040         | -0.051         | -0.171         | 0.019          | -0.019         | -0.022         | -0.025         | -0.029         | -0.025         | 0.003          | -0.006         | -0.019         | -0.045         | -0.034         | -0.027         | -0.003         | -0.004         | -0.000         | -0.002         | -0.004         | -0.008 |
| sd   | 300 | 5   | trad.  | 0.055       | 0.078         | 0.205         | 0.194         | 0.207         | 0.198         | 0.067          | 0.049          | 0.058          | 0.060          | 0.062          | 0.064          | 0.049          | 0.051          | 0.051          | 0.170          | 0.139          | 0.102          | 0.083          | 0.057          | 0.060          | 0.079          | 0.076          | 0.068          | 0.069          | 0.044          | 0.045  |
| mean | 300 | 5   | rob.   | 0.006       | -0.009        | -0.019        | 0.018         | -0.000        | -0.025        | -0.037         | -0.001         | -0.002         | 0.001          | -0.001         | -0.004         | -0.000         | -0.005         | -0.006         | -0.008         | -0.000         | -0.035         | -0.057         | -0.034         | -0.025         | 0.001          | -0.007         | -0.003         | -0.003         | -0.006         | -0.010 |
| sd   | 300 | 5   | rob.   | 0.057       | 0.093         | 0.154         | 0.155         | 0.139         | 0.136         | 0.071          | 0.042          | 0.040          | 0.071          | 0.068          | 0.068          | 0.056          | 0.056          | 0.057          | 0.208          | 0.154          | 0.122          | 0.094          | 0.062          | 0.068          | 0.089          | 0.088          | 0.078          | 0.079          | 0.050          | 0.049  |
| mean | 300 | 10  | trad.  | 0.121       | -0.007        | -0.286        | 0.245         | 0.380         | -0.374        | -0.041         | -0.078         | -0.273         | 0.015          | -0.024         | -0.026         | -0.037         | -0.037         | -0.038         | 0.001          | -0.003         | -0.021         | -0.042         | -0.030         | -0.028         | -0.003         | -0.007         | -0.003         | -0.005         | -0.006         | -0.006 |
| sd   | 300 | 10  | trad.  | 0.061       | 0.084         | 0.281         | 0.268         | 0.333         | 0.324         | 0.082          | 0.060          | 0.069          | 0.070          | 0.062          | 0.061          | 0.050          | 0.052          | 0.052          | 0.170          | 0.132          | 0.103          | 0.085          | 0.056          | 0.061          | 0.084          | 0.082          | 0.069          | 0.071          | 0.045          | 0.044  |
| mean | 300 | 10  | rob.   | 0.012       | -0.012        | 0.027         | 0.027         | -0.028        | -0.039        | -0.004         | -0.004         | -0.004         | 0.017          | -0.002         | -0.004         | -0.007         | -0.002         | -0.006         | -0.009         | -0.011         | -0.032         | -0.056         | -0.032         | -0.029         | -0.004         | -0.007         | -0.002         | -0.002         | -0.010         | -0.008 |
| sd   | 300 | 10  | rob.   | 0.058       | 0.094         | 0.161         | 0.163         | 0.149         | 0.146         | 0.074          | 0.043          | 0.042          | 0.073          | 0.072          | 0.073          | 0.061          | 0.060          | 0.063          | 0.198          | 0.163          | 0.124          | 0.100          | 0.063          | 0.067          | 0.095          | 0.094          | 0.080          | 0.082          | 0.051          | 0.052  |
| mean | 300 | 20  | trad.  | 0.142       | -0.015        | -0.384        | 0.344         | 0.522         | -0.519        | -0.052         | -0.092         | -0.412         | -0.032         | -0.022         | -0.025         | -0.036         | -0.038         | -0.036         | 0.002          | -0.008         | -0.023         | -0.044         | -0.028         | -0.027         | 0.001          | 0.001          | -0.001         | -0.006         | -0.009         | -0.009 |
| sd   | 300 | 20  | trad.  | 0.071       | 0.080         | 0.361         | 0.345         | 0.420         | 0.408         | 0.093          | 0.073          | 0.082          | 0.085          | 0.062          | 0.061          | 0.052          | 0.052          | 0.053          | 0.177          | 0.141          | 0.109          | 0.084          | 0.056          | 0.061          | 0.080          | 0.079          | 0.071          | 0.072          | 0.044          | 0.044  |
| mean | 300 | 20  | rob.   | 0.043       | -0.008        | 0.070         | 0.080         | -0.096        | -0.088        | -0.013         | 0.060          | 0.069          | 0.070          | -0.004         | -0.007         | -0.010         | -0.016         | -0.013         | -0.001         | -0.002         | -0.034         | -0.063         | -0.029         | -0.029         | 0.001          | -0.005         | 0.001          | -0.002         | -0.009         | -0.012 |
| sd   | 300 | 20  | rob.   | 0.062       | 0.094         | 0.194         | 0.188         | 0.216         | 0.212         | 0.083          | 0.049          | 0.065          | 0.074          | 0.072          | 0.073          | 0.061          | 0.060          | 0.063          | 0.198          | 0.163          | 0.124          | 0.100          | 0.063          | 0.067          | 0.095          | 0.094          | 0.080          | 0.082          | 0.051          | 0.052  |
| mean | 300 | 40  | trad.  | 0.117       | -0.010        | -0.280        | 0.237         | 0.417         | -0.424        | -0.044         | -0.077         | -0.588         | -0.139         | -0.015         | -0.015         | -0.023         | -0.024         | -0.025         | -0.003         | 0.001          | -0.022         | -0.044         | -0.029         | -0.027         | -0.005         | -0.000         | -0.000         | -0.004         | -0.008         | -0.006 |
| sd   | 300 | 40  | trad.  | 0.095       | 0.085         | 0.434         | 0.413         | 0.511         | 0.496         | 0.096          | 0.092          | 0.080          | 0.090          | 0.064          | 0.062          | 0.053          | 0.051          | 0.052          | 0.164          | 0.135          | 0.103          | 0.081          | 0.055          | 0.059          | 0.079          | 0.078          | 0.071          | 0.070          | 0.043          | 0.043  |
| mean | 300 | 40  | rob.   | 0.107       | -0.017        | -0.209        | 0.188         | -0.386        | -0.396        | -0.069         | -0.069         | -0.580         | -0.136         | -0.014         | -0.016         | -0.028         | -0.025         | -0.022         | -0.001         | -0.013         | -0.028         | -0.056         | -0.030         | -0.027         | 0.001          | 0.000          | -0.010         | -0.010         | -0.043         | -0.043 |
| sd   | 300 | 40  | rob.   | 0.100       | 0.098         | 0.398         | 0.376         | 0.500         | 0.483         | 0.110          | 0.074          | 0.097          | 0.109          | 0.070          | 0.071          | 0.059          | 0.059          | 0.060          | 0.199          | 0.153          | 0.116          | 0.094          | 0.063          | 0.067          | 0.090          | 0.086          | 0.081          | 0.081          | 0.049          | 0.050  |
| mean | 300 | 50  | trad.  | 0.109       | -0.012        | -0.191        | 0.173         | 0.388         | -0.397        | -0.039         | -0.074         | -0.643         | -0.177         | -0.013         | -0.010         | -0.020         | -0.023         | -0.023         | 0.003          | -0.002         | -0.021         | -0.043         | -0.030         | -0.025         | -0.002         | -0.004         | -0.004         | -0.001         | -0.007         | -0.007 |
| sd   | 300 | 50  | trad.  | 0.101       | 0.086         | 0.416         | 0.398         | 0.518         | 0.506         | 0.094          | 0.100          | 0.088          | 0.101          | 0.065          | 0.063          | 0.054          | 0.055          | 0.053          | 0.168          | 0.132          | 0.098          | 0.080          | 0.056          | 0.059          | 0.083          | 0.080          | 0.067          | 0.068          | 0.043          | 0.043  |
| mean | 300 | 50  | rob.   | 0.092       | -0.014        | -0.167        | 0.151         | 0.341         | -0.350        | -0.038         | -0.059         | -0.643         | -0.184         | -0.014         | -0.016         | -0.015         | -0.018         | -0.018         | 0.004          | -0.006         | -0.031         | -0.051         | -0.028         | -0.027         | -0.001         | -0.003         | -0.004         | -0.002         | -0.011         | -0.010 |
| sd   | 300 | 50  | rob.   | 0.108       | 0.097         | 0.360         | 0.337         | 0.516         | 0.501         | 0.109          | 0.105          | 0.099          | 0.109          | 0.071          | 0.074          | 0.058          | 0.061          | 0.060          | 0.191          | 0.153          | 0.110          | 0.094          | 0.065          | 0.068          | 0.094          | 0.092          | 0.076          | 0.075          | 0.049          | 0.049  |

Table 15 Results for the model with five composites and systematic outlier in all indicators

| n    | out | estim. | $\rho_{12}$ | $\gamma_{32}$ | $\gamma_{41}$ | $\gamma_{42}$ | $\gamma_{51}$ | $\gamma_{52}$ | $\gamma_{53}$ | $w_{11}$ | $w_{12}$ | $w_{21}$ | $w_{22}$ | $w_{23}$ | $w_{24}$ | $w_{25}$ | $w_{26}$ | $w_{31}$ | $w_{32}$ | $w_{33}$ | $w_{34}$ | $w_{41}$ | $w_{42}$ | $w_{51}$ | $w_{52}$ | $w_{53}$ | $w_{54}$ | $w_{55}$ | $w_{56}$ |
|------|-----|--------|-------------|---------------|---------------|---------------|---------------|---------------|---------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| mean | 100 | 0      | trad.       | 0.007         | -0.072        | 0.024         | -0.061        | -0.000        | -0.005        | -0.002   | -0.005   | -0.003   | -0.001   | -0.004   | -0.009   | -0.051   | -0.075   | -0.097   | -0.077   | -0.004   | -0.003   | -0.020   | -0.025   | -0.012   | -0.029   | -0.003   | -0.006   |          |          |
| sd   |     |        |             | 0.087         | 0.111         | 0.105         | 0.110         | 0.114         | 0.116         | 0.071    | 0.076    | 0.076    | 0.078    | 0.078    | 0.076    | 0.346    | 0.430    | 0.525    | 0.597    | 0.093    | 0.111    | 0.172    | 0.167    | 0.179    | 0.161    | 0.172    | -0.006   |          |          |
| mean | 100 | 0      | rob.        | 0.013         | -0.123        | 0.051         | -0.073        | -0.006        | -0.013        | -0.001   | -0.010   | -0.006   | -0.005   | -0.011   | -0.097   | -0.058   | -0.164   | -0.243   | -0.062   | -0.014   | 0.001    | -0.026   | -0.060   | -0.046   | -0.053   | -0.013   | -0.015   |          |          |
| sd   |     |        |             | 0.159         | 0.137         | 0.178         | 0.186         | 0.155         | 0.165         | 0.116    | 0.120    | 0.118    | 0.127    | 0.126    | 0.124    | 0.437    | 0.569    | 0.695    | 0.782    | 0.135    | 0.157    | 0.271    | 0.254    | 0.261    | 0.251    | 0.269    | -0.058   |          |          |
| mean | 100 | 5      | trad.       | 0.182         | 0.324         | -0.493        | 0.170         | -0.316        | -0.035        | -0.075   | -0.094   | -0.088   | -0.064   | -0.040   | -0.112   | 0.421    | 0.342    | 0.345    | -0.490   | -0.331   | -0.037   | -0.046   | -0.091   | -0.093   | -0.098   | -0.044   | -0.036   |          |          |
| sd   |     |        |             | 0.018         | 0.391         | 0.205         | 0.199         | 0.243         | 0.074         | 0.077    | 0.076    | 0.075    | 0.084    | 0.086    | 0.079    | 0.681    | 0.242    | 0.345    | 0.376    | 0.213    | 0.255    | 0.337    | 0.318    | 0.332    | 0.301    | 0.314    | -0.039   |          |          |
| mean | 100 | 5      | rob.        | 0.008         | -0.116        | 0.001         | -0.120        | 0.050         | -0.084        | -0.002   | -0.010   | -0.005   | -0.007   | -0.005   | -0.112   | -0.067   | -0.119   | -0.205   | -0.121   | -0.010   | -0.006   | -0.037   | -0.049   | -0.045   | -0.033   | -0.021   | -0.021   |          |          |
| sd   |     |        |             | 0.074         | 0.230         | 0.155         | 0.133         | 0.173         | 0.172         | 0.118    | 0.118    | 0.118    | 0.118    | 0.118    | 0.123    | 0.449    | 0.543    | 0.686    | 0.782    | 0.142    | 0.169    | 0.272    | 0.251    | 0.251    | 0.243    | 0.260    | 0.264    |          |          |
| mean | 100 | 10     | trad.       | 0.219         | 0.592         | -0.603        | 0.186         | 0.136         | 0.025         | -0.385   | -0.039   | -0.039   | -0.386   | -0.039   | -0.042   | 0.103    | 0.684    | -0.285   | -0.376   | -0.068   | -0.024   | -0.099   | -0.185   | -0.145   | -0.120   | -0.071   | -0.047   |          |          |
| sd   |     |        |             | 0.012         | 0.297         | 0.265         | 0.270         | 0.309         | 0.067         | 0.086    | 0.080    | 0.075    | 0.078    | 0.085    | 0.083    | 0.083    | 0.083    | 0.172    | 0.228    | 0.245    | 0.297    | 0.344    | 0.404    | 0.383    | 0.367    | 0.398    | -0.030   |          |          |
| mean | 100 | 10     | rob.        | 0.009         | -0.104        | 0.006         | -0.104        | 0.006         | -0.005        | -0.121   | 0.062    | -0.077   | -0.007   | -0.009   | -0.003   | -0.097   | -0.067   | -0.117   | -0.205   | -0.114   | -0.011   | -0.002   | -0.021   | -0.058   | -0.048   | -0.023   | -0.016   |          |          |
| sd   |     |        |             | 0.071         | 0.253         | 0.147         | 0.133         | 0.177         | 0.180         | 0.155    | 0.115    | 0.119    | 0.123    | 0.129    | 0.122    | 0.444    | 0.547    | 0.672    | 0.772    | 0.135    | 0.163    | 0.262    | 0.248    | 0.257    | 0.248    | 0.254    | 0.255    |          |          |
| mean | 100 | 20     | trad.       | 0.242         | 0.753         | -0.615        | 0.121         | 0.055         | 0.154         | -0.432   | -0.033   | -0.033   | -0.432   | -0.033   | -0.044   | 0.103    | 0.684    | -0.285   | -0.376   | -0.068   | -0.024   | -0.099   | -0.185   | -0.145   | -0.120   | -0.071   | -0.047   |          |          |
| sd   |     |        |             | 0.009         | 0.196         | 0.343         | 0.356         | 0.363         | 0.363         | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    | 0.363    |          |          |
| mean | 100 | 20     | rob.        | 0.015         | -0.100        | -0.021        | 0.024         | -0.011        | 0.048         | -0.079   | -0.013   | -0.060   | -0.088   | -0.087   | -0.100   | -0.059   | -0.111   | -0.225   | -0.092   | -0.049   | -0.006   | -0.016   | -0.068   | -0.058   | -0.042   | -0.021   | -0.003   |          |          |
| sd   |     |        |             | 0.075         | 0.248         | 0.167         | 0.137         | 0.175         | 0.182         | 0.158    | 0.110    | 0.111    | 0.122    | 0.117    | 0.114    | 0.454    | 0.514    | 0.677    | 0.775    | 0.135    | 0.163    | 0.268    | 0.245    | 0.232    | 0.244    | 0.252    | 0.253    |          |          |
| mean | 100 | 40     | trad.       | 0.250         | 0.841         | -0.406        | -0.283        | -0.098        | -0.156        | -0.088   | -0.177   | -0.177   | -0.182   | -0.122   | -0.066   | 0.782    | 0.293    | -0.540   | -0.343   | -0.217   | -0.077   | -0.098   | -0.279   | -0.252   | -0.196   | -0.138   | -0.071   |          |          |
| sd   |     |        |             | 0.007         | 0.122         | 0.378         | 0.401         | 0.365         | 0.401         | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    | 0.365    |          |          |
| mean | 100 | 40     | rob.        | 0.253         | 0.804         | -0.437        | -0.117        | -0.045        | -0.117        | -0.045   | -0.117   | -0.045   | -0.117   | -0.045   | -0.117   | 0.719    | -0.296   | -0.529   | -0.337   | -0.286   | -0.076   | -0.119   | -0.281   | -0.237   | -0.219   | -0.100   | -0.046   |          |          |
| sd   |     |        |             | 0.011         | 0.314         | 0.575         | 0.618         | 0.545         | 0.701         | 0.373    | 0.108    | 0.144    | 0.143    | 0.142    | 0.151    | 0.139    | 0.149    | 0.185    | 0.199    | 0.587    | 0.596    | 0.465    | 0.472    | 0.474    | 0.464    | 0.472    | 0.479    |          |          |
| mean | 100 | 50     | trad.       | 0.248         | 0.857         | -0.300        | -0.283        | -0.098        | -0.156        | -0.088   | -0.177   | -0.177   | -0.182   | -0.122   | -0.066   | 0.782    | 0.293    | -0.540   | -0.343   | -0.217   | -0.077   | -0.098   | -0.279   | -0.252   | -0.196   | -0.138   | -0.071   |          |          |
| sd   |     |        |             | 0.008         | 0.058         | 0.348         | 0.371         | 0.331         | 0.444         | 0.248    | 0.064    | 0.088    | 0.090    | 0.084    | 0.093    | 0.113    | 0.126    | 0.157    | 0.174    | 0.408    | 0.436    | 0.435    | 0.408    | 0.421    | 0.421    | 0.417    | 0.409    |          |          |
| mean | 100 | 50     | rob.        | 0.250         | 0.845         | -0.358        | -0.117        | -0.045        | -0.117        | -0.045   | -0.117   | -0.045   | -0.117   | -0.045   | -0.117   | 0.719    | -0.296   | -0.529   | -0.337   | -0.286   | -0.076   | -0.119   | -0.281   | -0.237   | -0.219   | -0.100   | -0.046   |          |          |
| sd   |     |        |             | 0.012         | 0.221         | 0.526         | 0.576         | 0.520         | 0.685         | 0.397    | 0.117    | 0.146    | 0.148    | 0.148    | 0.149    | 0.152    | 0.152    | 0.228    | 0.141    | 0.177    | 0.194    | 0.575    | 0.588    | 0.492    | 0.467    | 0.445    | 0.471    |          |          |
| mean | 300 | 0      | trad.       | 0.023         | -0.001        | 0.004         | -0.032        | 0.000         | -0.001        | -0.003   | -0.001   | -0.003   | -0.001   | -0.002   | -0.002   | 0.100    | -0.016   | -0.014   | -0.023   | -0.026   | -0.001   | -0.003   | -0.005   | -0.006   | -0.005   | -0.007   | -0.005   |          |          |
| sd   |     |        |             | 0.029         | 0.066         | 0.059         | 0.051         | 0.066         | 0.065         | 0.042    | 0.040    | 0.042    | 0.043    | 0.044    | 0.040    | 0.195    | 0.240    | 0.279    | 0.336    | 0.053    | 0.065    | 0.098    | 0.089    | 0.091    | 0.090    | 0.092    | 0.094    |          |          |
| mean | 300 | 0      | rob.        | 0.004         | -0.031        | -0.001        | 0.006         | -0.037        | 0.004         | -0.051   | 0.001    | -0.001   | -0.002   | -0.003   | -0.001   | -0.099   | -0.015   | -0.017   | -0.038   | -0.032   | -0.003   | -0.000   | -0.007   | -0.010   | -0.007   | -0.010   | -0.005   |          |          |
| sd   |     |        |             | 0.034         | 0.080         | 0.066         | 0.058         | 0.074         | 0.075         | 0.048    | 0.046    | 0.046    | 0.046    | 0.046    | 0.049    | 0.050    | 0.045    | 0.225    | 0.279    | 0.330    | 0.389    | 0.061    | 0.075    | 0.110    | 0.102    | 0.108    | 0.108    |          |          |
| mean | 300 | 5      | trad.       | 0.181         | 0.459         | -0.519        | 0.187         | 0.287         | -0.198        | -0.315   | -0.036   | -0.086   | -0.086   | -0.086   | -0.101   | 0.796    | -0.273   | -0.560   | -0.368   | -0.068   | -0.008   | -0.014   | -0.028   | -0.037   | -0.022   | -0.016   | -0.013   |          |          |
| sd   |     |        |             | 0.010         | 0.168         | 0.112         | 0.107         | 0.124         | 0.121         | 0.124    | 0.041    | 0.041    | 0.039    | 0.039    | 0.041    | 0.442    | 0.045    | 0.142    | 0.187    | 0.186    | 0.133    | 0.198    | 0.183    | 0.193    | 0.188    | 0.191    | 0.194    |          |          |
| mean | 300 | 5      | rob.        | 0.002         | -0.031        | -0.002        | 0.006         | -0.045        | 0.012         | -0.051   | -0.002   | -0.002   | -0.002   | -0.002   | -0.001   | -0.102   | -0.017   | -0.035   | -0.038   | -0.019   | -0.002   | -0.003   | -0.001   | -0.010   | -0.010   | -0.004   | -0.004   |          |          |
| sd   |     |        |             | 0.033         | 0.077         | 0.069         | 0.059         | 0.073         | 0.065         | 0.073    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    | 0.065    |          |          |
| mean | 300 | 10     | trad.       | 0.219         | 0.644         | -0.673        | 0.246         | 0.322         | -0.214        | -0.322   | -0.036   | -0.036   | -0.036   | -0.036   | -0.036   | 0.796    | -0.273   | -0.560   | -0.368   | -0.068   | -0.008   | -0.014   | -0.028   | -0.037   | -0.022   | -0.016   | -0.013   |          |          |
| sd   |     |        |             | 0.007         | 0.049         | 0.143         | 0.140         | 0.185         | 0.140         | 0.185    | 0.040    | 0.040    | 0.040    | 0.040    | 0.040    | 0.195    | 0.240    | 0.279    | 0.336    | 0.053    | 0.065    | 0.098    | 0.089    | 0.091    | 0.090    | 0.092    | 0.094    |          |          |
| mean | 300 | 10     | rob.        | 0.002         | -0.030        | -0.004        | 0.006         | -0.045        | 0.014         | -0.049   | -0.001   | -0.001   | -0.001   | -0.001   | -0.001   | -0.097   | -0.017   | -0.024   | -0.033   | -0.032   | -0.001   | -0.004   | -0.005   | -0.006   | -0.007   | -0.008   | -0.006   |          |          |
| sd   |     |        |             | 0.035         | 0.078         | 0.067         | 0.059         | 0.074         | 0.068         | 0.074    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    |          |          |
| mean | 300 | 20     | trad.       | 0.243         | 0.768         | -0.700        | 0.195         | 0.210         | -0.049        | -0.151   | -0.430   | -0.035   | -0.151   | -0.149   | -0.107   | 0.796    | -0.273   | -0.560   | -0.368   | -0.068   | -0.008   | -0.014   | -0.028   | -0.037   | -0.022   | -0.016   | -0.013   |          |          |
| sd   |     |        |             | 0.005         | 0.019         | 0.183         | 0.184         | 0.253         | 0.345         | 0.144    | 0.032    | 0.032    | 0.032    | 0.032    | 0.032    | 0.195    | 0.240    | 0.279    | 0.336    | 0.053    | 0.065    | 0.098    | 0.089    | 0.091    | 0.090    | 0.092    | 0.094    |          |          |
| mean | 300 | 20     | rob.        | 0.003         | -0.029        | -0.001        | 0.003         | -0.042        | 0.011         | -0.048   | -0.002   | -0.001   | -0.001   | -0.001   | -0.001   | -0.099   | -0.015   | -0.012   | -0.046   | -0.039   | -0.001   | -0.004   | -0.005   | -0.006   | -0.007   | -0.008   | -0.006   |          |          |
| sd   |     |        |             | 0.036         | 0.082         | 0.072         | 0.062         | 0.076         | 0.066         | 0.076    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    | 0.077    |          |          |
| mean | 300 | 40     | trad.       | 0.250         | 0.841         | -0.474        | -0.094        | -0.009        | -0.179        | -0.174   | -0.048   | -0.048   | -0.048   | -0.048   | -0.048   | 0.796    | -0.273   | -0.560   | -0.368   | -0.068   | -0.008   | -0.014   | -0.028   | -0.037   | -0.022   | -0.016   | -0.013   |          |          |
| sd   |     |        |             | 0.004         | 0.041         | 0.143         | 0.140         | 0.185         | 0.140         | 0.185    | 0.040    | 0.040    | 0.040    | 0.040    | 0.040    | 0.195    | 0.240    | 0.279    | 0.336    | 0.053    | 0.065    | 0.098    | 0.089    | 0.091    | 0.090    | 0.092    | 0.094    |          |          |
| mean | 300 | 40     | rob.        | 0.002         | -0.030        | -0.004        | 0.006         | -0.045        | 0.014         | -0.049   | -0.001   | -0.001   | -0.001   | -0.001   | -0.001   | -0.097   | -0.017   | -0.024   | -0.033   | -0.032   | -0.001   | -0.004   | -0.005   | -0.006   | -0.007   | -0.008   | -0.006   |          |          |
| sd   |     |        |             | 0.035         | 0.078         | 0.067         | 0.059         | 0.074         | 0.068         | 0.074    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    | 0.073    |          |          |
| mean | 300 | 50     | trad.       | 0.248         | 0.852         | -0.362        | -0.231        | -0.073        | -0.389        | -0.228   | -0.462   | -0.025   | -0.185   | -0.185   | -0.121   | 0.796    | -0.273   | -0.560   | -0.368   | -0.068   | -0.008   | -0.014   | -0.028   | -0.037   |          |          |          |          |          |

Table 16 Results for the model with five composites and systematic outliers in two indicators

|      | n   | out | estim. | $\rho_{12}$ | $\gamma_{32}$ | $\gamma_{41}$ | $\gamma_{42}$ | $\gamma_{51}$ | $\gamma_{52}$ | $\gamma_{53}$ | $w_{11}$ | $w_{12}$ | $w_{21}$ | $w_{22}$ | $w_{23}$ | $w_{24}$ | $w_{25}$ | $w_{26}$ | $w_{31}$ | $w_{32}$ | $w_{33}$ | $w_{34}$ | $w_{41}$ | $w_{42}$ | $w_{51}$ | $w_{52}$ | $w_{53}$ | $w_{54}$ | $w_{55}$ | $w_{56}$ |        |
|------|-----|-----|--------|-------------|---------------|---------------|---------------|---------------|---------------|---------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------|
| mean | 100 | 0   | trad.  | 0.006       | -0.072        | -0.007        | 0.013         | -0.074        | 0.027         | -0.058        | -0.008   | -0.004   | -0.006   | -0.005   | 0.000    | -0.003   | 0.000    | -0.103   | -0.041   | -0.075   | -0.110   | -0.066   | -0.010   | 0.001    | -0.019   | -0.015   | -0.021   | -0.016   | -0.013   | -0.007   |        |
| sd   |     |     |        | 0.050       | 0.138         | 0.102         | 0.090         | 0.112         | 0.103         | 0.106         | 0.113    | 0.116    | 0.076    | 0.074    | 0.076    | 0.078    | 0.078    | 0.080    | 0.332    | 0.446    | 0.446    | 0.528    | 0.608    | 0.101    | 0.119    | 0.162    | 0.159    | 0.163    | 0.163    | 0.170    |        |
| mean | 100 | 0   | rob.   | 0.010       | -0.108        | -0.008        | 0.020         | -0.124        | 0.058         | -0.061        | -0.017   | -0.015   | -0.004   | -0.008   | -0.009   | -0.009   | -0.009   | -0.124   | -0.038   | -0.119   | -0.204   | -0.130   | -0.018   | 0.000    | -0.036   | -0.052   | -0.046   | -0.046   | -0.022   | -0.018   |        |
| sd   |     |     |        | 0.073       | 0.236         | 0.156         | 0.134         | 0.172         | 0.180         | 0.182         | 0.164    | 0.167    | 0.118    | 0.119    | 0.118    | 0.124    | 0.127    | 0.124    | 0.431    | 0.560    | 0.685    | 0.780    | 0.146    | 0.170    | 0.267    | 0.253    | 0.254    | 0.250    | 0.261    | 0.275    |        |
| mean | 100 | 5   | trad.  | -0.030      | -0.069        | 0.089         | -0.085        | -0.150        | 0.113         | -0.049        | -0.001   | -0.009   | -0.159   | -0.094   | 0.063    | 0.057    | 0.053    | -0.053   | -0.047   | -0.058   | -0.132   | -0.050   | -0.005   | -0.002   | -0.021   | -0.029   | -0.016   | -0.008   | -0.014   | -0.010   |        |
| sd   |     |     |        | 0.056       | 0.138         | 0.101         | 0.093         | 0.113         | 0.106         | 0.107         | 0.115    | 0.114    | 0.092    | 0.098    | 0.084    | 0.090    | 0.092    | 0.092    | 0.365    | 0.426    | 0.499    | 0.570    | 0.099    | 0.117    | 0.176    | 0.168    | 0.172    | 0.179    | 0.172    | 0.179    |        |
| mean | 100 | 5   | rob.   | 0.012       | -0.108        | 0.005         | 0.010         | -0.126        | 0.056         | -0.074        | -0.007   | -0.013   | -0.016   | -0.007   | 0.002    | -0.007   | -0.007   | -0.103   | -0.075   | -0.091   | -0.219   | -0.114   | -0.017   | 0.003    | -0.040   | -0.063   | -0.030   | -0.038   | -0.028   | -0.014   |        |
| sd   |     |     |        | 0.072       | 0.231         | 0.156         | 0.140         | 0.176         | 0.172         | 0.198         | 0.162    | 0.159    | 0.117    | 0.119    | 0.117    | 0.123    | 0.119    | 0.125    | 0.455    | 0.557    | 0.645    | 0.739    | 0.137    | 0.157    | 0.273    | 0.248    | 0.260    | 0.247    | 0.268    | 0.253    |        |
| mean | 100 | 10  | trad.  | -0.042      | -0.077        | 0.113         | -0.112        | -0.179        | 0.141         | -0.056        | -0.012   | -0.009   | -0.210   | -0.128   | 0.078    | 0.078    | 0.070    | -0.034   | -0.036   | -0.060   | -0.115   | -0.076   | -0.006   | -0.004   | -0.008   | -0.022   | -0.032   | -0.012   | -0.016   | -0.009   |        |
| sd   |     |     |        | 0.059       | 0.141         | 0.096         | 0.085         | 0.110         | 0.105         | 0.111         | 0.117    | 0.113    | 0.088    | 0.093    | 0.353    | 0.434    | 0.093    | 0.353    | 0.434    | 0.434    | 0.514    | 0.618    | 0.101    | 0.119    | 0.185    | 0.174    | 0.169    | 0.173    | 0.174    | 0.191    |        |
| mean | 100 | 10  | rob.   | 0.004       | -0.122        | 0.009         | 0.004         | -0.140        | 0.073         | -0.081        | -0.018   | -0.013   | -0.029   | -0.014   | -0.001   | 0.005    | -0.008   | -0.098   | -0.065   | -0.089   | -0.216   | -0.129   | -0.015   | -0.001   | -0.021   | -0.045   | -0.054   | -0.029   | -0.022   | -0.018   |        |
| sd   |     |     |        | 0.074       | 0.232         | 0.147         | 0.132         | 0.173         | 0.170         | 0.191         | 0.159    | 0.156    | 0.134    | 0.119    | 0.115    | 0.123    | 0.123    | 0.128    | 0.445    | 0.546    | 0.663    | 0.767    | 0.134    | 0.159    | 0.271    | 0.239    | 0.248    | 0.236    | 0.260    | 0.254    |        |
| mean | 100 | 20  | trad.  | -0.046      | -0.068        | 0.121         | -0.123        | -0.186        | 0.152         | -0.050        | -0.005   | -0.005   | -0.266   | -0.150   | 0.088    | 0.103    | 0.081    | -0.029   | -0.030   | -0.055   | -0.128   | -0.081   | -0.006   | -0.003   | -0.023   | -0.028   | -0.028   | -0.015   | -0.008   | -0.008   |        |
| sd   |     |     |        | 0.058       | 0.142         | 0.100         | 0.093         | 0.116         | 0.105         | 0.114         | 0.116    | 0.117    | 0.088    | 0.094    | 0.349    | 0.426    | 0.099    | 0.098    | 0.349    | 0.426    | 0.540    | 0.620    | 0.101    | 0.121    | 0.187    | 0.178    | 0.178    | 0.181    | 0.187    | 0.187    |        |
| mean | 100 | 20  | rob.   | -0.017      | -0.105        | 0.067         | -0.055        | -0.173        | 0.118         | -0.068        | -0.012   | -0.022   | -0.176   | -0.131   | 0.044    | 0.059    | 0.040    | -0.063   | -0.062   | -0.072   | -0.225   | -0.134   | -0.011   | -0.010   | -0.042   | -0.068   | -0.061   | -0.029   | -0.010   | -0.022   |        |
| sd   |     |     |        | 0.080       | 0.240         | 0.155         | 0.142         | 0.184         | 0.189         | 0.197         | 0.161    | 0.167    | 0.210    | 0.189    | 0.134    | 0.148    | 0.146    | 0.147    | 0.444    | 0.539    | 0.676    | 0.754    | 0.149    | 0.170    | 0.274    | 0.257    | 0.259    | 0.268    | 0.273    | 0.266    |        |
| mean | 100 | 40  | trad.  | -0.059      | -0.074        | 0.145         | -0.148        | -0.201        | 0.165         | -0.054        | -0.004   | -0.004   | -0.282   | -0.163   | 0.096    | 0.102    | 0.100    | -0.013   | -0.036   | -0.076   | -0.130   | -0.045   | -0.006   | -0.007   | -0.019   | -0.024   | -0.016   | -0.021   | -0.018   | -0.009   |        |
| sd   |     |     |        | 0.060       | 0.144         | 0.103         | 0.094         | 0.109         | 0.105         | 0.108         | 0.120    | 0.117    | 0.160    | 0.163    | 0.090    | 0.089    | 0.103    | 0.100    | 0.344    | 0.442    | 0.527    | 0.612    | 0.102    | 0.124    | 0.190    | 0.173    | 0.180    | 0.173    | 0.181    | 0.183    |        |
| mean | 100 | 40  | rob.   | -0.050      | -0.114        | 0.141         | -0.138        | -0.238        | 0.174         | -0.062        | -0.012   | -0.024   | -0.289   | -0.199   | 0.089    | 0.087    | 0.094    | -0.019   | -0.056   | -0.105   | -0.243   | -0.107   | -0.009   | -0.010   | -0.035   | -0.070   | -0.053   | -0.054   | -0.030   | -0.005   |        |
| sd   |     |     |        | 0.087       | 0.244         | 0.153         | 0.138         | 0.174         | 0.179         | 0.198         | 0.172    | 0.173    | 0.265    | 0.263    | 0.142    | 0.156    | 0.157    | 0.166    | 0.455    | 0.556    | 0.675    | 0.779    | 0.151    | 0.179    | 0.289    | 0.268    | 0.271    | 0.267    | 0.280    | 0.278    |        |
| mean | 100 | 50  | trad.  | -0.058      | -0.078        | 0.143         | -0.147        | -0.217        | 0.182         | -0.047        | -0.005   | -0.011   | -0.257   | -0.247   | 0.098    | 0.110    | 0.098    | -0.011   | -0.020   | -0.048   | -0.104   | -0.091   | -0.004   | 0.001    | -0.001   | -0.007   | -0.008   | -0.003   | -0.006   | -0.001   |        |
| sd   |     |     |        | 0.060       | 0.137         | 0.101         | 0.092         | 0.108         | 0.107         | 0.105         | 0.116    | 0.118    | 0.163    | 0.163    | 0.095    | 0.100    | 0.102    | 0.100    | 0.335    | 0.423    | 0.527    | 0.620    | 0.101    | 0.123    | 0.187    | 0.172    | 0.179    | 0.171    | 0.177    | 0.188    |        |
| mean | 100 | 50  | rob.   | -0.049      | -0.137        | 0.133         | -0.133        | -0.244        | 0.188         | -0.060        | -0.009   | -0.012   | -0.267   | -0.249   | 0.090    | 0.102    | 0.088    | -0.013   | -0.072   | -0.137   | -0.231   | -0.085   | -0.011   | -0.006   | -0.048   | -0.060   | -0.057   | -0.033   | -0.030   | -0.013   |        |
| sd   |     |     |        | 0.088       | 0.230         | 0.152         | 0.138         | 0.174         | 0.179         | 0.208         | 0.169    | 0.169    | 0.256    | 0.271    | 0.144    | 0.155    | 0.158    | 0.162    | 0.446    | 0.549    | 0.669    | 0.769    | 0.146    | 0.177    | 0.291    | 0.268    | 0.273    | 0.258    | 0.274    | 0.282    |        |
| mean | 300 | 0   | trad.  | 0.002       | -0.023        | -0.000        | 0.003         | -0.037        | 0.010         | -0.048        | 0.001    | -0.003   | 0.000    | -0.001   | 0.000    | 0.000    | -0.001   | -0.100   | -0.007   | -0.008   | -0.018   | -0.038   | -0.004   | 0.001    | -0.001   | -0.007   | -0.008   | -0.003   | -0.006   | -0.001   |        |
| sd   |     |     |        | 0.030       | 0.064         | 0.059         | 0.050         | 0.063         | 0.057         | 0.047         | 0.065    | 0.062    | 0.040    | 0.040    | 0.040    | 0.042    | 0.041    | 0.043    | 0.189    | 0.246    | 0.280    | 0.329    | 0.053    | 0.063    | 0.097    | 0.086    | 0.093    | 0.087    | 0.096    | 0.096    |        |
| mean | 300 | 0   | rob.   | 0.002       | -0.029        | -0.000        | 0.004         | -0.042        | 0.013         | -0.048        | 0.000    | -0.003   | 0.001    | -0.002   | -0.000   | 0.000    | -0.001   | -0.100   | -0.013   | -0.011   | -0.029   | -0.045   | -0.004   | 0.000    | -0.003   | -0.008   | -0.011   | -0.001   | -0.007   | -0.002   |        |
| sd   |     |     |        | 0.034       | 0.075         | 0.067         | 0.057         | 0.073         | 0.066         | 0.055         | 0.076    | 0.072    | 0.051    | 0.048    | 0.047    | 0.048    | 0.048    | 0.050    | 0.216    | 0.284    | 0.344    | 0.404    | 0.062    | 0.074    | 0.112    | 0.099    | 0.108    | 0.099    | 0.109    | 0.108    |        |
| mean | 300 | 5   | trad.  | -0.035      | -0.020        | 0.090         | -0.097        | -0.125        | 0.105         | -0.048        | -0.002   | 0.003    | -0.152   | -0.092   | 0.062    | 0.064    | 0.058    | -0.052   | -0.018   | -0.022   | -0.034   | -0.005   | -0.011   | 0.001    | -0.011   | -0.003   | -0.007   | -0.008   | -0.004   | -0.001   | -0.001 |
| sd   |     |     |        | 0.032       | 0.064         | 0.060         | 0.054         | 0.063         | 0.057         | 0.047         | 0.066    | 0.064    | 0.053    | 0.055    | 0.045    | 0.047    | 0.047    | 0.049    | 0.193    | 0.245    | 0.285    | 0.343    | 0.056    | 0.066    | 0.100    | 0.096    | 0.096    | 0.091    | 0.095    | 0.095    |        |
| mean | 300 | 5   | rob.   | 0.035       | -0.028        | 0.050         | -0.006        | -0.052        | 0.018         | -0.048        | -0.001   | -0.001   | -0.022   | -0.011   | 0.004    | 0.006    | 0.004    | -0.096   | -0.026   | -0.034   | -0.047   | -0.003   | -0.003   | -0.001   | -0.007   | -0.008   | -0.008   | -0.010   | -0.004   | 0.001    | 0.001  |
| sd   |     |     |        | 0.035       | 0.081         | 0.066         | 0.058         | 0.076         | 0.070         | 0.056         | 0.075    | 0.072    | 0.054    | 0.049    | 0.049    | 0.048    | 0.050    | 0.050    | 0.226    | 0.265    | 0.333    | 0.391    | 0.063    | 0.075    | 0.114    | 0.106    | 0.104    | 0.102    | 0.111    | 0.109    |        |
| mean | 300 | 20  | trad.  | -0.058      | -0.019        | 0.135         | -0.145        | -0.168        | 0.151         | -0.044        | -0.001   | -0.002   | -0.264   | -0.151   | 0.098    | 0.069    | 0.089    | -0.019   | -0.014   | -0.031   | -0.019   | -0.013   | -0.006   | 0.002    | -0.006   | -0.010   | -0.005   | -0.003   | -0.006   | 0.002    | 0.002  |
| sd   |     |     |        | 0.035       | 0.065         | 0.058         | 0.053         | 0.063         | 0.056         | 0.048         | 0.067    | 0.065    | 0.073    | 0.072    | 0.048    | 0.053    | 0.055    | 0.056    | 0.190    | 0.235    | 0.274    | 0.324    | 0.058    | 0.068    | 0.097    | 0.091    | 0.094    | 0.090    | 0.100    | 0.100    |        |
| mean | 300 | 20  | rob.   | -0.009      | -0.030        | 0.031         | -0.029        | -0.075        | 0.043         | -0.047        | -0.003   | -0.001   | -0.062   | -0.030   | 0.019    | 0.016    | 0.016    | -0.083   | -0.014   | -0.042   | -0.032   | -0.022   | -0.004   | -0.001   | -0.006   | -0.014   | -0.006   | -0.003   | -0.011   | 0.000    | 0.000  |
| sd   |     |     |        | 0.040       | 0.080         | 0.077         | 0.070         | 0.081         | 0.074         | 0.057         | 0.076    | 0.074    | 0.081    | 0.065    | 0.057    | 0.059    | 0.060    | 0.056    | 0.229    | 0.279    | 0.340    | 0.387    | 0.064    | 0.075    | 0.111    | 0.106    | 0.110    | 0.101    | 0.115    | 0.112    |        |
| mean | 300 | 40  | trad.  | -0.064      | -0.017        | 0.148         | -0.158        | -0.181        | 0.166         | -0.044        | -0.000   | -0.004   | -0.271   | -0.212   | 0.104    | 0.116    | 0.100    | -0.015   | -0.022   | -0.013   | -0.028   | -0.015   | -0.002   | -0.001   | -0.003   | -0.010   | -0.007   | -0.004   | -0.002   | -0.004   | -0.004 |
| sd   |     |     |        | 0.034       | 0.065         | 0.058         | 0.053         | 0.062         | 0.059         | 0.049         | 0.067    | 0.067    | 0.079    | 0.081    | 0.051    | 0.054    | 0.056    | 0.053    | 0.190    | 0.230    | 0.282    | 0.337    | 0.056    | 0.069    | 0.101    | 0.094    | 0.096    | 0.096    | 0.099    | 0.099    |        |
| mean | 300 | 40  | rob.   | -0.064      | -0.024        | 0.147         | -0.157        | -0.183        | 0.165         | -0.045        | 0.002    | -0.005   | -0.273   | -0.207   | 0.103    | 0.115    | 0.100    | -0.016   | -0.025   | -0.021   | -0.027   | -0.006   | -0.002   | -0.002   | -0.003   | -0.011   | -0.011   | -0.006   | -0.002   | -0.002   | -0.002 |
| sd   |     |     |        | 0.040       | 0.078         | 0.067         | 0.062         | 0.074         | 0.068         | 0.058         | 0.077    | 0.076    | 0.095    | 0.096    | 0.058    | 0.062    | 0.065    | 0.062    | 0.227    | 0.267    | 0.319    | 0.391    | 0.065    | 0.079    | 0.118    | 0.110    | 0.109    | 0.112    | 0.116    | 0.114    |        |
| mean | 300 | 50  | trad.  | -0.066      | -             |               |               |               |               |               |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |        |

### 3 Inadmissible Solutions

Table 17 - 24 show the share of inadmissible solutions for the different simulation conditions.

#### 3.1 Unsystematic Outliers

**Table 17** Inadmissible solutions with unsystematic outliers in all indicators for three common factors/ three composites

| share Inadmissible solutions | n   | estim.           | out | modeltype        |
|------------------------------|-----|------------------|-----|------------------|
| 0.349                        | 100 | traditional PLSc | 0   | 3 Common Factors |
| 0.934                        | 100 | traditional PLSc | 5   | 3 Common Factors |
| 0.960                        | 100 | traditional PLSc | 10  | 3 Common Factors |
| 0.964                        | 100 | traditional PLSc | 20  | 3 Common Factors |
| 0.962                        | 100 | traditional PLSc | 40  | 3 Common Factors |
| 0.960                        | 100 | traditional PLSc | 50  | 3 Common Factors |
| 0.074                        | 300 | traditional PLSc | 0   | 3 Common Factors |
| 0.811                        | 300 | traditional PLSc | 5   | 3 Common Factors |
| 0.900                        | 300 | traditional PLSc | 10  | 3 Common Factors |
| 0.938                        | 300 | traditional PLSc | 20  | 3 Common Factors |
| 0.950                        | 300 | traditional PLSc | 40  | 3 Common Factors |
| 0.950                        | 300 | traditional PLSc | 50  | 3 Common Factors |
| 0.022                        | 500 | traditional PLSc | 0   | 3 Common Factors |
| 0.635                        | 500 | traditional PLSc | 5   | 3 Common Factors |
| 0.842                        | 500 | traditional PLSc | 10  | 3 Common Factors |
| 0.915                        | 500 | traditional PLSc | 20  | 3 Common Factors |
| 0.938                        | 500 | traditional PLSc | 40  | 3 Common Factors |
| 0.944                        | 500 | traditional PLSc | 50  | 3 Common Factors |
| 0.508                        | 100 | robust PLSc      | 0   | 3 Common Factors |
| 0.504                        | 100 | robust PLSc      | 5   | 3 Common Factors |
| 0.492                        | 100 | robust PLSc      | 10  | 3 Common Factors |
| 0.484                        | 100 | robust PLSc      | 20  | 3 Common Factors |
| 0.501                        | 100 | robust PLSc      | 40  | 3 Common Factors |
| 0.943                        | 100 | robust PLSc      | 50  | 3 Common Factors |
| 0.126                        | 300 | robust PLSc      | 0   | 3 Common Factors |
| 0.141                        | 300 | robust PLSc      | 5   | 3 Common Factors |
| 0.142                        | 300 | robust PLSc      | 10  | 3 Common Factors |
| 0.144                        | 300 | robust PLSc      | 20  | 3 Common Factors |
| 0.196                        | 300 | robust PLSc      | 40  | 3 Common Factors |
| 0.738                        | 300 | robust PLSc      | 50  | 3 Common Factors |
| 0.042                        | 500 | robust PLSc      | 0   | 3 Common Factors |
| 0.053                        | 500 | robust PLSc      | 5   | 3 Common Factors |
| 0.055                        | 500 | robust PLSc      | 10  | 3 Common Factors |
| 0.053                        | 500 | robust PLSc      | 20  | 3 Common Factors |
| 0.089                        | 500 | robust PLSc      | 40  | 3 Common Factors |
| 0.579                        | 500 | robust PLSc      | 50  | 3 Common Factors |
| 0.000                        | 100 | traditional PLS  | 0   | 3 Composites     |
| 0.045                        | 100 | traditional PLS  | 5   | 3 Composites     |
| 0.053                        | 100 | traditional PLS  | 10  | 3 Composites     |
| 0.045                        | 100 | traditional PLS  | 20  | 3 Composites     |
| 0.046                        | 100 | traditional PLS  | 40  | 3 Composites     |
| 0.044                        | 100 | traditional PLS  | 50  | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 0   | 3 Composites     |
| 0.042                        | 300 | traditional PLS  | 5   | 3 Composites     |
| 0.049                        | 300 | traditional PLS  | 10  | 3 Composites     |
| 0.038                        | 300 | traditional PLS  | 20  | 3 Composites     |
| 0.035                        | 300 | traditional PLS  | 40  | 3 Composites     |
| 0.037                        | 300 | traditional PLS  | 50  | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 0   | 3 Composites     |
| 0.037                        | 500 | traditional PLS  | 5   | 3 Composites     |
| 0.034                        | 500 | traditional PLS  | 10  | 3 Composites     |
| 0.032                        | 500 | traditional PLS  | 20  | 3 Composites     |
| 0.034                        | 500 | traditional PLS  | 40  | 3 Composites     |
| 0.036                        | 500 | traditional PLS  | 50  | 3 Composites     |
| 0.012                        | 100 | robust PLS       | 0   | 3 Composites     |
| 0.009                        | 100 | robust PLS       | 5   | 3 Composites     |
| 0.007                        | 100 | robust PLS       | 10  | 3 Composites     |
| 0.010                        | 100 | robust PLS       | 20  | 3 Composites     |
| 0.005                        | 100 | robust PLS       | 40  | 3 Composites     |
| 0.047                        | 100 | robust PLS       | 50  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 0   | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 5   | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 10  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 20  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 40  | 3 Composites     |
| 0.020                        | 300 | robust PLS       | 50  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 0   | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 5   | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 10  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 20  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 40  | 3 Composites     |
| 0.021                        | 500 | robust PLS       | 50  | 3 Composites     |

**Table 18** Inadmissible solutions with unsystematic outliers in all indicators for five common factors/ five composites

| share Inadmissible solutions | n   | estim.           | out | modeltype        |
|------------------------------|-----|------------------|-----|------------------|
| 0.370                        | 100 | traditional PLS  | 0   | 5 Common Factors |
| 0.907                        | 100 | traditional PLS  | 5   | 5 Common Factors |
| 0.934                        | 100 | traditional PLS  | 10  | 5 Common Factors |
| 0.942                        | 100 | traditional PLS  | 20  | 5 Common Factors |
| 0.945                        | 100 | traditional PLS  | 40  | 5 Common Factors |
| 0.945                        | 100 | traditional PLS  | 50  | 5 Common Factors |
| 0.128                        | 300 | traditional PLS  | 0   | 5 Common Factors |
| 0.679                        | 300 | traditional PLS  | 5   | 5 Common Factors |
| 0.779                        | 300 | traditional PLS  | 10  | 5 Common Factors |
| 0.842                        | 300 | traditional PLS  | 20  | 5 Common Factors |
| 0.879                        | 300 | traditional PLS  | 40  | 5 Common Factors |
| 0.885                        | 300 | traditional PLS  | 50  | 5 Common Factors |
| 0.072                        | 500 | traditional PLS  | 0   | 5 Common Factors |
| 0.534                        | 500 | traditional PLS  | 5   | 5 Common Factors |
| 0.648                        | 500 | traditional PLS  | 10  | 5 Common Factors |
| 0.758                        | 500 | traditional PLS  | 20  | 5 Common Factors |
| 0.821                        | 500 | traditional PLS  | 40  | 5 Common Factors |
| 0.836                        | 500 | traditional PLS  | 50  | 5 Common Factors |
| 0.649                        | 100 | robust PLS       | 0   | 5 Common Factors |
| 0.642                        | 100 | robust PLS       | 5   | 5 Common Factors |
| 0.644                        | 100 | robust PLS       | 10  | 5 Common Factors |
| 0.622                        | 100 | robust PLS       | 20  | 5 Common Factors |
| 0.570                        | 100 | robust PLS       | 40  | 5 Common Factors |
| 0.962                        | 100 | robust PLS       | 50  | 5 Common Factors |
| 0.174                        | 300 | robust PLS       | 0   | 5 Common Factors |
| 0.159                        | 300 | robust PLS       | 5   | 5 Common Factors |
| 0.158                        | 300 | robust PLS       | 10  | 5 Common Factors |
| 0.190                        | 300 | robust PLS       | 20  | 5 Common Factors |
| 0.224                        | 300 | robust PLS       | 40  | 5 Common Factors |
| 0.770                        | 300 | robust PLS       | 50  | 5 Common Factors |
| 0.076                        | 500 | robust PLS       | 0   | 5 Common Factors |
| 0.086                        | 500 | robust PLS       | 5   | 5 Common Factors |
| 0.085                        | 500 | robust PLS       | 10  | 5 Common Factors |
| 0.081                        | 500 | robust PLS       | 20  | 5 Common Factors |
| 0.120                        | 500 | robust PLS       | 40  | 5 Common Factors |
| 0.525                        | 500 | robust PLS       | 50  | 5 Common Factors |
| 0.004                        | 100 | traditional PLSc | 0   | 5 Composites     |
| 0.043                        | 100 | traditional PLSc | 5   | 5 Composites     |
| 0.073                        | 100 | traditional PLSc | 10  | 5 Composites     |
| 0.090                        | 100 | traditional PLSc | 20  | 5 Composites     |
| 0.121                        | 100 | traditional PLSc | 40  | 5 Composites     |
| 0.110                        | 100 | traditional PLSc | 50  | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 0   | 5 Composites     |
| 0.007                        | 300 | traditional PLSc | 5   | 5 Composites     |
| 0.011                        | 300 | traditional PLSc | 10  | 5 Composites     |
| 0.021                        | 300 | traditional PLSc | 20  | 5 Composites     |
| 0.038                        | 300 | traditional PLSc | 40  | 5 Composites     |
| 0.049                        | 300 | traditional PLSc | 50  | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 0   | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 5   | 5 Composites     |
| 0.004                        | 500 | traditional PLSc | 10  | 5 Composites     |
| 0.002                        | 500 | traditional PLSc | 20  | 5 Composites     |
| 0.015                        | 500 | traditional PLSc | 40  | 5 Composites     |
| 0.029                        | 500 | traditional PLSc | 50  | 5 Composites     |
| 0.007                        | 100 | robust PLSc      | 0   | 5 Composites     |
| 0.007                        | 100 | robust PLSc      | 5   | 5 Composites     |
| 0.010                        | 100 | robust PLSc      | 10  | 5 Composites     |
| 0.005                        | 100 | robust PLSc      | 20  | 5 Composites     |
| 0.004                        | 100 | robust PLSc      | 40  | 5 Composites     |
| 0.121                        | 100 | robust PLSc      | 50  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 0   | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 5   | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 10  | 5 Composites     |
| 0.001                        | 300 | robust PLSc      | 20  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 40  | 5 Composites     |
| 0.017                        | 300 | robust PLSc      | 50  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 0   | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 5   | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 10  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 20  | 5 Composites     |
| 0.001                        | 500 | robust PLSc      | 40  | 5 Composites     |
| 0.005                        | 500 | robust PLSc      | 50  | 5 Composites     |

**Table 19** Inadmissible solutions with unsystematic outliers in two indicators for three common factors/ three composites

| share Inadmissible solutions | n   | estim.           | out | modeltype        |
|------------------------------|-----|------------------|-----|------------------|
| 0.342                        | 100 | traditional PLSc | 0   | 3 Common Factors |
| 0.364                        | 100 | traditional PLSc | 5   | 3 Common Factors |
| 0.330                        | 100 | traditional PLSc | 10  | 3 Common Factors |
| 0.338                        | 100 | traditional PLSc | 20  | 3 Common Factors |
| 0.153                        | 100 | traditional PLSc | 40  | 3 Common Factors |
| 0.311                        | 100 | traditional PLSc | 50  | 3 Common Factors |
| 0.084                        | 300 | traditional PLSc | 0   | 3 Common Factors |
| 0.089                        | 300 | traditional PLSc | 5   | 3 Common Factors |
| 0.095                        | 300 | traditional PLSc | 10  | 3 Common Factors |
| 0.079                        | 300 | traditional PLSc | 20  | 3 Common Factors |
| 0.039                        | 300 | traditional PLSc | 40  | 3 Common Factors |
| 0.025                        | 300 | traditional PLSc | 50  | 3 Common Factors |
| 0.032                        | 500 | traditional PLSc | 0   | 3 Common Factors |
| 0.038                        | 500 | traditional PLSc | 5   | 3 Common Factors |
| 0.030                        | 500 | traditional PLSc | 10  | 3 Common Factors |
| 0.028                        | 500 | traditional PLSc | 20  | 3 Common Factors |
| 0.011                        | 500 | traditional PLSc | 40  | 3 Common Factors |
| 0.028                        | 500 | traditional PLSc | 50  | 3 Common Factors |
| 0.502                        | 100 | robust PLSc      | 0   | 3 Common Factors |
| 0.511                        | 100 | robust PLSc      | 5   | 3 Common Factors |
| 0.494                        | 100 | robust PLSc      | 10  | 3 Common Factors |
| 0.476                        | 100 | robust PLSc      | 20  | 3 Common Factors |
| 0.250                        | 100 | robust PLSc      | 40  | 3 Common Factors |
| 0.462                        | 100 | robust PLSc      | 50  | 3 Common Factors |
| 0.155                        | 300 | robust PLSc      | 0   | 3 Common Factors |
| 0.133                        | 300 | robust PLSc      | 5   | 3 Common Factors |
| 0.139                        | 300 | robust PLSc      | 10  | 3 Common Factors |
| 0.139                        | 300 | robust PLSc      | 20  | 3 Common Factors |
| 0.096                        | 300 | robust PLSc      | 40  | 3 Common Factors |
| 0.078                        | 300 | robust PLSc      | 50  | 3 Common Factors |
| 0.055                        | 500 | robust PLSc      | 0   | 3 Common Factors |
| 0.039                        | 500 | robust PLSc      | 5   | 3 Common Factors |
| 0.048                        | 500 | robust PLSc      | 10  | 3 Common Factors |
| 0.046                        | 500 | robust PLSc      | 20  | 3 Common Factors |
| 0.039                        | 500 | robust PLSc      | 40  | 3 Common Factors |
| 0.107                        | 500 | robust PLSc      | 50  | 3 Common Factors |
| 0.000                        | 100 | traditional PLS  | 0   | 3 Composites     |
| 0.020                        | 100 | traditional PLS  | 5   | 3 Composites     |
| 0.011                        | 100 | traditional PLS  | 10  | 3 Composites     |
| 0.003                        | 100 | traditional PLS  | 20  | 3 Composites     |
| 0.002                        | 100 | traditional PLS  | 40  | 3 Composites     |
| 0.005                        | 100 | traditional PLS  | 50  | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 0   | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 5   | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 10  | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 20  | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 40  | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 50  | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 0   | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 5   | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 10  | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 20  | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 40  | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 50  | 3 Composites     |
| 0.004                        | 100 | robust PLS       | 0   | 3 Composites     |
| 0.004                        | 100 | robust PLS       | 5   | 3 Composites     |
| 0.006                        | 100 | robust PLS       | 10  | 3 Composites     |
| 0.003                        | 100 | robust PLS       | 20  | 3 Composites     |
| 0.010                        | 100 | robust PLS       | 40  | 3 Composites     |
| 0.020                        | 100 | robust PLS       | 50  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 0   | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 5   | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 10  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 20  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 40  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 50  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 0   | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 5   | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 10  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 20  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 40  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 50  | 3 Composites     |

**Table 20** Inadmissible solutions with unsystematic outliers in two indicators for five common factors/ five composites

| share Inadmissible solutions | n   | estim.           | out | modeltype        |
|------------------------------|-----|------------------|-----|------------------|
| 0.366                        | 100 | traditional PLS  | 0   | 5 Common Factors |
| 0.463                        | 100 | traditional PLS  | 5   | 5 Common Factors |
| 0.530                        | 100 | traditional PLS  | 10  | 5 Common Factors |
| 0.645                        | 100 | traditional PLS  | 20  | 5 Common Factors |
| 0.746                        | 100 | traditional PLS  | 40  | 5 Common Factors |
| 0.765                        | 100 | traditional PLS  | 50  | 5 Common Factors |
| 0.144                        | 300 | traditional PLS  | 0   | 5 Common Factors |
| 0.123                        | 300 | traditional PLS  | 5   | 5 Common Factors |
| 0.182                        | 300 | traditional PLS  | 10  | 5 Common Factors |
| 0.276                        | 300 | traditional PLS  | 20  | 5 Common Factors |
| 0.498                        | 300 | traditional PLS  | 40  | 5 Common Factors |
| 0.577                        | 300 | traditional PLS  | 50  | 5 Common Factors |
| 0.071                        | 500 | traditional PLS  | 0   | 5 Common Factors |
| 0.063                        | 500 | traditional PLS  | 5   | 5 Common Factors |
| 0.089                        | 500 | traditional PLS  | 10  | 5 Common Factors |
| 0.151                        | 500 | traditional PLS  | 20  | 5 Common Factors |
| 0.376                        | 500 | traditional PLS  | 40  | 5 Common Factors |
| 0.457                        | 500 | traditional PLS  | 50  | 5 Common Factors |
| 0.632                        | 100 | robust PLS       | 0   | 5 Common Factors |
| 0.627                        | 100 | robust PLS       | 5   | 5 Common Factors |
| 0.634                        | 100 | robust PLS       | 10  | 5 Common Factors |
| 0.612                        | 100 | robust PLS       | 20  | 5 Common Factors |
| 0.708                        | 100 | robust PLS       | 40  | 5 Common Factors |
| 0.852                        | 100 | robust PLS       | 50  | 5 Common Factors |
| 0.173                        | 300 | robust PLS       | 0   | 5 Common Factors |
| 0.178                        | 300 | robust PLS       | 5   | 5 Common Factors |
| 0.170                        | 300 | robust PLS       | 10  | 5 Common Factors |
| 0.190                        | 300 | robust PLS       | 20  | 5 Common Factors |
| 0.227                        | 300 | robust PLS       | 40  | 5 Common Factors |
| 0.407                        | 300 | robust PLS       | 50  | 5 Common Factors |
| 0.104                        | 500 | robust PLS       | 0   | 5 Common Factors |
| 0.077                        | 500 | robust PLS       | 5   | 5 Common Factors |
| 0.084                        | 500 | robust PLS       | 10  | 5 Common Factors |
| 0.106                        | 500 | robust PLS       | 20  | 5 Common Factors |
| 0.113                        | 500 | robust PLS       | 40  | 5 Common Factors |
| 0.165                        | 500 | robust PLS       | 50  | 5 Common Factors |
| 0.004                        | 100 | traditional PLSc | 0   | 5 Composites     |
| 0.001                        | 100 | traditional PLSc | 5   | 5 Composites     |
| 0.003                        | 100 | traditional PLSc | 10  | 5 Composites     |
| 0.005                        | 100 | traditional PLSc | 20  | 5 Composites     |
| 0.001                        | 100 | traditional PLSc | 40  | 5 Composites     |
| 0.003                        | 100 | traditional PLSc | 50  | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 0   | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 5   | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 10  | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 20  | 5 Composites     |
| 0.001                        | 300 | traditional PLSc | 40  | 5 Composites     |
| 0.001                        | 300 | traditional PLSc | 50  | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 0   | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 5   | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 10  | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 20  | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 40  | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 50  | 5 Composites     |
| 0.008                        | 100 | robust PLSc      | 0   | 5 Composites     |
| 0.010                        | 100 | robust PLSc      | 5   | 5 Composites     |
| 0.009                        | 100 | robust PLSc      | 10  | 5 Composites     |
| 0.006                        | 100 | robust PLSc      | 20  | 5 Composites     |
| 0.007                        | 100 | robust PLSc      | 40  | 5 Composites     |
| 0.019                        | 100 | robust PLSc      | 50  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 0   | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 5   | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 10  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 20  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 40  | 5 Composites     |
| 0.001                        | 300 | robust PLSc      | 50  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 0   | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 5   | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 10  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 20  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 40  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 50  | 5 Composites     |

## 3.2 Systematic Outliers

**Table 21** Inadmissible solutions with systematic outliers in all indicators for three common factors/ three composites

| share Inadmissible solutions | n   | estim.           | out | modeltype        |
|------------------------------|-----|------------------|-----|------------------|
| 0.349                        | 100 | traditional PLSc | 0   | 3 Common Factors |
| 0.032                        | 100 | traditional PLSc | 5   | 3 Common Factors |
| 0.008                        | 100 | traditional PLSc | 10  | 3 Common Factors |
| 0.000                        | 100 | traditional PLSc | 20  | 3 Common Factors |
| 0.001                        | 100 | traditional PLSc | 40  | 3 Common Factors |
| 0.000                        | 100 | traditional PLSc | 50  | 3 Common Factors |
| 0.087                        | 300 | traditional PLSc | 0   | 3 Common Factors |
| 0.000                        | 300 | traditional PLSc | 5   | 3 Common Factors |
| 0.000                        | 300 | traditional PLSc | 10  | 3 Common Factors |
| 0.000                        | 300 | traditional PLSc | 20  | 3 Common Factors |
| 0.000                        | 300 | traditional PLSc | 40  | 3 Common Factors |
| 0.000                        | 300 | traditional PLSc | 50  | 3 Common Factors |
| 0.021                        | 500 | traditional PLSc | 0   | 3 Common Factors |
| 0.000                        | 500 | traditional PLSc | 5   | 3 Common Factors |
| 0.000                        | 500 | traditional PLSc | 10  | 3 Common Factors |
| 0.000                        | 500 | traditional PLSc | 20  | 3 Common Factors |
| 0.000                        | 500 | traditional PLSc | 40  | 3 Common Factors |
| 0.000                        | 500 | traditional PLSc | 50  | 3 Common Factors |
| 0.508                        | 100 | robust PLSc      | 0   | 3 Common Factors |
| 0.497                        | 100 | robust PLSc      | 5   | 3 Common Factors |
| 0.490                        | 100 | robust PLSc      | 10  | 3 Common Factors |
| 0.483                        | 100 | robust PLSc      | 20  | 3 Common Factors |
| 0.300                        | 100 | robust PLSc      | 40  | 3 Common Factors |
| 0.023                        | 100 | robust PLSc      | 50  | 3 Common Factors |
| 0.124                        | 300 | robust PLSc      | 0   | 3 Common Factors |
| 0.145                        | 300 | robust PLSc      | 5   | 3 Common Factors |
| 0.141                        | 300 | robust PLSc      | 10  | 3 Common Factors |
| 0.142                        | 300 | robust PLSc      | 20  | 3 Common Factors |
| 0.127                        | 300 | robust PLSc      | 40  | 3 Common Factors |
| 0.000                        | 300 | robust PLSc      | 50  | 3 Common Factors |
| 0.045                        | 500 | robust PLSc      | 0   | 3 Common Factors |
| 0.049                        | 500 | robust PLSc      | 5   | 3 Common Factors |
| 0.057                        | 500 | robust PLSc      | 10  | 3 Common Factors |
| 0.061                        | 500 | robust PLSc      | 20  | 3 Common Factors |
| 0.042                        | 500 | robust PLSc      | 40  | 3 Common Factors |
| 0.000                        | 500 | robust PLSc      | 50  | 3 Common Factors |
| 0.000                        | 100 | traditional PLS  | 0   | 3 Composites     |
| 0.000                        | 100 | traditional PLS  | 5   | 3 Composites     |
| 0.000                        | 100 | traditional PLS  | 10  | 3 Composites     |
| 0.000                        | 100 | traditional PLS  | 20  | 3 Composites     |
| 0.000                        | 100 | traditional PLS  | 40  | 3 Composites     |
| 0.000                        | 100 | traditional PLS  | 50  | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 0   | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 5   | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 10  | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 20  | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 40  | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 50  | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 0   | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 5   | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 10  | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 20  | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 40  | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 50  | 3 Composites     |
| 0.007                        | 100 | robust PLS       | 0   | 3 Composites     |
| 0.005                        | 100 | robust PLS       | 5   | 3 Composites     |
| 0.002                        | 100 | robust PLS       | 10  | 3 Composites     |
| 0.008                        | 100 | robust PLS       | 20  | 3 Composites     |
| 0.002                        | 100 | robust PLS       | 40  | 3 Composites     |
| 0.000                        | 100 | robust PLS       | 50  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 0   | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 5   | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 10  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 20  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 40  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 50  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 0   | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 5   | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 10  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 20  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 40  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 50  | 3 Composites     |

**Table 22** Inadmissible solutions with systematic outliers in all indicators for five common factors/ five composites

| share Inadmissible solutions | n   | estim.           | out | modeltype        |
|------------------------------|-----|------------------|-----|------------------|
| 0.358                        | 100 | traditional PLS  | 0   | 5 Common Factors |
| 0.696                        | 100 | traditional PLS  | 5   | 5 Common Factors |
| 0.890                        | 100 | traditional PLS  | 10  | 5 Common Factors |
| 0.960                        | 100 | traditional PLS  | 20  | 5 Common Factors |
| 0.969                        | 100 | traditional PLS  | 40  | 5 Common Factors |
| 0.968                        | 100 | traditional PLS  | 50  | 5 Common Factors |
| 0.146                        | 300 | traditional PLS  | 0   | 5 Common Factors |
| 0.733                        | 300 | traditional PLS  | 5   | 5 Common Factors |
| 0.933                        | 300 | traditional PLS  | 10  | 5 Common Factors |
| 0.962                        | 300 | traditional PLS  | 20  | 5 Common Factors |
| 0.981                        | 300 | traditional PLS  | 40  | 5 Common Factors |
| 0.982                        | 300 | traditional PLS  | 50  | 5 Common Factors |
| 0.071                        | 500 | traditional PLS  | 0   | 5 Common Factors |
| 0.800                        | 500 | traditional PLS  | 5   | 5 Common Factors |
| 0.945                        | 500 | traditional PLS  | 10  | 5 Common Factors |
| 0.959                        | 500 | traditional PLS  | 20  | 5 Common Factors |
| 0.979                        | 500 | traditional PLS  | 40  | 5 Common Factors |
| 0.983                        | 500 | traditional PLS  | 50  | 5 Common Factors |
| 0.649                        | 100 | robust PLS       | 0   | 5 Common Factors |
| 0.627                        | 100 | robust PLS       | 5   | 5 Common Factors |
| 0.614                        | 100 | robust PLS       | 10  | 5 Common Factors |
| 0.642                        | 100 | robust PLS       | 20  | 5 Common Factors |
| 0.962                        | 100 | robust PLS       | 40  | 5 Common Factors |
| 0.966                        | 100 | robust PLS       | 50  | 5 Common Factors |
| 0.184                        | 300 | robust PLS       | 0   | 5 Common Factors |
| 0.155                        | 300 | robust PLS       | 5   | 5 Common Factors |
| 0.174                        | 300 | robust PLS       | 10  | 5 Common Factors |
| 0.155                        | 300 | robust PLS       | 20  | 5 Common Factors |
| 0.981                        | 300 | robust PLS       | 40  | 5 Common Factors |
| 0.980                        | 300 | robust PLS       | 50  | 5 Common Factors |
| 0.071                        | 500 | robust PLS       | 0   | 5 Common Factors |
| 0.085                        | 500 | robust PLS       | 5   | 5 Common Factors |
| 0.097                        | 500 | robust PLS       | 10  | 5 Common Factors |
| 0.091                        | 500 | robust PLS       | 20  | 5 Common Factors |
| 0.979                        | 500 | robust PLS       | 40  | 5 Common Factors |
| 0.984                        | 500 | robust PLS       | 50  | 5 Common Factors |
| 0.004                        | 100 | traditional PLSc | 0   | 5 Composites     |
| 0.007                        | 100 | traditional PLSc | 5   | 5 Composites     |
| 0.002                        | 100 | traditional PLSc | 10  | 5 Composites     |
| 0.001                        | 100 | traditional PLSc | 20  | 5 Composites     |
| 0.000                        | 100 | traditional PLSc | 40  | 5 Composites     |
| 0.000                        | 100 | traditional PLSc | 50  | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 0   | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 5   | 5 Composites     |
| 0.002                        | 300 | traditional PLSc | 10  | 5 Composites     |
| 0.002                        | 300 | traditional PLSc | 20  | 5 Composites     |
| 0.001                        | 300 | traditional PLSc | 40  | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 50  | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 0   | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 5   | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 10  | 5 Composites     |
| 0.001                        | 500 | traditional PLSc | 20  | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 40  | 5 Composites     |
| 0.003                        | 500 | traditional PLSc | 50  | 5 Composites     |
| 0.006                        | 100 | robust PLSc      | 0   | 5 Composites     |
| 0.016                        | 100 | robust PLSc      | 5   | 5 Composites     |
| 0.007                        | 100 | robust PLSc      | 10  | 5 Composites     |
| 0.011                        | 100 | robust PLSc      | 20  | 5 Composites     |
| 0.000                        | 100 | robust PLSc      | 40  | 5 Composites     |
| 0.001                        | 100 | robust PLSc      | 50  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 0   | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 5   | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 10  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 20  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 40  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 50  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 0   | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 5   | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 10  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 20  | 5 Composites     |
| 0.002                        | 500 | robust PLSc      | 40  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 50  | 5 Composites     |

**Table 23** Inadmissible solutions with systematic outliers in two indicators for three common factors/ three composites

| share Inadmissible solutions | n   | estim.           | out | modeltype        |
|------------------------------|-----|------------------|-----|------------------|
| 0.354                        | 100 | traditional PLSc | 0   | 3 Common Factors |
| 0.308                        | 100 | traditional PLSc | 5   | 3 Common Factors |
| 0.324                        | 100 | traditional PLSc | 10  | 3 Common Factors |
| 0.442                        | 100 | traditional PLSc | 20  | 3 Common Factors |
| 0.523                        | 100 | traditional PLSc | 40  | 3 Common Factors |
| 0.781                        | 100 | traditional PLSc | 50  | 3 Common Factors |
| 0.078                        | 300 | traditional PLSc | 0   | 3 Common Factors |
| 0.082                        | 300 | traditional PLSc | 5   | 3 Common Factors |
| 0.100                        | 300 | traditional PLSc | 10  | 3 Common Factors |
| 0.143                        | 300 | traditional PLSc | 20  | 3 Common Factors |
| 0.429                        | 300 | traditional PLSc | 40  | 3 Common Factors |
| 0.794                        | 300 | traditional PLSc | 50  | 3 Common Factors |
| 0.027                        | 500 | traditional PLSc | 0   | 3 Common Factors |
| 0.030                        | 500 | traditional PLSc | 5   | 3 Common Factors |
| 0.043                        | 500 | traditional PLSc | 10  | 3 Common Factors |
| 0.055                        | 500 | traditional PLSc | 20  | 3 Common Factors |
| 0.413                        | 500 | traditional PLSc | 40  | 3 Common Factors |
| 0.821                        | 500 | traditional PLSc | 50  | 3 Common Factors |
| 0.511                        | 100 | robust PLSc      | 0   | 3 Common Factors |
| 0.479                        | 100 | robust PLSc      | 5   | 3 Common Factors |
| 0.482                        | 100 | robust PLSc      | 10  | 3 Common Factors |
| 0.460                        | 100 | robust PLSc      | 20  | 3 Common Factors |
| 0.539                        | 100 | robust PLSc      | 40  | 3 Common Factors |
| 0.824                        | 100 | robust PLSc      | 50  | 3 Common Factors |
| 0.129                        | 300 | robust PLSc      | 0   | 3 Common Factors |
| 0.153                        | 300 | robust PLSc      | 5   | 3 Common Factors |
| 0.145                        | 300 | robust PLSc      | 10  | 3 Common Factors |
| 0.133                        | 300 | robust PLSc      | 20  | 3 Common Factors |
| 0.332                        | 300 | robust PLSc      | 40  | 3 Common Factors |
| 0.804                        | 300 | robust PLSc      | 50  | 3 Common Factors |
| 0.040                        | 500 | robust PLSc      | 0   | 3 Common Factors |
| 0.049                        | 500 | robust PLSc      | 5   | 3 Common Factors |
| 0.057                        | 500 | robust PLSc      | 10  | 3 Common Factors |
| 0.061                        | 500 | robust PLSc      | 20  | 3 Common Factors |
| 0.236                        | 500 | robust PLSc      | 40  | 3 Common Factors |
| 0.826                        | 500 | robust PLSc      | 50  | 3 Common Factors |
| 0.001                        | 100 | traditional PLS  | 0   | 3 Composites     |
| 0.030                        | 100 | traditional PLS  | 5   | 3 Composites     |
| 0.065                        | 100 | traditional PLS  | 10  | 3 Composites     |
| 0.052                        | 100 | traditional PLS  | 20  | 3 Composites     |
| 0.034                        | 100 | traditional PLS  | 40  | 3 Composites     |
| 0.029                        | 100 | traditional PLS  | 50  | 3 Composites     |
| 0.000                        | 300 | traditional PLS  | 0   | 3 Composites     |
| 0.002                        | 300 | traditional PLS  | 5   | 3 Composites     |
| 0.037                        | 300 | traditional PLS  | 10  | 3 Composites     |
| 0.022                        | 300 | traditional PLS  | 20  | 3 Composites     |
| 0.003                        | 300 | traditional PLS  | 40  | 3 Composites     |
| 0.002                        | 300 | traditional PLS  | 50  | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 0   | 3 Composites     |
| 0.000                        | 500 | traditional PLS  | 5   | 3 Composites     |
| 0.017                        | 500 | traditional PLS  | 10  | 3 Composites     |
| 0.009                        | 500 | traditional PLS  | 20  | 3 Composites     |
| 0.001                        | 500 | traditional PLS  | 40  | 3 Composites     |
| 0.002                        | 500 | traditional PLS  | 50  | 3 Composites     |
| 0.003                        | 100 | robust PLS       | 0   | 3 Composites     |
| 0.002                        | 100 | robust PLS       | 5   | 3 Composites     |
| 0.007                        | 100 | robust PLS       | 10  | 3 Composites     |
| 0.012                        | 100 | robust PLS       | 20  | 3 Composites     |
| 0.035                        | 100 | robust PLS       | 40  | 3 Composites     |
| 0.039                        | 100 | robust PLS       | 50  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 0   | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 5   | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 10  | 3 Composites     |
| 0.000                        | 300 | robust PLS       | 20  | 3 Composites     |
| 0.006                        | 300 | robust PLS       | 40  | 3 Composites     |
| 0.005                        | 300 | robust PLS       | 50  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 0   | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 5   | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 10  | 3 Composites     |
| 0.000                        | 500 | robust PLS       | 20  | 3 Composites     |
| 0.002                        | 500 | robust PLS       | 40  | 3 Composites     |
| 0.001                        | 500 | robust PLS       | 50  | 3 Composites     |

**Table 24** Inadmissible solutions with systematic outliers in two indicators for five common factors/ five composites

| share Inadmissible solutions | n   | estim.           | out | modeltype        |
|------------------------------|-----|------------------|-----|------------------|
| 0.383                        | 100 | traditional PLS  | 0   | 5 Common Factors |
| 0.424                        | 100 | traditional PLS  | 5   | 5 Common Factors |
| 0.551                        | 100 | traditional PLS  | 10  | 5 Common Factors |
| 0.713                        | 100 | traditional PLS  | 20  | 5 Common Factors |
| 0.825                        | 100 | traditional PLS  | 40  | 5 Common Factors |
| 0.834                        | 100 | traditional PLS  | 50  | 5 Common Factors |
| 0.125                        | 300 | traditional PLS  | 0   | 5 Common Factors |
| 0.123                        | 300 | traditional PLS  | 5   | 5 Common Factors |
| 0.197                        | 300 | traditional PLS  | 10  | 5 Common Factors |
| 0.464                        | 300 | traditional PLS  | 20  | 5 Common Factors |
| 0.646                        | 300 | traditional PLS  | 40  | 5 Common Factors |
| 0.646                        | 300 | traditional PLS  | 50  | 5 Common Factors |
| 0.059                        | 500 | traditional PLS  | 0   | 5 Common Factors |
| 0.068                        | 500 | traditional PLS  | 5   | 5 Common Factors |
| 0.086                        | 500 | traditional PLS  | 10  | 5 Common Factors |
| 0.339                        | 500 | traditional PLS  | 20  | 5 Common Factors |
| 0.558                        | 500 | traditional PLS  | 40  | 5 Common Factors |
| 0.558                        | 500 | traditional PLS  | 50  | 5 Common Factors |
| 0.643                        | 100 | robust PLS       | 0   | 5 Common Factors |
| 0.633                        | 100 | robust PLS       | 5   | 5 Common Factors |
| 0.628                        | 100 | robust PLS       | 10  | 5 Common Factors |
| 0.736                        | 100 | robust PLS       | 20  | 5 Common Factors |
| 0.911                        | 100 | robust PLS       | 40  | 5 Common Factors |
| 0.923                        | 100 | robust PLS       | 50  | 5 Common Factors |
| 0.167                        | 300 | robust PLS       | 0   | 5 Common Factors |
| 0.163                        | 300 | robust PLS       | 5   | 5 Common Factors |
| 0.183                        | 300 | robust PLS       | 10  | 5 Common Factors |
| 0.203                        | 300 | robust PLS       | 20  | 5 Common Factors |
| 0.680                        | 300 | robust PLS       | 40  | 5 Common Factors |
| 0.692                        | 300 | robust PLS       | 50  | 5 Common Factors |
| 0.082                        | 500 | robust PLS       | 0   | 5 Common Factors |
| 0.093                        | 500 | robust PLS       | 5   | 5 Common Factors |
| 0.103                        | 500 | robust PLS       | 10  | 5 Common Factors |
| 0.097                        | 500 | robust PLS       | 20  | 5 Common Factors |
| 0.599                        | 500 | robust PLS       | 40  | 5 Common Factors |
| 0.598                        | 500 | robust PLS       | 50  | 5 Common Factors |
| 0.002                        | 100 | traditional PLSc | 0   | 5 Composites     |
| 0.001                        | 100 | traditional PLSc | 5   | 5 Composites     |
| 0.007                        | 100 | traditional PLSc | 10  | 5 Composites     |
| 0.000                        | 100 | traditional PLSc | 20  | 5 Composites     |
| 0.000                        | 100 | traditional PLSc | 40  | 5 Composites     |
| 0.001                        | 100 | traditional PLSc | 50  | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 0   | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 5   | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 10  | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 20  | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 40  | 5 Composites     |
| 0.000                        | 300 | traditional PLSc | 50  | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 0   | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 5   | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 10  | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 20  | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 40  | 5 Composites     |
| 0.000                        | 500 | traditional PLSc | 50  | 5 Composites     |
| 0.011                        | 100 | robust PLSc      | 0   | 5 Composites     |
| 0.007                        | 100 | robust PLSc      | 5   | 5 Composites     |
| 0.011                        | 100 | robust PLSc      | 10  | 5 Composites     |
| 0.005                        | 100 | robust PLSc      | 20  | 5 Composites     |
| 0.012                        | 100 | robust PLSc      | 40  | 5 Composites     |
| 0.013                        | 100 | robust PLSc      | 50  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 0   | 5 Composites     |
| 0.001                        | 300 | robust PLSc      | 5   | 5 Composites     |
| 0.001                        | 300 | robust PLSc      | 10  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 20  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 40  | 5 Composites     |
| 0.000                        | 300 | robust PLSc      | 50  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 0   | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 5   | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 10  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 20  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 40  | 5 Composites     |
| 0.000                        | 500 | robust PLSc      | 50  | 5 Composites     |