

# 基于逐步非线性回归的血管紧张素转化酶抑制肽 QSAR 建模

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附表 1 141 个 ACE 抑制二肽的序列与观察活性值

Table S1 Sequences and activities of 141 ACE-inhibitory dipeptides

| No. | Pep. | Obsd. | No. | Pep. | Obsd. | No. | Pep. | Obsd. | No. | Pep. | Obsd. |
|-----|------|-------|-----|------|-------|-----|------|-------|-----|------|-------|
| 1   | AA   | 2.25  | 37  | GM   | 3.15  | 73  | MY   | 2.29  | 109 | WM   | 1.98  |
| 2   | AF   | 1.83  | 38  | GP   | 2.63  | 74  | NF   | 1.67  | 110 | WV   | 2.70  |
| 3   | AG   | 3.40  | 39  | GQ   | 3.74  | 75  | NG   | 4.08  | 111 | WY   | 1.58  |
| 4   | AP   | 2.40  | 40  | GR   | 3.51  | 76  | NK   | 2.91  | 112 | YA   | 2.66  |
| 5   | AR   | 1.98  | 41  | GS   | 3.58  | 77  | NP   | 3.36  | 113 | YE   | 2.80  |
| 6   | AV   | 2.90  | 42  | GT   | 3.76  | 78  | NY   | 1.51  | 114 | YG   | 3.18  |
| 7   | AW   | 1.08  | 43  | GV   | 3.28  | 79  | PG   | 4.23  | 115 | YH   | 0.71  |
| 8   | AY   | 1.61  | 44  | GW   | 1.48  | 80  | PR   | 0.61  | 116 | YK   | 2.79  |
| 9   | DA   | 3.58  | 45  | GY   | 2.26  | 81  | QG   | 3.94  | 117 | YL   | 1.91  |
| 10  | DF   | 2.56  | 46  | HG   | 3.80  | 82  | QK   | 2.95  | 118 | YN   | 1.71  |
| 11  | DG   | 2.62  | 47  | HL   | 3.51  | 83  | RA   | 2.66  | 119 | YP   | 2.91  |
| 12  | DL   | 3.30  | 48  | HY   | 1.42  | 84  | RF   | 2.17  | 120 | YV   | 2.76  |
| 13  | DM   | 2.78  | 49  | IA   | 2.18  | 85  | RG   | 3.08  | 121 | YW   | 0.97  |
| 14  | DW   | 1.11  | 50  | IF   | 2.97  | 86  | RL   | 3.39  | 122 | CF   | 0.30  |
| 15  | DY   | 2.00  | 51  | IG   | 3.08  | 87  | RP   | 1.91  | 123 | AI   | 0.53  |
| 16  | EA   | 4.00  | 52  | IL   | 1.74  | 88  | RR   | 2.43  | 124 | FE   | 0.16  |
| 17  | EG   | 3.94  | 53  | IP   | 2.11  | 89  | RW   | 1.27  | 125 | WW   | 1.91  |
| 18  | EP   | 3.08  | 54  | IR   | 2.88  | 90  | RY   | 1.37  | 126 | AH   | 2.72  |
| 19  | ER   | 2.82  | 55  | IW   | 0.67  | 91  | SF   | 2.11  | 127 | DP   | 0.33  |
| 20  | EY   | 0.43  | 56  | IY   | 0.48  | 92  | SG   | 3.93  | 128 | FK   | 2.42  |
| 21  | FG   | 3.57  | 57  | KA   | 2.04  | 93  | SY   | 1.82  | 129 | QN   | 1.95  |
| 22  | FL   | 1.20  | 58  | KF   | 1.76  | 94  | TF   | 1.26  | 130 | ST   | 0.61  |
| 23  | FP   | 2.50  | 59  | KG   | 3.51  | 95  | TG   | 4.00  | 131 | VL   | 1.11  |
| 24  | FQ   | 1.71  | 60  | KL   | 1.70  | 96  | TK   | 3.21  | 132 | WP   | 2.34  |
| 25  | FR   | 2.96  | 61  | KP   | 1.50  | 97  | TP   | 2.89  | 133 | WT   | 2.80  |
| 26  | FW   | 0.77  | 62  | KR   | 2.58  | 98  | VF   | 1.64  | 134 | YS   | 2.61  |
| 27  | FY   | 0.81  | 63  | KW   | 0.89  | 99  | VG   | 3.04  | 135 | DK   | 2.71  |
| 28  | GA   | 3.30  | 64  | KY   | 1.00  | 100 | VK   | 1.11  | 136 | MA   | 2.18  |
| 29  | GD   | 3.96  | 65  | LA   | 2.49  | 101 | VP   | 2.69  | 137 | MP   | 2.13  |
| 30  | GE   | 3.79  | 66  | LF   | 2.47  | 102 | VQ   | 3.11  | 138 | PL   | 2.53  |
| 31  | GF   | 2.75  | 67  | LG   | 3.94  | 103 | VR   | 2.40  | 139 | QP   | 1.82  |
| 32  | GG   | 3.90  | 68  | LW   | 1.24  | 104 | VW   | 0.49  | 140 | RS   | 1.79  |
| 33  | GH   | 3.49  | 69  | LY   | 1.26  | 105 | VY   | 1.34  | 141 | WH   | 0.71  |
| 34  | GI   | 3.10  | 70  | MF   | 1.65  | 106 | WA   | 2.44  |     |      |       |
| 35  | GK   | 3.73  | 71  | MG   | 3.68  | 107 | WG   | 3.77  |     |      |       |
| 36  | GL   | 3.40  | 72  | MW   | 1.23  | 108 | WL   | 1.65  |     |      |       |

附表 2 150 个 ACE 抑制三肽的序列与观察活性值

Table S2 Sequences and activities of 150 ACE-inhibitory tripeptides

| No. | Pep. | Obsd. | No. | Pep. | Obsd. | No. | Pep. | Obsd. | No. | Pep. | Obsd. |
|-----|------|-------|-----|------|-------|-----|------|-------|-----|------|-------|
| 1   | AAP  | 4.52  | 39  | GPM  | 4.77  | 77  | LIY  | 6.09  | 115 | RPG  | 2.91  |
| 2   | ADA  | 3.83  | 40  | GPP  | 4.92  | 78  | LKA  | 5.07  | 116 | RPP  | 4.22  |
| 3   | AEL  | 4.24  | 41  | GQP  | 5.49  | 79  | LKP  | 6.02  | 117 | RRR  | 4.23  |
| 4   | AFL  | 4.20  | 42  | GRP  | 4.70  | 80  | LKY  | 6.11  | 118 | SVY  | 5.09  |
| 5   | AGP  | 3.25  | 43  | GSH  | 4.49  | 81  | LLF  | 4.10  | 119 | TNP  | 3.68  |
| 6   | ALP  | 3.62  | 44  | GVV  | 4.18  | 82  | LLL  | 4.65  | 120 | VAA  | 4.89  |
| 7   | AQL  | 4.24  | 45  | GYG  | 3.67  | 83  | LLP  | 4.80  | 121 | VAF  | 4.45  |
| 8   | AVP  | 3.47  | 46  | GY Y | 4.93  | 84  | LPF  | 4.40  | 122 | VGP  | 4.58  |
| 9   | DLP  | 5.32  | 47  | HIR  | 3.02  | 85  | LPP  | 5.02  | 123 | VIY  | 5.12  |
| 10  | FAL  | 4.58  | 48  | HLL  | 4.24  | 86  | LRP  | 6.21  | 124 | VLP  | 4.09  |
| 11  | FCF  | 4.96  | 49  | HQG  | 3.13  | 87  | LQP  | 5.83  | 125 | VL Y | 4.51  |
| 12  | FDK  | 3.41  | 50  | IAE  | 4.46  | 88  | LQW  | 5.42  | 126 | VPP  | 5.05  |
| 13  | FEP  | 4.92  | 51  | IAP  | 5.57  | 89  | LSA  | 5.11  | 127 | VQV  | 5.06  |
| 14  | FFF  | 4.80  | 52  | IAQ  | 4.46  | 90  | LSP  | 5.77  | 128 | VRP  | 5.66  |
| 15  | FFG  | 3.29  | 53  | IFL  | 4.35  | 91  | LTF  | 5.56  | 129 | VSP  | 5.00  |
| 16  | FFL  | 4.43  | 54  | IKP  | 5.68  | 92  | LVL  | 5.19  | 130 | VSW  | 4.63  |
| 17  | FFP  | 4.92  | 55  | IKY  | 6.68  | 93  | LVQ  | 4.85  | 131 | VTR  | 3.87  |
| 18  | FGF  | 4.71  | 56  | ILP  | 4.49  | 94  | LVR  | 4.85  | 132 | VVF  | 4.45  |
| 19  | FGG  | 3.21  | 57  | IMY  | 5.74  | 95  | LVY  | 5.74  | 133 | VVV  | 4.37  |
| 20  | FGK  | 3.80  | 58  | IPA  | 3.85  | 96  | LWA  | 4.90  | 134 | VWY  | 5.03  |
| 21  | FIV  | 3.96  | 59  | IPP  | 5.30  | 97  | LWY  | 5.30  | 135 | VYP  | 3.83  |
| 22  | FNF  | 5.16  | 60  | IRA  | 5.01  | 98  | LYP  | 5.18  | 136 | YPF  | 4.40  |
| 23  | FPF  | 4.68  | 61  | IRP  | 5.74  | 99  | MNP  | 4.18  | 137 | YPR  | 4.78  |
| 24  | FPK  | 3.55  | 62  | ITF  | 4.31  | 100 | PFP  | 4.26  | 138 | YYY  | 4.46  |
| 25  | FPP  | 4.50  | 63  | IVQ  | 4.02  | 101 | PGI  | 3.77  | 139 | AMY  | 5.26  |
| 26  | FQP  | 4.92  | 64  | IVY  | 5.84  | 102 | PGG  | 2.86  | 140 | FAP  | 5.42  |
| 27  | FWN  | 4.74  | 65  | IWH  | 5.46  | 103 | PGL  | 4.86  | 141 | GGY  | 5.89  |
| 28  | FYN  | 4.74  | 66  | IYP  | 4.21  | 104 | PGP  | 4.18  | 142 | HHL  | 5.27  |
| 29  | GEG  | 3.72  | 67  | KPF  | 4.49  | 105 | PGR  | 3.33  | 143 | IKW  | 6.68  |
| 30  | GFF  | 4.98  | 68  | LAA  | 4.89  | 106 | PIP  | 4.31  | 144 | LRY  | 6.82  |
| 31  | GFG  | 3.47  | 69  | LAP  | 5.73  | 107 | PLW  | 4.44  | 145 | MKY  | 5.14  |
| 32  | GGF  | 4.89  | 70  | LAY  | 5.41  | 108 | PPG  | 2.82  | 146 | PRY  | 5.60  |
| 33  | GGG  | 3.39  | 71  | LDP  | 4.37  | 109 | PPP  | 4.14  | 147 | RIY  | 4.55  |
| 34  | GGP  | 4.72  | 72  | LEE  | 4.00  | 110 | PSY  | 4.80  | 148 | TVY  | 4.82  |
| 35  | GKV  | 5.41  | 73  | LEL  | 4.81  | 111 | PWP  | 3.66  | 149 | VAP  | 5.70  |
| 36  | GLG  | 3.55  | 74  | LEP  | 5.24  | 112 | PYP  | 3.66  | 150 | Y EY | 5.40  |
| 37  | GLY  | 5.05  | 75  | LGI  | 4.54  | 113 | RFH  | 3.48  |     |      |       |
| 38  | GPL  | 5.59  | 76  | LGL  | 4.48  | 114 | RGP  | 4.27  |     |      |       |

附表 3

|               | V1    | V2    | V3    | V4      | V5      | V6    | V7    | V8     |
|---------------|-------|-------|-------|---------|---------|-------|-------|--------|
| <b>Ala(A)</b> | 0.870 | 1.520 | 0.400 | 1.800   | 19.200  | 0.058 | 5.080 | 0.007  |
| <b>Arg(R)</b> | 0.850 | 1.520 | 0.300 | 12.500  | 74.770  | 0.085 | 4.750 | 0.044  |
| <b>Asn(N)</b> | 0.090 | 1.520 | 0.900 | -5.600  | 42.180  | 0.091 | 5.750 | 0.005  |
| <b>Asp(D)</b> | 0.660 | 1.520 | 0.800 | 5.050   | 40.470  | 0.081 | 5.960 | -0.024 |
| <b>Cys(C)</b> | 1.520 | 1.520 | 0.500 | -16.500 | 40.470  | 0.128 | 2.950 | -0.037 |
| <b>Gln(Q)</b> | 0.000 | 1.520 | 0.700 | 6.300   | 52.130  | 0.098 | 4.240 | 0.049  |
| <b>Glu(E)</b> | 0.670 | 1.520 | 1.300 | 12.000  | 51.790  | 0.064 | 6.040 | 0.007  |
| <b>Gly(G)</b> | 0.100 | 1.000 | 0.000 | 0.000   | 0.000   | 0.152 | 8.200 | 0.179  |
| <b>His(H)</b> | 0.870 | 1.520 | 1.000 | -38.500 | 55.560  | 0.054 | 2.100 | -0.011 |
| <b>Ile(I)</b> | 3.150 | 1.900 | 0.400 | 12.400  | 56.590  | 0.056 | 4.950 | 0.022  |
| <b>Leu(L)</b> | 2.170 | 1.520 | 0.600 | -11.000 | 57.620  | 0.070 | 8.030 | 0.052  |
| <b>Lys(K)</b> | 1.640 | 1.520 | 0.400 | 14.600  | 65.850  | 0.095 | 4.930 | 0.018  |
| <b>Met(M)</b> | 1.670 | 1.520 | 0.300 | -10.000 | 64.140  | 0.055 | 2.610 | 0.003  |
| <b>Phe(F)</b> | 2.870 | 1.520 | 0.700 | -34.500 | 79.910  | 0.065 | 4.360 | 0.038  |
| <b>Pro(P)</b> | 2.770 | 1.520 | 0.900 | -86.200 | 43.560  | 0.068 | 4.840 | 0.240  |
| <b>Ser(S)</b> | 0.070 | 1.520 | 0.400 | -7.500  | 25.030  | 0.106 | 6.410 | 0.005  |
| <b>Thr(T)</b> | 0.070 | 1.730 | 0.400 | -28.000 | 38.410  | 0.079 | 5.870 | 0.003  |
| <b>Trp(W)</b> | 3.770 | 1.520 | 0.600 | -33.700 | 100.150 | 0.167 | 2.310 | 0.038  |
| <b>Tyr(Y)</b> | 2.670 | 1.520 | 1.200 | -10.000 | 88.830  | 0.125 | 4.550 | 0.024  |
| <b>Val(V)</b> | 1.870 | 1.900 | 0.400 | 5.630   | 43.900  | 0.053 | 6.070 | 0.057  |

The G-scale descriptor includes 8 properties of amino acid, i.e., hydrophobicity (V1), STERIMOL minimum width of the side chain (V2), loss of side chain hydrophathy by helix formation (V3), optical rotation (V4), side chain molecular volume (V5), frequency of the 4th residue in turn (V6), AA composition of EXT of multi-spanning proteins (V7), and net charge index (V8), which are selected by stepwise multiple regression (SMR) on the original 457 physicochemical properties classified into three sorts of parameters including hydrophobic, steric, and electric properties.

附表 4 ACE 抑制二肽的预测与拟合精度

Table S4 Prediction and fitting accuracies on ACE-inhibitory dipeptides

| FS Method | Descriptor | SVR                  |                                |                                |                     |                               | PLSR                 |                                |                                |                     |                               | MLR                  |                                |                                |                     |                               |
|-----------|------------|----------------------|--------------------------------|--------------------------------|---------------------|-------------------------------|----------------------|--------------------------------|--------------------------------|---------------------|-------------------------------|----------------------|--------------------------------|--------------------------------|---------------------|-------------------------------|
|           |            | RMSE <sub>pred</sub> | R <sup>2</sup> <sub>pred</sub> | Q <sup>2</sup> <sub>pred</sub> | RMSE <sub>fit</sub> | R <sup>2</sup> <sub>fit</sub> | RMSE <sub>pred</sub> | R <sup>2</sup> <sub>pred</sub> | Q <sup>2</sup> <sub>pred</sub> | RMSE <sub>fit</sub> | R <sup>2</sup> <sub>fit</sub> | RMSE <sub>pred</sub> | R <sup>2</sup> <sub>pred</sub> | Q <sup>2</sup> <sub>pred</sub> | RMSE <sub>fit</sub> | R <sup>2</sup> <sub>fit</sub> |
| SSNR      | DPPS       | 0.5740               | 0.6547                         | 0.6548                         | 0.5387              | 0.7030                        | 0.5477               | 0.6856                         | 0.6857                         | 0.6791              | 0.5281                        | 0.5518               | 0.6810                         | 0.6810                         | 0.6770              | 0.5310                        |
|           | G-scale    | 0.5946               | 0.6295                         | 0.6295                         | 0.5502              | 0.6837                        | 0.6224               | 0.5940                         | 0.5940                         | 0.5788              | 0.6500                        | 0.6046               | 0.6169                         | 0.6169                         | 0.5639              | 0.6677                        |
|           | ST-scale   | 0.6288               | 0.5856                         | 0.5857                         | 0.5796              | 0.6740                        | 0.6147               | 0.6041                         | 0.6051                         | 0.7107              | 0.5098                        | 0.6361               | 0.5760                         | 0.5770                         | 0.6954              | 0.5307                        |
|           | VHSE       | 0.5505               | 0.6824                         | 0.6827                         | 0.6100              | 0.6265                        | 0.5680               | 0.6619                         | 0.6622                         | 0.6552              | 0.5691                        | 0.6389               | 0.5722                         | 0.5722                         | 0.6156              | 0.6196                        |
|           | VSW        | 0.6897               | 0.5014                         | 0.5026                         | 0.6499              | 0.5876                        | 0.6718               | 0.5270                         | 0.5282                         | 0.6585              | 0.5765                        | 0.6774               | 0.5191                         | 0.5202                         | 0.6459              | 0.5926                        |
|           | ICM        | 0.5571               | 0.6747                         | 0.6748                         | —                   | —                             | 0.5585               | 0.6732                         | 0.6732                         | —                   | —                             | 0.5564               | 0.6756                         | 0.6757                         | —                   | —                             |
| GA-PLS    | DPPS       | 0.9273               | 0.0988                         | 0.0990                         | 0.5391              | 0.7026                        | 0.7111               | 0.4700                         | 0.4702                         | 0.7024              | 0.4950                        | 0.7833               | 0.3570                         | 0.3571                         | 0.6886              | 0.5148                        |
|           | G-scale    | 0.7623               | 0.3910                         | 0.3910                         | 0.6573              | 0.5486                        | 0.6509               | 0.5560                         | 0.5560                         | 0.5893              | 0.6372                        | 0.6206               | 0.5964                         | 0.5964                         | 0.5679              | 0.6630                        |
|           | ST-scale   | 0.6222               | 0.5943                         | 0.5954                         | 0.6731              | 0.5602                        | 0.6850               | 0.5082                         | 0.5095                         | 0.7318              | 0.4802                        | 0.6850               | 0.5082                         | 0.5095                         | 0.7318              | 0.4802                        |
|           | VHSE       | 0.6028               | 0.6192                         | 0.6196                         | 0.6808              | 0.5348                        | 0.6375               | 0.5741                         | 0.5745                         | 0.6974              | 0.5119                        | 0.6100               | 0.6101                         | 0.6104                         | 0.6927              | 0.5184                        |
|           | VSW        | 0.7552               | 0.4022                         | 0.4037                         | 0.7300              | 0.4797                        | 0.7878               | 0.3497                         | 0.3512                         | 0.7728              | 0.4168                        | 0.7820               | 0.3591                         | 0.3607                         | 0.7666              | 0.4262                        |
|           | ICM        | 0.7037               | 0.4810                         | 0.4811                         | —                   | —                             | 0.6450               | 0.5640                         | 0.5641                         | —                   | —                             | 0.6424               | 0.5675                         | 0.5676                         | —                   | —                             |
| SLR       | DPPS       | 0.5966               | 0.6269                         | 0.6270                         | 0.5504              | 0.6899                        | 0.7086               | 0.4737                         | 0.4737                         | 0.6049              | 0.6255                        | 0.7142               | 0.4654                         | 0.4654                         | 0.6048              | 0.6256                        |
|           | G-scale    | 0.6477               | 0.5603                         | 0.5603                         | 0.5397              | 0.6956                        | 0.6456               | 0.5632                         | 0.5632                         | 0.6006              | 0.6231                        | 0.6566               | 0.5482                         | 0.5482                         | 0.5996              | 0.6244                        |
|           | ST-scale   | 0.6276               | 0.5872                         | 0.5883                         | 0.6742              | 0.5589                        | 0.6422               | 0.5677                         | 0.5688                         | 0.7003              | 0.5240                        | 0.6422               | 0.5677                         | 0.5688                         | 0.7003              | 0.5240                        |
|           | VHSE       | 0.6129               | 0.6063                         | 0.6067                         | 0.6307              | 0.6008                        | 0.6384               | 0.5729                         | 0.5733                         | 0.6234              | 0.6100                        | 0.6384               | 0.5729                         | 0.5733                         | 0.6234              | 0.6100                        |
|           | VSW        | 0.6684               | 0.5317                         | 0.5317                         | 0.6614              | 0.5728                        | 0.7703               | 0.3781                         | 0.3796                         | 0.6719              | 0.5592                        | 0.7655               | 0.3859                         | 0.3874                         | 0.6706              | 0.5609                        |
|           | ICM        | 0.5934               | 0.6310                         | 0.6310                         | —                   | —                             | 0.6471               | 0.5612                         | 0.5613                         | —                   | —                             | 0.6493               | 0.5582                         | 0.5582                         | —                   | —                             |

附表 5 ACE 抑制三肽的预测与拟合精度

Table S5 Prediction and fitting accuracies on ACE-inhibitory tripeptides

| FS Method | Descriptor | SVR                  |                                |                                |                     |                               | PLSR                 |                                |                                |                     |                               | MLR                  |                                |                                |                     |                               |
|-----------|------------|----------------------|--------------------------------|--------------------------------|---------------------|-------------------------------|----------------------|--------------------------------|--------------------------------|---------------------|-------------------------------|----------------------|--------------------------------|--------------------------------|---------------------|-------------------------------|
|           |            | RMSE <sub>pred</sub> | R <sup>2</sup> <sub>pred</sub> | Q <sup>2</sup> <sub>pred</sub> | RMSE <sub>fit</sub> | R <sup>2</sup> <sub>fit</sub> | RMSE <sub>pred</sub> | R <sup>2</sup> <sub>pred</sub> | Q <sup>2</sup> <sub>pred</sub> | RMSE <sub>fit</sub> | R <sup>2</sup> <sub>fit</sub> | RMSE <sub>pred</sub> | R <sup>2</sup> <sub>pred</sub> | Q <sup>2</sup> <sub>pred</sub> | RMSE <sub>fit</sub> | R <sup>2</sup> <sub>fit</sub> |
| SSNR      | DPPS       | 0.5889               | 0.4745                         | 0.4745                         | 0.2126              | 0.9291                        | 0.4553               | 0.6858                         | 0.6858                         | 0.4649              | 0.6610                        | 0.4548               | 0.6866                         | 0.6866                         | 0.4649              | 0.6610                        |
|           | G-scale    | 0.5845               | 0.4822                         | 0.4322                         | 0.4367              | 0.7010                        | 0.5834               | 0.4841                         | 0.4841                         | 0.5382              | 0.5457                        | 0.6112               | 0.4340                         | 0.4340                         | 0.5294              | 0.5604                        |
|           | ST-scale   | 0.5734               | 0.5017                         | 0.5017                         | 0.3285              | 0.8308                        | 0.5442               | 0.5512                         | 0.5512                         | 0.5157              | 0.5829                        | 0.5545               | 0.5341                         | 0.5341                         | 0.5121              | 0.5887                        |
|           | VHSE       | 0.5041               | 0.6149                         | 0.6149                         | 0.3978              | 0.7518                        | 0.4347               | 0.7136                         | 0.7137                         | 0.4372              | 0.7002                        | 0.4254               | 0.7258                         | 0.7258                         | 0.4303              | 0.7096                        |
|           | VSW        | 0.5266               | 0.5798                         | 0.5798                         | 0.3728              | 0.7821                        | 0.5715               | 0.5051                         | 0.5051                         | 0.5024              | 0.6042                        | 0.5598               | 0.5251                         | 0.5251                         | 0.4932              | 0.6185                        |
|           | ICM        | 0.4819               | 0.6480                         | 0.6480                         | —                   | —                             | 0.4672               | 0.6692                         | 0.6692                         | —                   | —                             | 0.4652               | 0.6720                         | 0.6720                         | —                   | —                             |
| GA-PLS    | DPPS       | 0.5654               | 0.5155                         | 0.5155                         | 0.5014              | 0.6057                        | 0.7011               | 0.2550                         | 0.2550                         | 0.5609              | 0.5065                        | 0.6985               | 0.2607                         | 0.2607                         | 0.5608              | 0.5067                        |
|           | G-scale    | 0.7544               | 0.1375                         | 0.1375                         | 0.6188              | 0.3995                        | 0.7554               | 0.1352                         | 0.1352                         | 0.6186              | 0.3999                        | 0.7541               | 0.1382                         | 0.1382                         | 0.6170              | 0.4029                        |
|           | ST-scale   | 0.5285               | 0.5767                         | 0.5767                         | 0.4525              | 0.6789                        | 0.5328               | 0.5698                         | 0.5698                         | 0.5372              | 0.5474                        | 0.5328               | 0.5698                         | 0.5698                         | 0.5372              | 0.5474                        |
|           | VHSE       | 0.4930               | 0.6317                         | 0.6317                         | 0.4650              | 0.6610                        | 0.5115               | 0.6036                         | 0.6036                         | 0.4915              | 0.6212                        | 0.5122               | 0.6025                         | 0.6025                         | 0.4915              | 0.6212                        |
|           | VSW        | 0.5036               | 0.6157                         | 0.6157                         | 0.4131              | 0.7324                        | 0.6096               | 0.4369                         | 0.4369                         | 0.4789              | 0.6404                        | 0.6074               | 0.4409                         | 0.4409                         | 0.4784              | 0.6410                        |
|           | ICM        | 0.4779               | 0.6538                         | 0.6538                         | —                   | —                             | 0.5305               | 0.5734                         | 0.5734                         | —                   | —                             | 0.5313               | 0.5722                         | 0.5722                         | —                   | —                             |
| SLR       | DPPS       | 0.6082               | 0.4395                         | 0.4395                         | 0.3283              | 0.8310                        | 0.4923               | 0.6327                         | 0.6327                         | 0.4539              | 0.6768                        | 0.4917               | 0.6336                         | 0.6336                         | 0.4636              | 0.6773                        |
|           | G-scale    | 0.6035               | 0.4480                         | 0.4480                         | 0.4790              | 0.6401                        | 0.5492               | 0.5429                         | 0.5429                         | 0.4840              | 0.6326                        | 0.5491               | 0.5431                         | 0.5431                         | 0.4840              | 0.6326                        |
|           | ST-scale   | 0.5479               | 0.5451                         | 0.5451                         | 0.4592              | 0.6693                        | 0.5725               | 0.5033                         | 0.5033                         | 0.5318              | 0.5566                        | 0.5725               | 0.5033                         | 0.5033                         | 0.5318              | 0.5566                        |
|           | VHSE       | 0.4768               | 0.6555                         | 0.6555                         | 0.4284              | 0.7122                        | 0.4714               | 0.6632                         | 0.6632                         | 0.4429              | 0.6923                        | 0.4714               | 0.6632                         | 0.6632                         | 0.4429              | 0.6923                        |
|           | VSW        | 0.5079               | 0.6090                         | 0.6090                         | 0.4674              | 0.6575                        | 0.5506               | 0.5406                         | 0.5406                         | 0.4984              | 0.6105                        | 0.5352               | 0.5660                         | 0.5660                         | 0.4972              | 0.6124                        |
|           | ICM        | 0.4708               | 0.6641                         | 0.6641                         | —                   | —                             | 0.4591               | 0.6806                         | 0.6806                         | —                   | —                             | 0.4585               | 0.6814                         | 0.6814                         | —                   | —                             |