# Supplimentary Materials

# Table S.1 Descriptive statistics of variables

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Year | Variable | I1 | I2 | O1 | O2 | O3 | O4 | E1 | E2 | E3 | T1 | T2 | T3 | T4 | T5 | T6 | T7 |
| 2004 | Mean | 36.81 | 6.35 | 52515.05 | 238.36 | 887.80 | 8.88 | 4162.00 | 5241.21 | 664.28 | 0.02 | 13535.39 | 0.43 | 7225.39 | 0.77 | 6.29 | 9.74 |
|  | Std dev | 32.32 | 3.27 | 53110.75 | 228.70 | 1332.48 | 20.38 | 2658.90 | 4303.20 | 389.81 | 0.05 | 9352.73 | 0.08 | 2147.17 | 0.19 | 4.92 | 17.47 |
|  | Max | 134.60 | 13.30 | 241965.10 | 1069.30 | 5054.00 | 109.00 | 9717.00 | 18658.30 | 1852.95 | 0.25 | 44998.00 | 0.56 | 13628.00 | 1.21 | 25.30 | 79.48 |
|  | Min | 0.40 | 0.20 | 0.00 | 0.00 | 2.00 | 0.00 | 276.00 | 217.90 | 123.02 | 0.00 | 4244.00 | 0.24 | 5336.00 | 0.00 | 0.10 | 0.00 |
| 2005 | Mean | 41.61 | 6.35 | 60245.66 | 259.73 | 1042.00 | 10.94 | 4148.52 | 6099.52 | 811.43 | 0.03 | 15437.19 | 0.44 | 7961.19 | 0.75 | 6.79 | 15.35 |
|  | Std dev | 41.08 | 3.27 | 57811.33 | 216.40 | 1470.51 | 27.19 | 2635.66 | 5118.03 | 480.40 | 0.04 | 10422.43 | 0.08 | 2396.66 | 0.13 | 5.33 | 21.31 |
|  | Max | 182.00 | 13.30 | 245042.50 | 871.60 | 5051.00 | 151.32 | 9380.00 | 21963.00 | 2289.07 | 0.18 | 49377.00 | 0.59 | 15022.00 | 0.93 | 29.00 | 92.74 |
|  | Min | 0.50 | 0.20 | 0.00 | 0.00 | 1.00 | 0.00 | 280.00 | 243.10 | 151.24 | 0.00 | 5218.00 | 0.25 | 5960.00 | 0.16 | 0.30 | 0.00 |
| 2006 | Mean | 42.42 | 6.35 | 65362.06 | 253.95 | 1478.76 | 9.33 | 4178.16 | 7128.19 | 981.66 | 0.04 | 17716.42 | 0.45 | 8628.00 | 0.75 | 7.29 | 21.45 |
|  | Std dev | 41.09 | 3.27 | 58582.58 | 221.20 | 1747.65 | 10.28 | 2651.25 | 6036.73 | 552.01 | 0.04 | 11628.53 | 0.08 | 2660.40 | 0.07 | 5.84 | 25.64 |
|  | Max | 161.42 | 13.30 | 237456.00 | 921.60 | 6048.00 | 37.11 | 9442.00 | 25961.20 | 2553.34 | 0.16 | 54996.00 | 0.59 | 16869.00 | 0.90 | 32.70 | 106.00 |
|  | Min | 1.71 | 0.20 | 0.00 | 14.60 | 1.00 | 0.00 | 285.00 | 285.90 | 174.54 | 0.00 | 6103.00 | 0.25 | 6508.00 | 0.53 | 0.40 | 0.96 |
| 2007 | Mean | 47.34 | 6.35 | 73220.87 | 304.45 | 1378.33 | 11.15 | 4206.23 | 8731.53 | 1236.75 | 0.07 | 21339.45 | 0.45 | 9804.94 | 0.75 | 7.79 | 27.69 |
|  | Std dev | 42.15 | 3.27 | 66176.91 | 256.25 | 1634.36 | 14.08 | 2662.20 | 7353.36 | 683.22 | 0.04 | 13517.30 | 0.08 | 2846.47 | 0.08 | 6.42 | 30.35 |
|  | Max | 173.97 | 13.30 | 284412.00 | 1155.80 | 5819.60 | 59.30 | 9660.00 | 31742.60 | 3159.57 | 0.16 | 63951.00 | 0.61 | 19243.00 | 0.97 | 36.40 | 119.26 |
|  | Min | 0.00 | 0.20 | 0.00 | 14.60 | 0.40 | 0.00 | 289.00 | 344.10 | 241.85 | 0.02 | 7778.00 | 0.23 | 7768.00 | 0.63 | 0.50 | 1.93 |
| 2008 | Mean | 58.10 | 6.36 | 82581.97 | 332.48 | 1609.67 | 12.56 | 4239.81 | 10329.12 | 1588.66 | 0.08 | 24847.06 | 0.46 | 11002.81 | 0.73 | 8.29 | 33.93 |
|  | Std dev | 51.28 | 3.28 | 77013.44 | 267.94 | 1873.86 | 15.45 | 2681.39 | 8576.62 | 836.72 | 0.04 | 14484.69 | 0.09 | 3121.75 | 0.08 | 7.05 | 35.35 |
|  | Max | 223.84 | 13.30 | 338312.00 | 1193.30 | 6373.00 | 63.40 | 9893.00 | 36704.20 | 3778.57 | 0.14 | 69154.00 | 0.61 | 21875.00 | 0.89 | 40.10 | 132.52 |
|  | Min | 0.20 | 0.20 | 0.00 | 0.00 | 4.00 | 0.00 | 292.00 | 398.20 | 324.61 | 0.02 | 9697.00 | 0.21 | 8383.00 | 0.56 | 0.60 | 2.90 |
| 2009 | Mean | 81.03 | 6.64 | 90111.52 | 362.34 | 1582.92 | 13.81 | 4272.35 | 11287.48 | 1969.17 | 0.09 | 26704.87 | 0.45 | 12042.00 | 0.72 | 8.79 | 42.28 |
|  | Std dev | 68.53 | 3.36 | 80155.37 | 289.76 | 1896.25 | 15.91 | 2703.58 | 9343.87 | 981.16 | 0.03 | 15033.14 | 0.08 | 3454.87 | 0.08 | 7.73 | 49.92 |
|  | Max | 296.00 | 13.60 | 355762.00 | 1283.90 | 7261.10 | 54.10 | 10130.00 | 39464.70 | 4334.37 | 0.17 | 72363.00 | 0.57 | 23929.00 | 0.85 | 43.80 | 215.31 |
|  | Min | 2.71 | 0.20 | 0.00 | 0.00 | 1.50 | 0.00 | 296.00 | 445.70 | 432.36 | 0.02 | 10814.00 | 0.21 | 9088.00 | 0.56 | 0.70 | 2.69 |
| 2010 | Mean | 136.27 | 7.06 | 100549.42 | 397.35 | 1847.23 | 16.54 | 4302.74 | 13376.47 | 2383.37 | 0.09 | 31180.48 | 0.46 | 13260.61 | 0.71 | 9.43 | 51.25 |
|  | Std dev | 219.34 | 3.63 | 92012.44 | 307.79 | 2578.83 | 16.51 | 2720.02 | 10948.40 | 1182.98 | 0.03 | 16355.86 | 0.08 | 3889.38 | 0.08 | 8.24 | 57.98 |
|  | Max | 1262.73 | 14.00 | 436041.00 | 1398.00 | 12007.30 | 58.10 | 10441.00 | 45944.60 | 5421.54 | 0.17 | 79396.00 | 0.60 | 26737.00 | 0.86 | 45.70 | 214.44 |
|  | Min | 0.29 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 300.00 | 512.90 | 551.04 | 0.03 | 12882.00 | 0.22 | 10106.00 | 0.50 | 0.70 | 2.71 |
| 2011 | Mean | 147.01 | 7.44 | 108906.74 | 422.26 | 2273.03 | 29.56 | 4344.74 | 15852.25 | 2991.41 | 0.08 | 36438.94 | 0.46 | 14924.48 | 0.70 | 9.64 | 60.83 |
|  | Std dev | 113.44 | 3.83 | 99901.05 | 315.77 | 3034.50 | 52.23 | 2754.43 | 12668.53 | 1406.69 | 0.03 | 17445.14 | 0.08 | 4197.95 | 0.08 | 8.73 | 63.04 |
|  | Max | 434.25 | 14.40 | 479607.00 | 1449.00 | 13394.00 | 290.96 | 10756.00 | 53072.80 | 6712.40 | 0.15 | 86246.00 | 0.62 | 28929.00 | 0.87 | 50.60 | 218.50 |
|  | Min | 0.00 | 0.20 | 0.00 | 0.00 | 9.00 | 0.00 | 309.00 | 611.50 | 705.91 | 0.02 | 16024.00 | 0.21 | 11407.00 | 0.50 | 0.70 | 3.38 |
| 2012 | Mean | 163.31 | 7.86 | 117362.55 | 467.40 | 2282.03 | 22.52 | 4377.23 | 17518.17 | 3457.69 | 0.06 | 39916.58 | 0.45 | 16443.48 | 0.70 | 10.66 | 72.33 |
|  | Std dev | 120.75 | 3.95 | 109402.65 | 363.82 | 3057.89 | 23.65 | 2785.27 | 13735.58 | 1572.06 | 0.02 | 18119.78 | 0.08 | 4361.30 | 0.09 | 9.32 | 72.68 |
|  | Max | 446.46 | 15.60 | 543394.00 | 1690.60 | 11655.00 | 97.64 | 11041.00 | 57007.70 | 7387.86 | 0.13 | 92758.00 | 0.59 | 30256.00 | 0.92 | 54.00 | 257.24 |
|  | Min | 0.75 | 0.20 | 5.00 | 0.00 | 6.00 | 0.00 | 315.00 | 710.20 | 864.36 | 0.02 | 18947.00 | 0.20 | 12507.00 | 0.48 | 1.10 | 5.09 |
| 2013 | Mean | 168.12 | 8.36 | 123191.87 | 496.58 | 2676.52 | 22.62 | 4403.10 | 19289.51 | 3862.59 | 0.06 | 43631.10 | 0.44 | 17841.68 | 0.71 | 12.51 | 87.59 |
|  | Std dev | 133.55 | 4.07 | 115626.96 | 375.56 | 4674.97 | 23.55 | 2810.60 | 15071.84 | 1783.54 | 0.02 | 19237.12 | 0.08 | 4690.68 | 0.10 | 10.74 | 87.17 |
|  | Max | 528.36 | 16.30 | 586519.00 | 1770.30 | 23429.00 | 109.17 | 11270.00 | 62503.40 | 8411.00 | 0.14 | 100569.00 | 0.56 | 32447.00 | 0.96 | 59.70 | 344.94 |
|  | Min | 1.54 | 0.20 | 6.00 | 0.00 | 7.00 | 0.00 | 317.00 | 828.20 | 922.48 | 0.02 | 22089.00 | 0.20 | 13679.00 | 0.48 | 1.10 | 4.17 |
| 2014 | Mean | 176.25 | 8.69 | 129554.77 | 528.84 | 2593.13 | 29.97 | 4432.81 | 20913.04 | 4168.24 | 0.05 | 46895.81 | 0.43 | 19291.48 | 0.72 | 13.16 | 92.83 |
|  | Std dev | 141.92 | 4.35 | 118195.56 | 401.79 | 4476.74 | 27.48 | 2839.99 | 16395.86 | 1920.69 | 0.01 | 20391.93 | 0.08 | 4998.18 | 0.10 | 10.97 | 87.07 |
|  | Max | 579.31 | 17.30 | 597118.00 | 1912.70 | 22927.00 | 113.07 | 11489.00 | 68173.00 | 9152.64 | 0.08 | 106732.00 | 0.53 | 35182.00 | 0.97 | 59.80 | 327.10 |
|  | Min | 2.20 | 0.20 | 1710.00 | 0.00 | 3.00 | 0.00 | 325.00 | 939.70 | 1000.45 | 0.02 | 25101.00 | 0.19 | 14637.00 | 0.50 | 1.10 | 4.42 |
| 2015 | Mean | 159.70 | 8.82 | 138330.68 | 581.06 | 2355.94 | 37.87 | 4454.74 | 22375.55 | 4849.54 | 0.05 | 49498.29 | 0.41 | 20715.58 | 0.73 | 13.24 | 109.17 |
|  | Std dev | 119.46 | 4.46 | 123827.63 | 454.83 | 3444.57 | 34.74 | 2867.32 | 18035.51 | 2444.63 | 0.02 | 21859.67 | 0.07 | 5248.49 | 0.08 | 11.08 | 122.01 |
|  | Max | 452.12 | 18.30 | 628706.00 | 2124.60 | 14729.00 | 120.34 | 11678.00 | 74732.40 | 12827.80 | 0.09 | 113692.00 | 0.51 | 36946.00 | 0.97 | 59.30 | 569.55 |
|  | Min | 7.70 | 0.20 | 2478.00 | 0.00 | 4.00 | 0.00 | 330.00 | 1043.00 | 1138.49 | 0.03 | 25946.00 | 0.18 | 15819.00 | 0.54 | 1.20 | 5.41 |
| 2016 | Mean | 290.89 | 8.69 | 144772.39 | 634.64 | 2749.42 | 139.27 | 4483.97 | 24224.15 | 5172.62 | 0.04 | 53260.00 | 0.39 | 22344.03 | 0.73 | 13.54 | 125.09 |
|  | Std dev | 217.78 | 4.26 | 128397.71 | 487.53 | 3888.10 | 124.95 | 2903.66 | 19682.92 | 2566.99 | 0.01 | 23995.25 | 0.07 | 5519.72 | 0.09 | 12.36 | 150.48 |
|  | Max | 780.80 | 17.60 | 647773.00 | 2300.60 | 19139.00 | 465.70 | 11908.00 | 82163.20 | 13446.09 | 0.10 | 123391.00 | 0.50 | 39857.00 | 0.96 | 69.00 | 742.97 |
|  | Min | 14.10 | 0.20 | 7819.00 | 42.00 | 22.00 | 0.00 | 340.00 | 1173.00 | 1254.54 | 0.02 | 27396.00 | 0.17 | 16993.00 | 0.55 | 1.20 | 4.81 |
| 2017 | Mean | 19.63 | 8.67 | 150158.39 | 678.53 | 3042.35 | 192.67 | 4509.00 | 26841.82 | 5588.01 | 0.04 | 58706.74 | 0.39 | 23645.94 | 0.73 | 13.56 | 143.23 |
|  | Std dev | 14.73 | 4.25 | 132749.46 | 540.98 | 4530.88 | 172.56 | 2935.88 | 21801.20 | 2842.30 | 0.02 | 26378.97 | 0.07 | 5796.11 | 0.10 | 12.85 | 168.70 |
|  | Max | 64.00 | 18.10 | 673323.00 | 2591.20 | 21501.00 | 726.00 | 12141.00 | 91648.70 | 15037.48 | 0.11 | 136172.00 | 0.48 | 42304.00 | 1.01 | 71.20 | 823.89 |
|  | Min | 1.79 | 0.20 | 7694.00 | 44.40 | 46.00 | 0.10 | 349.00 | 1349.00 | 1372.78 | 0.02 | 29103.00 | 0.17 | 18349.00 | 0.52 | 1.00 | 8.49 |
| 2018 | Mean | 19.01 | 8.39 | 160520.23 | 727.92 | 3331.77 | 218.99 | 4526.13 | 29487.66 | 6070.85 | 0.05 | 64366.13 | 0.38 | 25420.48 | 0.71 | 13.27 | 167.95 |
|  | Std dev | 14.60 | 4.42 | 139631.73 | 594.56 | 5183.44 | 199.44 | 2964.21 | 23743.70 | 3085.20 | 0.02 | 28922.64 | 0.07 | 6151.19 | 0.10 | 13.20 | 207.63 |
|  | Max | 54.58 | 20.40 | 716216.00 | 3031.60 | 25601.00 | 774.80 | 12348.00 | 99945.20 | 15729.26 | 0.09 | 150962.00 | 0.49 | 46015.00 | 0.92 | 71.70 | 1034.71 |
|  | Min | 1.00 | 0.50 | 7844.00 | 51.80 | 23.00 | 0.60 | 354.00 | 1548.40 | 1419.06 | 0.02 | 32178.00 | 0.17 | 19790.00 | 0.46 | 0.80 | 8.12 |
| 2019 | Mean | 194.12 | 7.89 | 173202.65 | 774.61 | 3559.90 | 243.20 | 4542.10 | 31687.76 | 6572.36 | 0.05 | 68867.10 | 0.37 | 27264.77 | 0.68 | 14.01 | 192.08 |
|  | Std dev | 149.12 | 4.30 | 151284.76 | 645.83 | 5734.98 | 223.52 | 2984.87 | 25428.32 | 3354.86 | 0.01 | 30562.55 | 0.07 | 6591.42 | 0.09 | 13.98 | 235.84 |
|  | Max | 562.09 | 18.00 | 782028.00 | 3345.70 | 27402.00 | 1046.10 | 12489.00 | 107986.90 | 17297.85 | 0.09 | 161776.00 | 0.47 | 48272.00 | 0.90 | 68.90 | 1168.79 |
|  | Min | 9.75 | 0.50 | 9130.00 | 63.60 | 25.00 | 0.50 | 361.00 | 1697.80 | 1438.29 | 0.02 | 34707.00 | 0.16 | 21159.00 | 0.51 | 1.20 | 7.28 |
| 2020 | Mean | 220.71 | 7.93 | 179767.16 | 756.52 | 2959.71 | 246.14 | 4548.81 | 32578.63 | 6793.02 | 0.04 | 70658.23 | 0.36 | 26080.68 | 0.66 | 13.92 | 187.16 |
|  | Std dev | 161.70 | 4.51 | 155363.87 | 606.77 | 4370.30 | 232.50 | 3004.31 | 26224.30 | 3486.48 | 0.01 | 30830.70 | 0.07 | 5945.43 | 0.10 | 12.58 | 206.09 |
|  | Max | 534.79 | 20.40 | 811273.00 | 3101.00 | 19546.00 | 1004.41 | 12624.00 | 111151.60 | 17430.79 | 0.08 | 164158.00 | 0.46 | 44839.00 | 0.87 | 58.20 | 955.73 |
|  | Min | 3.12 | 0.60 | 9663.00 | 62.10 | 1.00 | 0.49 | 366.00 | 1902.70 | 1480.36 | 0.02 | 35848.00 | 0.16 | 20332.00 | 0.49 | 1.00 | 8.99 |
| 2021 | Mean | 212.20 | 8.15 | 197385.61 | 801.27 | 2867.00 | 272.93 | 4550.32 | 36854.29 | 6794.29 | 0.03 | 80141.84 | 0.38 | 29306.39 | 0.63 | 14.53 | 208.52 |
|  | Std dev | 154.80 | 4.62 | 173139.73 | 637.42 | 4666.05 | 215.25 | 3011.14 | 29581.27 | 3697.81 | 0.01 | 34985.73 | 0.07 | 6931.96 | 0.10 | 13.51 | 225.38 |
|  | Max | 566.76 | 21.70 | 908773.00 | 3288.60 | 21664.00 | 1008.20 | 12684.00 | 124719.50 | 18247.01 | 0.06 | 187526.00 | 0.51 | 51295.00 | 0.85 | 61.20 | 982.76 |
|  | Min | 12.97 | 0.70 | 9106.00 | 69.00 | 5.00 | 0.10 | 366.00 | 2080.20 | 1427.89 | 0.01 | 40976.00 | 0.18 | 21966.00 | 0.45 | 1.10 | 8.34 |

# Table S.2 First-stage DEA results

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Province | 2004 |  |  |  | 2005 |  |  |  | 2006 |  |  |  | 2007 |  |  |  | 2008 |  |  |  |
| TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale |
| Peking | 0.69 | 0.697 | 0.991 | irs | 0.747 | 0.753 | 0.993 | drs | 0.826 | 0.827 | 0.999 | irs | 0.825 | 0.848 | 0.972 | drs | 0.845 | 0.856 | 0.988 | drs |
| Tianjin | 0.477 | 0.511 | 0.934 | irs | 0.517 | 0.553 | 0.934 | irs | 0.614 | 0.684 | 0.898 | irs | 0.538 | 0.572 | 0.941 | irs | 0.501 | 0.542 | 0.925 | irs |
| Hebei | 0.921 | 1 | 0.921 | drs | 0.851 | 1 | 0.851 | drs | 0.623 | 0.631 | 0.988 | drs | 0.789 | 0.948 | 0.832 | drs | 0.856 | 1 | 0.856 | drs |
| Shanxi | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Inner Mongolia | 0.347 | 0.36 | 0.965 | irs | 0.339 | 0.354 | 0.956 | irs | 0.521 | 0.522 | 0.999 | - | 0.45 | 0.451 | 0.997 | irs | 0.724 | 0.876 | 0.826 | drs |
| Liaoning | 0.73 | 1 | 0.73 | drs | 0.717 | 1 | 0.717 | drs | 0.749 | 1 | 0.749 | drs | 0.741 | 1 | 0.741 | drs | 0.801 | 1 | 0.801 | drs |
| Jilin | 0.593 | 0.642 | 0.923 | drs | 0.482 | 0.548 | 0.88 | drs | 0.318 | 0.325 | 0.978 | irs | 0.439 | 0.439 | 0.998 | irs | 0.408 | 0.412 | 0.992 | irs |
| Heilongjiang | 0.473 | 0.474 | 0.999 | irs | 0.667 | 0.684 | 0.975 | drs | 0.42 | 0.423 | 0.993 | irs | 0.504 | 0.512 | 0.984 | irs | 0.326 | 0.34 | 0.959 | irs |
| Shanghai | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Jiangsu | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.863 | 0.934 | 0.924 | drs | 0.859 | 0.994 | 0.864 | drs | 0.843 | 0.917 | 0.919 | drs |
| Zhejiang | 0.972 | 0.981 | 0.99 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Anhui | 0.684 | 0.69 | 0.993 | irs | 0.556 | 0.561 | 0.991 | irs | 0.578 | 0.602 | 0.96 | irs | 0.63 | 0.641 | 0.982 | irs | 0.546 | 0.556 | 0.982 | irs |
| Fujian | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.782 | 0.791 | 0.988 | irs | 0.946 | 0.946 | 0.999 | irs | 1 | 1 | 1 | - |
| Jiangxi | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.793 | 0.794 | 0.999 | irs | 0.917 | 1 | 0.917 | drs | 0.996 | 1 | 0.996 | drs |
| Shandong | 1 | 1 | 1 | - | 0.664 | 0.664 | 1 | - | 0.76 | 0.792 | 0.959 | drs | 0.935 | 1 | 0.935 | drs | 0.843 | 1 | 0.843 | drs |
| Henan | 0.557 | 0.573 | 0.973 | drs | 0.645 | 0.74 | 0.872 | drs | 0.485 | 0.485 | 0.999 | - | 0.554 | 0.554 | 0.999 | - | 0.639 | 0.757 | 0.844 | drs |
| Hubei | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.781 | 0.8 | 0.977 | irs | 0.779 | 0.781 | 0.998 | irs | 0.74 | 0.746 | 0.992 | irs |
| Hunan | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.701 | 0.705 | 0.994 | irs | 0.48 | 0.485 | 0.989 | irs | 0.46 | 0.472 | 0.973 | irs |
| Guangdong | 0.837 | 1 | 0.837 | drs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Guangxi | 0.64 | 0.647 | 0.989 | irs | 0.608 | 0.618 | 0.983 | irs | 0.599 | 0.615 | 0.975 | irs | 0.642 | 0.669 | 0.958 | drs | 0.612 | 0.624 | 0.98 | irs |
| Hainan | 0.872 | 0.901 | 0.968 | irs | 0.855 | 0.903 | 0.946 | irs | 0.988 | 1 | 0.988 | irs | 0.332 | 0.382 | 0.869 | irs | 0.445 | 0.476 | 0.933 | irs |
| Chongqing | 0.457 | 0.51 | 0.897 | irs | 0.518 | 0.568 | 0.912 | irs | 0.593 | 0.606 | 0.979 | irs | 0.596 | 0.601 | 0.992 | irs | 0.682 | 0.729 | 0.936 | irs |
| Sichuan | 0.481 | 0.487 | 0.986 | irs | 0.623 | 0.623 | 1 | - | 0.656 | 0.667 | 0.984 | drs | 0.65 | 0.672 | 0.967 | drs | 0.743 | 0.776 | 0.957 | drs |
| Guizhou | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Yunnan | 0.939 | 0.959 | 0.979 | drs | 0.883 | 0.907 | 0.973 | drs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Tibet | 0.021 | 1 | 0.021 | irs | 0 | 1 | 0 | irs | 0.89 | 1 | 0.89 | irs | 1 | 1 | 1 | - | 0 | 1 | 0 | irs |
| Shaanxi | 0.434 | 0.434 | 0.999 | - | 0.506 | 0.51 | 0.992 | drs | 0.594 | 0.594 | 1 | - | 0.458 | 0.459 | 0.998 | irs | 0.641 | 0.645 | 0.993 | irs |
| Gansu | 0.661 | 0.665 | 0.993 | drs | 0.445 | 0.479 | 0.929 | irs | 1 | 1 | 1 | - | 0.623 | 0.643 | 0.969 | irs | 0.63 | 0.651 | 0.967 | irs |
| Qinghai | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.96 | 1 | 0.96 | irs | 0.783 | 0.8 | 0.978 | irs | 0.591 | 0.788 | 0.749 | irs |
| Ningxia | 0.411 | 0.49 | 0.84 | irs | 0.55 | 0.615 | 0.894 | irs | 0.426 | 0.455 | 0.936 | irs | 0.4 | 0.437 | 0.914 | irs | 0.426 | 0.501 | 0.85 | irs |
| Xinjiang | 0.419 | 0.44 | 0.952 | irs | 0.422 | 0.452 | 0.935 | irs | 0.571 | 0.593 | 0.963 | irs | 0.344 | 0.361 | 0.953 | irs | 0.395 | 0.419 | 0.941 | irs |
| Mean | 0.73 | 0.789 | 0.932 |  | 0.729 | 0.791 | 0.927 |  | 0.745 | 0.769 | 0.97 |  | 0.716 | 0.748 | 0.96 |  | 0.7 | 0.777 | 0.91 |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Province | 2009 |  |  |  | 2010 |  |  |  | 2011 |  |  |  | 2012 |  |  |  | 2013 |  |  |  |
| TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale |
| Peking | 0.715 | 0.716 | 0.998 | irs | 0.726 | 0.73 | 0.995 | drs | 0.688 | 0.701 | 0.982 | irs | 0.57 | 0.583 | 0.977 | irs | 0.627 | 0.639 | 0.98 | irs |
| Tianjin | 0.517 | 0.557 | 0.928 | irs | 0.549 | 0.587 | 0.936 | irs | 0.555 | 0.606 | 0.916 | irs | 0.467 | 0.515 | 0.908 | irs | 0.496 | 0.539 | 0.921 | irs |
| Hebei | 0.825 | 0.879 | 0.939 | drs | 1 | 1 | 1 | - | 0.805 | 0.807 | 0.999 | irs | 0.717 | 0.72 | 0.997 | irs | 1 | 1 | 1 | - |
| Shanxi | 0.983 | 1 | 0.983 | drs | 0.868 | 1 | 0.868 | drs | 1 | 1 | 1 | - | 0.819 | 0.822 | 0.997 | irs | 0.639 | 0.651 | 0.981 | irs |
| Inner Mongolia | 0.8 | 0.845 | 0.946 | drs | 0.744 | 0.749 | 0.993 | irs | 0.955 | 0.956 | 0.999 | irs | 1 | 1 | 1 | - | 0.766 | 0.768 | 0.997 | drs |
| Liaoning | 1 | 1 | 1 | - | 0.783 | 1 | 0.783 | drs | 0.931 | 1 | 0.931 | drs | 0.85 | 1 | 0.85 | drs | 0.777 | 0.82 | 0.948 | drs |
| Jilin | 0.477 | 0.479 | 0.997 | drs | 0.415 | 0.42 | 0.988 | irs | 0.677 | 0.677 | 1 | - | 0.285 | 0.297 | 0.959 | irs | 0.951 | 0.956 | 0.994 | drs |
| Heilongjiang | 0.324 | 0.336 | 0.965 | irs | 0.406 | 0.411 | 0.987 | irs | 0.496 | 0.499 | 0.994 | drs | 0.321 | 0.334 | 0.96 | irs | 0.326 | 0.34 | 0.958 | irs |
| Shanghai | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.918 | 0.937 | 0.979 | irs | 0.775 | 0.79 | 0.982 | irs |
| Jiangsu | 0.853 | 0.916 | 0.931 | drs | 0.924 | 1 | 0.924 | drs | 0.856 | 0.859 | 0.997 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Zhejiang | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.922 | 0.923 | 0.999 | drs | 0.751 | 0.756 | 0.995 | irs | 1 | 1 | 1 | - |
| Anhui | 0.561 | 0.573 | 0.98 | irs | 0.598 | 0.611 | 0.979 | irs | 0.613 | 0.629 | 0.974 | irs | 0.519 | 0.533 | 0.973 | irs | 0.578 | 0.595 | 0.971 | irs |
| Fujian | 1 | 1 | 1 | - | 0.988 | 1 | 0.988 | irs | 0.962 | 0.988 | 0.974 | irs | 0.853 | 0.879 | 0.971 | irs | 0.947 | 0.971 | 0.976 | irs |
| Jiangxi | 1 | 1 | 1 | - | 0.836 | 0.848 | 0.985 | irs | 0.537 | 0.564 | 0.951 | irs | 0.436 | 0.462 | 0.944 | irs | 0.404 | 0.425 | 0.95 | irs |
| Shandong | 1 | 1 | 1 | - | 0.788 | 0.896 | 0.88 | drs | 1 | 1 | 1 | - | 0.852 | 0.854 | 0.997 | irs | 0.714 | 0.716 | 0.996 | irs |
| Henan | 0.632 | 1 | 0.632 | drs | 0.673 | 0.803 | 0.839 | drs | 0.817 | 0.821 | 0.994 | drs | 0.59 | 0.592 | 0.997 | irs | 0.616 | 0.623 | 0.988 | irs |
| Hubei | 0.581 | 0.581 | 1 | - | 0.646 | 0.667 | 0.968 | drs | 0.577 | 0.589 | 0.979 | irs | 0.509 | 0.52 | 0.978 | irs | 0.675 | 0.688 | 0.982 | irs |
| Hunan | 0.442 | 0.453 | 0.975 | irs | 0.727 | 0.792 | 0.917 | drs | 0.907 | 0.907 | 1 | - | 0.643 | 0.65 | 0.99 | irs | 0.624 | 0.637 | 0.981 | irs |
| Guangdong | 0.961 | 1 | 0.961 | drs | 0.988 | 1 | 0.988 | drs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Guangxi | 0.516 | 0.527 | 0.98 | irs | 0.555 | 0.56 | 0.992 | irs | 0.439 | 0.451 | 0.974 | irs | 0.497 | 0.506 | 0.982 | irs | 0.361 | 0.377 | 0.959 | irs |
| Hainan | 0.339 | 0.442 | 0.766 | irs | 0.474 | 0.508 | 0.932 | irs | 0.825 | 0.833 | 0.99 | drs | 0.359 | 0.43 | 0.835 | irs | 0.372 | 0.458 | 0.812 | irs |
| Chongqing | 0.643 | 0.684 | 0.94 | irs | 0.694 | 0.723 | 0.959 | irs | 0.788 | 0.822 | 0.959 | irs | 0.643 | 0.675 | 0.953 | irs | 0.671 | 0.701 | 0.957 | irs |
| Sichuan | 0.846 | 1 | 0.846 | drs | 0.856 | 1 | 0.856 | drs | 1 | 1 | 1 | - | 0.827 | 1 | 0.827 | drs | 0.708 | 0.712 | 0.994 | irs |
| Guizhou | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.903 | 0.914 | 0.989 | irs | 0.791 | 0.811 | 0.974 | irs | 0.558 | 0.592 | 0.942 | irs |
| Yunnan | 0.749 | 0.751 | 0.997 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Tibet | 0 | 1 | 0 | irs | 0 | 1 | 0 | irs | 1 | 1 | 1 | - | 0.368 | 1 | 0.368 | irs | 0.16 | 1 | 0.16 | irs |
| Shaanxi | 0.444 | 0.454 | 0.978 | irs | 0.53 | 0.534 | 0.993 | irs | 0.567 | 0.575 | 0.987 | irs | 0.44 | 0.451 | 0.974 | irs | 0.485 | 0.501 | 0.969 | irs |
| Gansu | 0.805 | 0.813 | 0.99 | irs | 0.565 | 0.597 | 0.945 | irs | 0.933 | 0.935 | 0.997 | irs | 0.47 | 0.489 | 0.962 | irs | 0.515 | 0.518 | 0.994 | drs |
| Qinghai | 0.832 | 1 | 0.832 | irs | 0.713 | 0.835 | 0.854 | irs | 1 | 1 | 1 | - | 0.5 | 0.693 | 0.721 | irs | 1 | 1 | 1 | - |
| Ningxia | 0.484 | 0.67 | 0.723 | irs | 0.61 | 0.694 | 0.878 | irs | 0.832 | 0.85 | 0.978 | irs | 0.569 | 0.641 | 0.887 | irs | 0.512 | 0.597 | 0.858 | irs |
| Xinjiang | 0.396 | 0.427 | 0.927 | irs | 0.488 | 0.508 | 0.96 | irs | 0.55 | 0.578 | 0.951 | irs | 0.468 | 0.496 | 0.943 | irs | 0.503 | 0.532 | 0.946 | irs |
| Mean | 0.701 | 0.777 | 0.91 |  | 0.714 | 0.79 | 0.916 |  | 0.811 | 0.822 | 0.984 |  | 0.646 | 0.698 | 0.932 |  | 0.67 | 0.714 | 0.942 |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Province | 2014 |  |  |  | 2015 |  |  |  | 2016 |  |  |  | 2017 |  |  |  | 2018 |  |  |  |
| TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale |
| Peking | 0.668 | 0.68 | 0.982 | irs | 0.5 | 0.514 | 0.973 | irs | 0.426 | 0.615 | 0.693 | drs | 0.48 | 0.567 | 0.846 | drs | 0.49 | 0.501 | 0.979 | irs |
| Tianjin | 0.53 | 0.562 | 0.943 | irs | 0.581 | 0.608 | 0.954 | irs | 0.973 | 1 | 0.973 | irs | 0.575 | 0.757 | 0.76 | irs | 0.768 | 0.892 | 0.861 | irs |
| Hebei | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.637 | 0.641 | 0.994 | drs | 0.513 | 0.521 | 0.985 | drs | 0.505 | 0.515 | 0.98 | irs |
| Shanxi | 0.628 | 0.639 | 0.983 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Inner Mongolia | 0.985 | 0.991 | 0.993 | irs | 1 | 1 | 1 | - | 0.913 | 0.914 | 0.999 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Liaoning | 0.975 | 1 | 0.975 | drs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.74 | 0.765 | 0.967 | irs | 1 | 1 | 1 | - |
| Jilin | 1 | 1 | 1 | - | 0.721 | 0.735 | 0.98 | irs | 1 | 1 | 1 | - | 0.74 | 0.848 | 0.872 | irs | 0.715 | 0.738 | 0.969 | irs |
| Heilongjiang | 0.427 | 0.438 | 0.976 | irs | 0.367 | 0.38 | 0.967 | irs | 0.489 | 0.506 | 0.965 | irs | 0.427 | 0.54 | 0.79 | irs | 0.602 | 0.61 | 0.987 | irs |
| Shanghai | 0.768 | 0.78 | 0.985 | irs | 0.713 | 0.724 | 0.986 | irs | 0.675 | 0.675 | 1 | - | 0.64 | 0.655 | 0.977 | irs | 0.611 | 0.633 | 0.965 | irs |
| Jiangsu | 1 | 1 | 1 | - | 0.884 | 1 | 0.884 | drs | 0.859 | 1 | 0.859 | drs | 0.826 | 0.913 | 0.904 | drs | 1 | 1 | 1 | - |
| Zhejiang | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.972 | 1 | 0.972 | drs | 1 | 1 | 1 | - |
| Anhui | 0.543 | 0.56 | 0.97 | irs | 0.55 | 0.56 | 0.982 | irs | 0.649 | 0.652 | 0.994 | drs | 0.616 | 0.63 | 0.979 | drs | 0.777 | 0.808 | 0.962 | irs |
| Fujian | 0.934 | 0.956 | 0.977 | irs | 0.985 | 1 | 0.985 | irs | 0.807 | 0.888 | 0.908 | drs | 0.925 | 0.964 | 0.96 | drs | 1 | 1 | 1 | - |
| Jiangxi | 0.386 | 0.406 | 0.952 | irs | 0.343 | 0.362 | 0.948 | irs | 0.465 | 0.49 | 0.95 | drs | 0.439 | 0.455 | 0.966 | drs | 0.593 | 0.616 | 0.963 | irs |
| Shandong | 0.59 | 0.593 | 0.994 | irs | 0.691 | 0.869 | 0.795 | drs | 0.709 | 1 | 0.709 | drs | 0.693 | 1 | 0.693 | drs | 0.668 | 1 | 0.668 | drs |
| Henan | 0.59 | 0.598 | 0.988 | irs | 0.612 | 0.618 | 0.99 | irs | 0.642 | 0.649 | 0.989 | drs | 0.56 | 0.602 | 0.931 | drs | 0.564 | 0.569 | 0.993 | irs |
| Hubei | 0.623 | 0.634 | 0.983 | irs | 0.627 | 0.636 | 0.987 | irs | 0.855 | 0.977 | 0.875 | drs | 0.537 | 0.569 | 0.945 | drs | 0.542 | 0.556 | 0.974 | irs |
| Hunan | 0.621 | 0.634 | 0.98 | irs | 0.725 | 0.736 | 0.985 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Guangdong | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Guangxi | 0.49 | 0.5 | 0.979 | irs | 0.427 | 0.436 | 0.978 | irs | 0.651 | 0.655 | 0.994 | irs | 0.587 | 0.596 | 0.986 | irs | 0.65 | 0.677 | 0.96 | irs |
| Hainan | 1 | 1 | 1 | - | 0.453 | 0.609 | 0.743 | irs | 0.994 | 1 | 0.994 | irs | 0.427 | 0.628 | 0.68 | irs | 0.504 | 0.566 | 0.89 | irs |
| Chongqing | 0.666 | 0.693 | 0.961 | irs | 0.577 | 0.597 | 0.966 | irs | 0.573 | 0.594 | 0.964 | irs | 0.506 | 0.517 | 0.98 | drs | 0.589 | 0.612 | 0.961 | irs |
| Sichuan | 1 | 1 | 1 | - | 0.72 | 0.724 | 0.995 | irs | 0.682 | 0.682 | 1 | - | 0.585 | 0.59 | 0.992 | drs | 0.651 | 0.657 | 0.991 | irs |
| Guizhou | 0.537 | 0.568 | 0.945 | irs | 0.585 | 0.612 | 0.955 | irs | 0.568 | 0.569 | 0.998 | irs | 0.518 | 0.548 | 0.946 | irs | 0.494 | 0.534 | 0.925 | irs |
| Yunnan | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.803 | 0.817 | 0.983 | irs |
| Tibet | 0.298 | 1 | 0.298 | irs | 0.442 | 1 | 0.442 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.709 | 1 | 0.709 | irs |
| Shaanxi | 0.544 | 0.554 | 0.981 | irs | 0.546 | 0.557 | 0.98 | irs | 0.478 | 0.484 | 0.987 | drs | 0.488 | 0.488 | 1 | - | 0.553 | 0.569 | 0.972 | irs |
| Gansu | 0.699 | 0.715 | 0.977 | irs | 0.532 | 0.558 | 0.954 | irs | 0.53 | 0.596 | 0.888 | irs | 0.617 | 0.73 | 0.845 | irs | 0.443 | 0.449 | 0.987 | irs |
| Qinghai | 0.742 | 0.908 | 0.818 | irs | 0.904 | 1 | 0.904 | irs | 0.638 | 0.695 | 0.919 | irs | 0.504 | 1 | 0.504 | irs | 0.949 | 1 | 0.949 | irs |
| Ningxia | 0.548 | 0.632 | 0.867 | irs | 0.606 | 0.677 | 0.896 | irs | 0.799 | 0.828 | 0.966 | irs | 0.819 | 1 | 0.819 | irs | 0.862 | 1 | 0.862 | irs |
| Xinjiang | 0.921 | 0.94 | 0.98 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.611 | 0.624 | 0.979 | drs | 0.61 | 0.637 | 0.956 | irs |
| Mean | 0.733 | 0.774 | 0.951 |  | 0.733 | 0.774 | 0.951 |  | 0.775 | 0.81 | 0.955 |  | 0.689 | 0.758 | 0.912 |  | 0.731 | 0.773 | 0.95 |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Province | 2019 |  |  |  | 2020 |  |  |  | 2021 |  |  |  |
| TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale |
| Peking | 0.439 | 0.448 | 0.98 | irs | 0.451 | 0.46 | 0.98 | irs | 0.453 | 0.458 | 0.99 | irs |
| Tianjin | 0.661 | 0.733 | 0.902 | irs | 0.841 | 0.933 | 0.901 | irs | 0.966 | 1 | 0.966 | irs |
| Hebei | 0.526 | 0.537 | 0.981 | irs | 0.669 | 0.673 | 0.995 | drs | 0.602 | 0.643 | 0.936 | drs |
| Shanxi | 0.751 | 1 | 0.751 | drs | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Inner Mongolia | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Liaoning | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Jilin | 0.612 | 0.67 | 0.913 | irs | 0.837 | 0.879 | 0.952 | drs | 0.906 | 1 | 0.906 | drs |
| Heilongjiang | 0.509 | 0.53 | 0.96 | irs | 0.613 | 0.62 | 0.988 | drs | 0.568 | 0.574 | 0.99 | irs |
| Shanghai | 0.487 | 0.504 | 0.966 | irs | 0.757 | 0.907 | 0.835 | drs | 0.766 | 0.774 | 0.99 | drs |
| Jiangsu | 0.901 | 0.996 | 0.905 | drs | 0.964 | 0.972 | 0.992 | drs | 0.965 | 0.982 | 0.982 | drs |
| Zhejiang | 0.811 | 0.812 | 0.998 | irs | 0.899 | 0.904 | 0.994 | drs | 0.994 | 1 | 0.994 | drs |
| Anhui | 0.532 | 0.558 | 0.954 | irs | 0.766 | 0.79 | 0.969 | irs | 0.829 | 0.83 | 0.999 | drs |
| Fujian | 0.775 | 0.788 | 0.983 | irs | 0.802 | 0.805 | 0.995 | irs | 0.821 | 0.826 | 0.994 | irs |
| Jiangxi | 0.642 | 0.666 | 0.964 | irs | 0.646 | 0.648 | 0.997 | irs | 0.623 | 0.64 | 0.974 | drs |
| Shandong | 0.677 | 1 | 0.677 | drs | 0.785 | 1 | 0.785 | drs | 0.82 | 1 | 0.82 | drs |
| Henan | 0.482 | 0.487 | 0.991 | irs | 0.502 | 0.502 | 0.999 | drs | 0.445 | 0.456 | 0.975 | drs |
| Hubei | 0.529 | 0.54 | 0.979 | irs | 0.82 | 0.841 | 0.975 | irs | 0.839 | 0.854 | 0.982 | irs |
| Hunan | 0.743 | 0.824 | 0.901 | drs | 0.687 | 0.701 | 0.979 | irs | 0.689 | 0.692 | 0.995 | irs |
| Guangdong | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Guangxi | 0.534 | 0.552 | 0.968 | irs | 0.657 | 0.68 | 0.966 | irs | 0.795 | 0.805 | 0.988 | drs |
| Hainan | 0.549 | 0.732 | 0.749 | irs | 0.815 | 1 | 0.815 | drs | 1 | 1 | 1 | - |
| Chongqing | 0.743 | 0.797 | 0.932 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Sichuan | 0.701 | 0.708 | 0.991 | irs | 0.777 | 0.782 | 0.994 | drs | 0.802 | 0.851 | 0.943 | drs |
| Guizhou | 0.478 | 0.505 | 0.946 | irs | 0.539 | 0.549 | 0.981 | irs | 0.539 | 0.572 | 0.943 | irs |
| Yunnan | 0.574 | 0.594 | 0.966 | irs | 1 | 1 | 1 | - | 0.632 | 0.637 | 0.993 | drs |
| Tibet | 0.722 | 1 | 0.722 | irs | 1 | 1 | 1 | - | 0.68 | 1 | 0.68 | irs |
| Shaanxi | 0.423 | 0.429 | 0.985 | irs | 0.458 | 0.464 | 0.987 | irs | 0.547 | 0.551 | 0.993 | irs |
| Gansu | 0.364 | 0.405 | 0.899 | irs | 0.49 | 0.497 | 0.985 | irs | 0.478 | 0.478 | 0.999 | - |
| Qinghai | 0.751 | 1 | 0.751 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Ningxia | 0.88 | 1 | 0.88 | irs | 0.795 | 0.977 | 0.813 | irs | 1 | 1 | 1 | - |
| Xinjiang | 0.485 | 0.504 | 0.963 | irs | 0.463 | 0.471 | 0.984 | irs | 0.51 | 0.614 | 0.831 | drs |
| Mean | 0.654 | 0.72 | 0.921 |  | 0.775 | 0.808 | 0.963 |  | 0.783 | 0.814 | 0.963 |  |

Note: - means that the returns to scale are constant, drs means that the returns to scale are decreasing, and irs means that the returns to scale are increasing.

# Table S.3 Second-stage DEA results

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2004 |  |  |  | 2005 |  |  |  |
|  | Redundancy of UEI financial input | | Redundancy of UEI labor input | | Redundancy of UEI financial input | | Redundancy of UEI labor input | |
|  | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value |
| Constant | -1.716\*\*\* | -12.043 | -0.007 | -0.144 | -10.442\*\*\* | -4.516 | -0.003 | -0.370 |
| Urban population | 0.867\*\* | 3.603 | 0.043 | 0.153 | 5.965\*\* | 3.871 | 0.000 | -0.015 |
| Urban economy | -1.530\*\*\* | -5.047 | -0.008 | -0.116 | 4.613\*\* | 4.276 | 0.004 | 0.572 |
| Fiscal expenditure | 2.851\*\*\* | 4.646 | -0.051 | -0.104 | -6.895\*\*\* | -4.599 | -0.004 | -0.403 |
| Sigma-squared | 155.138\*\*\* | 157.376 | 4.224\*\*\* | 7.174 | 432.125\*\*\* | 433.096 | 3.729\*\* | 3.601 |
| Gamma | 1.000\*\*\* | 6980794.400 | 1.000\*\*\* | 49483096.000 | 1.000\*\*\* | 951.029 | 1.000\*\*\* | 860286.210 |
| Log-likelihood function | -97.030 |  | -44.773 |  | -115.224 |  | -43.212 |  |
| LR test of the one-sided error | 21.504 |  | 18.956 |  | 16.877 |  | 20.450 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2006 |  |  |  | 2007 |  |  |  |
|  | Redundancy of UEI financial input | | Redundancy of UEI labor input | | Redundancy of UEI financial input | | Redundancy of UEI labor input | |
|  | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value |
| Constant | -1.870 | -1.506 | -0.427\*\* | -4.525 | -4.892 | -1.104 | 0.017 | 0.227 |
| Urban population | 3.767 | 1.090 | 1.353\* | 2.268 | 1.028 | 0.258 | 0.003 | 0.021 |
| Urban economy | -0.071 | -0.020 | 0.253\*\* | 2.500 | -8.099\*\* | -2.657 | 0.016 | 0.126 |
| Fiscal expenditure | -2.525 | -0.297 | -1.368 | -0.882 | 9.208\*\* | 4.226 | -0.084 | -0.352 |
| Sigma-squared | 1143.688\*\*\* | 1140.945 | 5.197\*\*\* | 21.146 | 656.870\*\*\* | 656.676 | 5.766\*\*\* | 7.781 |
| Gamma | 1.000\*\*\* | 1254364.400 | 1.000\*\*\* | 140233.830 | 1.000\*\*\* | 13644.447 | 1.000\*\*\* | 1605471.600 |
| Log-likelihood function | -131.472 |  | -48.254 |  | -121.062 |  | -46.744 |  |
| LR test of the one-sided error | 23.199 |  | 11.046 |  | 20.118 |  | 13.153 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2008 |  |  |  | 2009 |  |  |  |
|  | Redundancy of UEI financial input | | Redundancy of UEI labor input | | Redundancy of UEI financial input | | Redundancy of UEI labor input | |
|  | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value |
| Constant | -12.642\*\*\* | -9.787 | -0.001 | -0.234 | -0.084 | -0.160 | 0.009 | 0.716 |
| Urban population | 3.609\*\*\* | 6.581 | -0.001 | -0.141 | -0.629\*\*\* | -11.925 | -0.016 | -0.404 |
| Urban economy | -7.566\*\*\* | -8.854 | 0.001 | 0.143 | 0.514 | 1.621 | 0.030 | 0.780 |
| Fiscal expenditure | 12.971\*\*\* | 8.506 | 0.000 | -0.072 | -0.288 | -1.462 | -0.039\* | -1.872 |
| Sigma-squared | 957.588\*\*\* | 957.728 | 3.926\*\*\* | 36.414 | 1936.695\*\*\* | 1790.857 | 3.984\*\*\* | 20.371 |
| Gamma | 1.000\*\*\* | 236509.560 | 1.000\*\*\* | 20365798.000 | 1.000\*\*\* | 8861402.000 | 1.000\*\*\* | 4659773.300 |
| Log-likelihood function | -124.693 |  | -44.794 |  | -135.355 |  | -46.806 |  |
| LR test of the one-sided error | 23.103 |  | 19.294 |  | 23.121 |  | 23.245 |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2010 |  |  |  | 2011 |  |  |  |
|  | Redundancy of UEI financial input | | Redundancy of UEI labor input | | Redundancy of UEI financial input | | Redundancy of UEI labor input | |
|  | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value |
| Constant | -8.003\*\* | -4.516 | -0.083 | -1.577 | -41.017\*\* | -3.514 | 0.001 | 0.158 |
| Urban population | -0.541 | -0.303 | 0.242\*\* | 2.514 | 6.096\*\* | 2.426 | 0.000 | 0.026 |
| Urban economy | -14.263\*\*\* | -7.869 | -0.170\* | -2.091 | 4.010\*\* | 4.509 | 0.001 | 0.060 |
| Fiscal expenditure | 15.292\*\*\* | 8.620 | -0.084 | -1.172 | 5.548 | 1.147 | -0.005 | -0.239 |
| Sigma-squared | 1395.956\*\*\* | 1395.956 | 5.191\*\* | 2.852 | 11111.274\*\*\* | 11109.276 | 6.428\*\*\* | 11.007 |
| Gamma | 1.000\*\*\* | 4387.344 | 1.000\*\*\* | 6450357.700 | 1.000\*\*\* | 64755.679 | 1.000\*\*\* | 16654989.000 |
| Log-likelihood function | -134.494 |  | -47.652 |  | -166.155 |  | -48.364 |  |
| LR test of the one-sided error | 14.689 |  | 19.979 |  | 15.672 |  | 21.905 |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2012 |  |  |  | 2013 |  |  |  |
|  | Redundancy of UEI financial input | | Redundancy of UEI labor input | | Redundancy of UEI financial input | | Redundancy of UEI labor input | |
|  | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value |
| Constant | -32.486\*\* | -3.324 | 0.331 | 1.425 | -66.262\*\* | -2.863 | -0.805 | -0.805 |
| Urban population | 22.671\*\*\* | 4.919 | 1.135 | 1.461 | -18.578\*\*\* | -75.304 | 1.204 | 0.937 |
| Urban economy | 1.149 | 0.466 | 0.075 | 1.490 | -48.875\*\*\* | -23.525 | -2.729\*\* | -2.670 |
| Fiscal expenditure | -13.330\*\* | -2.695 | -1.606 | -1.463 | 111.293\*\*\* | 565.862 | 3.086\* | 1.650 |
| Sigma-squared | 15591.317\*\*\* | 15590.042 | 8.122\*\*\* | 14.092 | 23395.377\*\*\* | 23453.467 | 4.878\* | 1.801 |
| Gamma | 1.000\*\*\* | 63715.481 | 1.000\*\*\* | 5847154.400 | 1.000\*\*\* | 78661.313 | 0.735\* | 2.085 |
| Log-likelihood function | -171.508 |  | -56.263 |  | -177.341 |  | -58.463 |  |
| LR test of the one-sided error | 15.468 |  | 13.753 |  | 16.382 |  | 0.504 |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2014 |  |  |  | 2015 |  |  |  |
|  | Redundancy of UEI financial input | | Redundancy of UEI labor input | | Redundancy of UEI financial input | | Redundancy of UEI labor input | |
|  | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value |
| Constant | -92.838\*\*\* | -92.679 | -0.005 | -0.271 | -97.253\*\*\* | -9.869 | -0.955 | -1.203 |
| Urban population | -59.712\*\*\* | -59.696 | 0.001 | 0.023 | -25.237\*\*\* | -7.241 | -0.048 | -0.041 |
| Urban economy | -14.849\*\*\* | -14.848 | -0.001 | -0.054 | -69.717\*\*\* | -24.109 | -1.235 | -1.103 |
| Fiscal expenditure | 123.388\*\*\* | 123.378 | 0.000 | 0.012 | 149.505\*\*\* | 42.204 | 1.882\* | 1.790 |
| Sigma-squared | 26865.182\*\*\* | 26865.182 | 8.086\*\* | 4.077 | 15535.543\*\*\* | 15535.544 | 7.607\*\*\* | 7.578 |
| Gamma | 1.000\*\*\* | 382059.100 | 1.000\*\*\* | 1505339.400 | 1.000\*\*\* | 118563.390 | 1.000\*\*\* | 5.643 |
| Log-likelihood function | -180.156 |  | -54.702 |  | -172.229 |  | -57.694 |  |
| LR test of the one-sided error | 15.041 |  | 19.031 |  | 13.916 |  | 11.026 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2016 |  |  |  | 2017 |  |  |  |
|  | Redundancy of UEI financial input | | Redundancy of UEI labor input | | Redundancy of UEI financial input | | Redundancy of UEI labor input | |
|  | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value |
| Constant | -154.957\*\*\* | -154.957 | -0.004 | -0.466 | -8.501\*\*\* | -15.505 | 0.433 | 0.096 |
| Urban population | -43.714\*\*\* | -43.714 | -0.002 | -0.334 | -2.600\*\* | -3.058 | 1.298 | 1.148 |
| Urban economy | -103.871\*\*\* | -103.871 | -0.008 | -0.825 | -8.822\*\*\* | -15.941 | -3.744\*\* | -3.137 |
| Fiscal expenditure | 239.732\*\*\* | 239.732 | 0.009 | 0.493 | 16.941\*\*\* | 19.786 | 4.411\* | 2.045 |
| Sigma-squared | 32474.515\*\*\* | 32474.515 | 5.686\*\*\* | 522.177 | 375.367\*\*\* | 375.764 | 3.698\*\* | 4.420 |
| Gamma | 1.000\*\*\* | 3283.434 | 1.000\*\*\* | 35943208.000 | 1.000\*\*\* | 361240.420 | 0.000 | 0.002 |
| Log-likelihood function | -183.509 |  | -51.819 |  | -111.257 |  | -64.257 |  |
| LR test of the one-sided error | 14.212 |  | 16.202 |  | 20.937 |  | 18.374 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2018 |  |  |  | 2019 |  |  |  |
|  | Redundancy of UEI financial input | | Redundancy of UEI labor input | | Redundancy of UEI financial input | | Redundancy of UEI labor input | |
|  | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value |
|  | -11.286\*\* | -3.063 | -2.695\*\*\* | -7.244 | -82.123\*\* | -2.682 | -1.868\*\*\* | -6.087 |
| Urban population | -6.035\*\*\* | -6.945 | 0.154 | 0.205 | -31.615\*\*\* | -5.008 | 1.013\*\*\* | 6.207 |
| Urban economy | -13.227\*\*\* | -8.341 | -4.002\*\*\* | -8.444 | -94.848\*\*\* | -5.399 | -3.400\*\*\* | -6.112 |
| Fiscal expenditure | 27.256\*\*\* | 30.581 | 6.009\*\*\* | 12.418 | 170.541\*\*\* | 48.965 | 4.060\*\*\* | 6.075 |
| Sigma-squared | 217.699\*\*\* | 218.081 | 9.162\*\*\* | 12.825 | 28043.715\*\*\* | 28036.446 | 9.173\*\*\* | 48.345 |
| Gamma | 1.000\*\*\* | 5877.810 | 1.000\*\*\* | 95651.193 | 1.000\*\*\* | 23.597 | 1.000\*\*\* | 8656748.700 |
| Log-likelihood function | -103.717 |  | -58.171 |  | -182.769 |  | -59.092 |  |
| LR test of the one-sided error | 18.639 |  | 8.645 |  | 13.081 |  | 9.979 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2020 |  |  |  | 2021 |  |  |  |
|  | Redundancy of UEI financial input | | Redundancy of UEI labor input | | Redundancy of UEI financial input | | Redundancy of UEI labor input | |
|  | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value | Coefficient | *t*-value |
| Constant | -76.844\*\*\* | -85.702 | -0.001 | -0.555 | -40.153\*\*\* | -3.528 | -1.530\* | -2.196 |
| Urban population | 38.815\*\*\* | 28.019 | -0.003 | -1.235 | 76.299\*\*\* | 6.488 | -0.081 | -0.079 |
| Urban economy | -54.929\*\*\* | -36.064 | 0.001 | 0.334 | -92.521\*\*\* | -8.310 | -3.682\*\* | -2.447 |
| Fiscal expenditure | 60.785\*\*\* | 51.993 | 0.002 | 0.507 | 44.317\*\*\* | 61.045 | 4.767\*\* | 2.614 |
| Sigma-squared | 9168.133\*\*\* | 9168.252 | 6.974\*\*\* | 18.861 | 7772.818\*\*\* | 7983.422 | 9.682\*\*\* | 6.278 |
| Gamma | 1.000\*\*\* | 151468.570 | 1.000\*\*\* | 29899729.000 | 1.000\*\*\* | 1523513.200 | 1.000\*\*\* | 115889.600 |
| Log-likelihood function | -172.783 |  | -51.718 |  | -164.406 |  | -57.155 |  |
| LR test of the one-sided error | 4.736 |  | 19.223 |  | 14.397 |  | 16.108 |  |

Note: \*\*\*, \*\*, \* indicate passing the 1%, 5%, 10% significance tests respectively.

# Table S.4 Results of SFA regression analysis of environmental variables in 2021

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Redundancy of financial input | | Redundancy of labour input | |
|  | Coefficient | *t*-value | Coefficient | *t*-value |
| Constant | -40.153\*\* | -3.528 | -1.530\* | -2.196 |
| Urban population | 76.299\*\*\* | 6.488 | -0.081 | -0.079 |
| Urban economy | -92.521\*\*\* | -8.310 | -3.682\*\* | -2.447 |
| Fiscal expenditure | 44.317\*\*\* | 61.045 | 4.767\*\* | 2.614 |
| Sigma-squared | 7772.818\*\*\* | 7983.422 | 9.682 \*\*\* | 6.278 |
| Gamma | 1.000\*\*\* | 1523513.200 | 1.000\*\*\* | 115889.600 |
| Log-likelihood function | -171.605 |  | -57.155 |  |
| LR test of the one-sided error | 14.397 |  | 16.108 |  |

Note: \*\*\*, \*\*, \* indicate passing the 1%, 5%, 10% significance tests respectively.

# Table S.5 Third-stage DEA results

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2004 |  |  |  | 2005 |  |  |  | 2006 |  |  |  | 2007 |  |  |  | 2008 |  |  |  |
| Province | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale |
| Peking | 0.761 | 0.834 | 0.913 | irs | 0.816 | 0.859 | 0.95 | irs | 0.833 | 0.86 | 0.968 | irs | 0.912 | 0.939 | 0.971 | irs | 0.935 | 0.936 | 0.998 | irs |
| Tianjin | 0.478 | 0.767 | 0.623 | irs | 0.512 | 0.806 | 0.636 | irs | 0.435 | 0.933 | 0.466 | irs | 0.484 | 0.862 | 0.561 | irs | 0.519 | 0.799 | 0.649 | irs |
| Hebei | 0.976 | 1 | 0.976 | drs | 0.908 | 1 | 0.908 | drs | 0.831 | 0.853 | 0.974 | irs | 0.9 | 0.982 | 0.917 | drs | 0.91 | 1 | 0.91 | drs |
| Shanxi | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Inner Mongolia | 0.428 | 0.557 | 0.768 | irs | 0.402 | 0.541 | 0.743 | irs | 0.684 | 0.707 | 0.967 | irs | 0.588 | 0.665 | 0.883 | irs | 0.833 | 0.951 | 0.876 | drs |
| Liaoning | 0.82 | 1 | 0.82 | drs | 0.776 | 1 | 0.776 | drs | 0.9 | 1 | 0.9 | drs | 0.869 | 1 | 0.869 | drs | 0.87 | 1 | 0.87 | drs |
| Jilin | 0.727 | 0.838 | 0.868 | irs | 0.565 | 0.813 | 0.695 | irs | 0.55 | 0.761 | 0.723 | irs | 0.651 | 0.729 | 0.893 | irs | 0.478 | 0.843 | 0.566 | irs |
| Heilongjiang | 0.57 | 0.64 | 0.89 | irs | 0.772 | 0.82 | 0.942 | irs | 0.452 | 0.759 | 0.596 | irs | 0.587 | 0.794 | 0.739 | irs | 0.372 | 0.632 | 0.589 | irs |
| Shanghai | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Jiangsu | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.999 | 1 | 0.999 | irs | 0.952 | 0.998 | 0.954 | drs | 0.933 | 0.965 | 0.967 | drs |
| Zhejiang | 0.935 | 0.992 | 0.942 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Anhui | 0.763 | 0.882 | 0.865 | irs | 0.69 | 0.861 | 0.801 | irs | 0.644 | 0.912 | 0.706 | irs | 0.691 | 0.844 | 0.819 | irs | 0.646 | 0.772 | 0.837 | irs |
| Fujian | 0.962 | 1 | 0.962 | irs | 0.91 | 1 | 0.91 | irs | 0.763 | 0.989 | 0.772 | irs | 0.913 | 0.988 | 0.925 | irs | 0.976 | 1 | 0.976 | irs |
| Jiangxi | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.933 | 0.969 | 0.963 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Shandong | 1 | 1 | 1 | - | 0.757 | 0.758 | 0.999 | irs | 0.94 | 0.941 | 0.999 | drs | 1 | 1 | 1 | - | 0.918 | 1 | 0.918 | drs |
| Henan | 0.76 | 0.787 | 0.966 | irs | 0.951 | 0.954 | 0.997 | drs | 0.714 | 0.831 | 0.859 | irs | 0.793 | 0.796 | 0.996 | drs | 0.926 | 0.95 | 0.975 | drs |
| Hubei | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.755 | 0.958 | 0.789 | irs | 0.776 | 0.942 | 0.824 | irs | 0.748 | 0.908 | 0.823 | irs |
| Hunan | 1 | 1 | 1 | - | 0.972 | 1 | 0.972 | irs | 0.583 | 0.952 | 0.613 | irs | 0.541 | 0.804 | 0.673 | irs | 0.505 | 0.751 | 0.673 | irs |
| Guangdong | 0.975 | 1 | 0.975 | drs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Guangxi | 0.752 | 0.871 | 0.864 | irs | 0.62 | 0.881 | 0.704 | irs | 0.742 | 0.914 | 0.811 | irs | 0.841 | 0.846 | 0.993 | irs | 0.674 | 0.843 | 0.8 | irs |
| Hainan | 0.33 | 0.982 | 0.336 | irs | 0.293 | 0.995 | 0.295 | irs | 0.197 | 1 | 0.197 | irs | 0.252 | 0.881 | 0.286 | irs | 0.257 | 0.934 | 0.276 | irs |
| Chongqing | 0.463 | 0.785 | 0.59 | irs | 0.531 | 0.814 | 0.653 | irs | 0.497 | 0.917 | 0.543 | irs | 0.568 | 0.86 | 0.66 | irs | 0.634 | 0.908 | 0.699 | irs |
| Sichuan | 0.574 | 0.651 | 0.882 | irs | 0.734 | 0.792 | 0.927 | irs | 0.844 | 0.923 | 0.914 | irs | 0.792 | 0.821 | 0.964 | irs | 0.973 | 0.984 | 0.989 | drs |
| Guizhou | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Yunnan | 0.733 | 1 | 0.733 | irs | 0.863 | 0.975 | 0.885 | irs | 0.656 | 1 | 0.656 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Tibet | 0.002 | 1 | 0.002 | irs | 0 | 1 | 0 | irs | 0.084 | 1 | 0.084 | irs | 0.113 | 1 | 0.113 | irs | 0 | 1 | 0 | irs |
| Shaanxi | 0.532 | 0.682 | 0.781 | irs | 0.644 | 0.811 | 0.795 | irs | 0.726 | 0.864 | 0.84 | irs | 0.574 | 0.721 | 0.797 | irs | 0.753 | 0.815 | 0.924 | irs |
| Gansu | 0.567 | 0.946 | 0.6 | irs | 0.339 | 0.896 | 0.379 | irs | 1 | 1 | 1 | - | 0.558 | 0.902 | 0.618 | irs | 0.619 | 0.922 | 0.672 | irs |
| Qinghai | 0.411 | 1 | 0.411 | irs | 0.372 | 1 | 0.372 | irs | 0.264 | 1 | 0.264 | irs | 0.351 | 0.972 | 0.361 | irs | 0.298 | 0.967 | 0.308 | irs |
| Ningxia | 0.344 | 0.842 | 0.409 | irs | 0.366 | 0.941 | 0.389 | irs | 0.279 | 0.908 | 0.307 | irs | 0.352 | 0.831 | 0.424 | irs | 0.353 | 0.884 | 0.399 | irs |
| Xinjiang | 0.506 | 0.779 | 0.65 | irs | 0.416 | 0.783 | 0.531 | irs | 0.282 | 0.944 | 0.299 | irs | 0.363 | 0.813 | 0.446 | irs | 0.416 | 0.812 | 0.512 | irs |
| Mean | 0.722 | 0.898 | 0.801 |  | 0.716 | 0.913 | 0.783 |  | 0.696 | 0.932 | 0.749 |  | 0.723 | 0.903 | 0.796 |  | 0.727 | 0.922 | 0.781 |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2009 |  |  |  | 2010 |  |  |  | 2011 |  |  |  | 2012 |  |  |  | 2013 |  |  |  |
| Province | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale |
| Peking | 0.809 | 0.832 | 0.972 | irs | 0.85 | 0.851 | 0.999 | drs | 0.736 | 0.844 | 0.872 | irs | 0.576 | 0.693 | 0.832 | irs | 0.624 | 0.711 | 0.877 | irs |
| Tianjin | 0.542 | 0.796 | 0.682 | irs | 0.572 | 0.832 | 0.688 | irs | 0.495 | 0.858 | 0.576 | irs | 0.381 | 0.814 | 0.468 | irs | 0.336 | 0.893 | 0.376 | irs |
| Hebei | 0.928 | 0.947 | 0.98 | drs | 1 | 1 | 1 | - | 0.898 | 0.911 | 0.986 | irs | 0.865 | 0.894 | 0.968 | irs | 1 | 1 | 1 | - |
| Shanxi | 1 | 1 | 1 | - | 0.935 | 1 | 0.935 | drs | 1 | 1 | 1 | - | 0.892 | 0.949 | 0.939 | irs | 0.668 | 0.901 | 0.741 | irs |
| Inner Mongolia | 0.93 | 0.934 | 0.996 | irs | 0.835 | 0.874 | 0.955 | irs | 0.976 | 0.986 | 0.99 | irs | 1 | 1 | 1 | - | 0.761 | 0.918 | 0.829 | irs |
| Liaoning | 1 | 1 | 1 | - | 0.982 | 1 | 0.982 | drs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Jilin | 0.645 | 0.786 | 0.821 | irs | 0.598 | 0.617 | 0.969 | irs | 0.501 | 0.92 | 0.544 | irs | 0.295 | 0.869 | 0.339 | irs | 0.749 | 0.991 | 0.756 | irs |
| Heilongjiang | 0.481 | 0.59 | 0.815 | irs | 0.533 | 0.644 | 0.827 | irs | 0.443 | 0.872 | 0.509 | irs | 0.365 | 0.632 | 0.578 | irs | 0.389 | 0.727 | 0.534 | irs |
| Shanghai | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.834 | 1 | 0.834 | irs | 0.757 | 0.936 | 0.808 | irs | 0.688 | 0.961 | 0.715 | irs |
| Jiangsu | 0.939 | 0.964 | 0.974 | drs | 1 | 1 | 1 | - | 0.91 | 0.935 | 0.973 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Zhejiang | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.855 | 0.969 | 0.883 | irs | 0.823 | 0.88 | 0.936 | irs | 1 | 1 | 1 | - |
| Anhui | 0.658 | 0.734 | 0.897 | irs | 0.703 | 0.804 | 0.875 | irs | 0.667 | 0.809 | 0.825 | irs | 0.577 | 0.766 | 0.753 | irs | 0.572 | 0.717 | 0.798 | irs |
| Fujian | 0.93 | 1 | 0.93 | irs | 0.914 | 1 | 0.914 | irs | 0.821 | 0.997 | 0.823 | irs | 0.725 | 0.954 | 0.76 | irs | 0.641 | 0.867 | 0.74 | irs |
| Jiangxi | 1 | 1 | 1 | - | 0.853 | 0.946 | 0.901 | irs | 0.559 | 0.792 | 0.706 | irs | 0.449 | 0.694 | 0.647 | irs | 0.409 | 0.767 | 0.533 | irs |
| Shandong | 1 | 1 | 1 | - | 0.91 | 0.956 | 0.952 | drs | 1 | 1 | 1 | - | 0.928 | 0.951 | 0.976 | irs | 0.824 | 0.848 | 0.972 | irs |
| Henan | 1 | 1 | 1 | - | 0.889 | 0.891 | 0.998 | irs | 0.853 | 0.97 | 0.879 | irs | 0.777 | 0.812 | 0.957 | irs | 0.725 | 0.886 | 0.818 | irs |
| Hubei | 0.833 | 0.846 | 0.985 | irs | 0.801 | 0.832 | 0.963 | irs | 0.642 | 0.752 | 0.853 | irs | 0.583 | 0.731 | 0.798 | irs | 0.671 | 0.865 | 0.775 | irs |
| Hunan | 0.556 | 0.648 | 0.858 | irs | 0.831 | 0.915 | 0.908 | irs | 0.829 | 0.981 | 0.845 | irs | 0.758 | 0.837 | 0.906 | irs | 0.662 | 0.868 | 0.762 | irs |
| Guangdong | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Guangxi | 0.614 | 0.702 | 0.876 | irs | 0.71 | 0.749 | 0.948 | irs | 0.498 | 0.733 | 0.679 | irs | 0.589 | 0.775 | 0.761 | irs | 0.417 | 0.797 | 0.524 | irs |
| Hainan | 0.25 | 0.903 | 0.276 | irs | 0.28 | 0.904 | 0.31 | irs | 0.372 | 0.984 | 0.378 | irs | 0.266 | 0.947 | 0.281 | irs | 0.209 | 0.957 | 0.218 | irs |
| Chongqing | 0.627 | 0.874 | 0.717 | irs | 0.702 | 0.907 | 0.774 | irs | 0.7 | 0.942 | 0.743 | irs | 0.552 | 0.85 | 0.649 | irs | 0.495 | 0.898 | 0.551 | irs |
| Sichuan | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.774 | 0.994 | 0.778 | irs |
| Guizhou | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.618 | 0.988 | 0.626 | irs | 0.634 | 0.978 | 0.648 | irs | 0.43 | 0.979 | 0.439 | irs |
| Yunnan | 0.903 | 0.904 | 0.998 | drs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Tibet | 0 | 1 | 0 | irs | 0 | 1 | 0 | irs | 0.008 | 1 | 0.008 | irs | 0.01 | 1 | 0.01 | irs | 0.003 | 1 | 0.003 | irs |
| Shaanxi | 0.602 | 0.646 | 0.932 | irs | 0.665 | 0.7 | 0.95 | irs | 0.596 | 0.827 | 0.721 | irs | 0.478 | 0.716 | 0.667 | irs | 0.514 | 0.84 | 0.612 | irs |
| Gansu | 0.871 | 0.936 | 0.931 | irs | 0.607 | 0.846 | 0.717 | irs | 0.597 | 0.985 | 0.606 | irs | 0.508 | 0.826 | 0.615 | irs | 0.455 | 0.916 | 0.496 | irs |
| Qinghai | 0.279 | 1 | 0.279 | irs | 0.3 | 0.984 | 0.305 | irs | 0.337 | 1 | 0.337 | irs | 0.18 | 0.968 | 0.186 | irs | 0.259 | 1 | 0.259 | irs |
| Ningxia | 0.312 | 0.967 | 0.323 | irs | 0.47 | 0.922 | 0.51 | irs | 0.425 | 0.978 | 0.434 | irs | 0.318 | 0.967 | 0.329 | irs | 0.212 | 0.945 | 0.225 | irs |
| Xinjiang | 0.467 | 0.784 | 0.595 | irs | 0.591 | 0.836 | 0.706 | irs | 0.662 | 0.937 | 0.707 | irs | 0.677 | 1 | 0.677 | irs | 0.757 | 1 | 0.757 | irs |
| Mean | 0.748 | 0.897 | 0.833 |  | 0.759 | 0.904 | 0.841 |  | 0.704 | 0.935 | 0.753 |  | 0.644 | 0.885 | 0.725 |  | 0.621 | 0.911 | 0.68 |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2014 |  |  |  | 2015 |  |  |  | 2016 |  |  |  | 2017 |  |  |  | 2018 |  |  |  |
| Province | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale |
| Peking | 0.711 | 0.832 | 0.855 | irs | 0.539 | 0.694 | 0.776 | irs | 0.67 | 0.75 | 0.894 | irs | 0.64 | 0.887 | 0.722 | irs | 0.532 | 0.73 | 0.729 | irs |
| Tianjin | 0.486 | 0.833 | 0.583 | irs | 0.498 | 0.864 | 0.577 | irs | 0.445 | 1 | 0.445 | irs | 0.312 | 0.992 | 0.315 | irs | 0.427 | 0.968 | 0.441 | irs |
| Hebei | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.706 | 0.794 | 0.889 | irs | 0.748 | 0.834 | 0.898 | irs | 0.607 | 0.77 | 0.788 | irs |
| Shanxi | 0.692 | 0.86 | 0.804 | irs | 0.941 | 1 | 0.941 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Inner Mongolia | 0.933 | 0.974 | 0.958 | irs | 0.962 | 0.988 | 0.974 | irs | 0.934 | 0.958 | 0.975 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Liaoning | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.986 | 1 | 0.986 | irs | 0.817 | 0.971 | 0.842 | irs | 0.764 | 1 | 0.764 | irs |
| Jilin | 0.779 | 1 | 0.779 | irs | 0.697 | 0.911 | 0.765 | irs | 0.711 | 1 | 0.711 | irs | 0.491 | 1 | 0.491 | irs | 0.492 | 1 | 0.492 | irs |
| Heilongjiang | 0.45 | 0.773 | 0.582 | irs | 0.411 | 0.777 | 0.529 | irs | 0.493 | 0.886 | 0.557 | irs | 0.461 | 0.999 | 0.462 | irs | 0.364 | 1 | 0.364 | irs |
| Shanghai | 0.767 | 0.976 | 0.786 | irs | 0.724 | 0.888 | 0.816 | irs | 0.714 | 0.962 | 0.742 | irs | 0.601 | 1 | 0.601 | irs | 0.64 | 0.963 | 0.664 | irs |
| Jiangsu | 1 | 1 | 1 | - | 0.88 | 1 | 0.88 | drs | 0.885 | 1 | 0.885 | drs | 0.98 | 1 | 0.98 | drs | 0.949 | 1 | 0.949 | drs |
| Zhejiang | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.925 | 0.963 | 0.961 | irs | 0.949 | 0.99 | 0.958 | irs |
| Anhui | 0.584 | 0.756 | 0.772 | irs | 0.573 | 0.755 | 0.759 | irs | 0.705 | 0.797 | 0.884 | irs | 0.578 | 0.84 | 0.688 | irs | 0.641 | 0.951 | 0.674 | irs |
| Fujian | 0.804 | 0.987 | 0.815 | irs | 0.78 | 0.977 | 0.799 | irs | 0.829 | 0.961 | 0.862 | irs | 0.627 | 0.914 | 0.686 | irs | 0.65 | 0.891 | 0.73 | irs |
| Jiangxi | 0.429 | 0.708 | 0.606 | irs | 0.363 | 0.629 | 0.577 | irs | 0.549 | 0.707 | 0.777 | irs | 0.528 | 0.836 | 0.631 | irs | 0.576 | 0.917 | 0.627 | irs |
| Shandong | 0.657 | 0.701 | 0.937 | irs | 0.761 | 0.925 | 0.822 | drs | 0.761 | 1 | 0.761 | drs | 0.896 | 1 | 0.896 | drs | 0.763 | 1 | 0.763 | drs |
| Henan | 0.655 | 0.761 | 0.861 | irs | 0.662 | 0.735 | 0.9 | irs | 0.701 | 0.788 | 0.89 | irs | 0.814 | 0.882 | 0.923 | irs | 0.632 | 0.757 | 0.835 | irs |
| Hubei | 0.679 | 0.79 | 0.859 | irs | 0.675 | 0.778 | 0.867 | irs | 0.662 | 0.724 | 0.914 | irs | 0.671 | 0.859 | 0.781 | irs | 0.537 | 0.719 | 0.746 | irs |
| Hunan | 0.67 | 0.799 | 0.838 | irs | 0.728 | 0.877 | 0.831 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Guangdong | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Guangxi | 0.539 | 0.758 | 0.711 | irs | 0.464 | 0.682 | 0.68 | irs | 0.71 | 0.878 | 0.81 | irs | 0.668 | 0.956 | 0.698 | irs | 0.666 | 0.922 | 0.722 | irs |
| Hainan | 0.312 | 0.971 | 0.321 | irs | 0.33 | 0.904 | 0.365 | irs | 0.331 | 0.934 | 0.354 | irs | 0.217 | 0.959 | 0.226 | irs | 0.239 | 0.942 | 0.253 | irs |
| Chongqing | 0.634 | 0.88 | 0.721 | irs | 0.561 | 0.806 | 0.696 | irs | 0.594 | 0.887 | 0.67 | irs | 0.461 | 0.937 | 0.493 | irs | 0.471 | 0.837 | 0.563 | irs |
| Sichuan | 1 | 1 | 1 | - | 0.832 | 0.899 | 0.925 | irs | 0.864 | 0.912 | 0.948 | irs | 0.818 | 0.923 | 0.885 | irs | 0.82 | 0.935 | 0.877 | irs |
| Guizhou | 0.527 | 0.89 | 0.592 | irs | 0.563 | 0.884 | 0.637 | irs | 0.53 | 0.949 | 0.559 | irs | 0.409 | 0.987 | 0.415 | irs | 0.452 | 0.966 | 0.467 | irs |
| Yunnan | 0.796 | 1 | 0.796 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.91 | 1 | 0.91 | irs | 0.816 | 1 | 0.816 | irs |
| Tibet | 0.033 | 1 | 0.033 | irs | 0.043 | 1 | 0.043 | irs | 0.224 | 1 | 0.224 | irs | 0.056 | 1 | 0.056 | irs | 0.103 | 1 | 0.103 | irs |
| Shaanxi | 0.619 | 0.799 | 0.775 | irs | 0.603 | 0.738 | 0.817 | irs | 0.543 | 0.693 | 0.783 | irs | 0.65 | 0.901 | 0.721 | irs | 0.585 | 0.909 | 0.644 | irs |
| Gansu | 0.57 | 0.917 | 0.622 | irs | 0.498 | 0.879 | 0.567 | irs | 0.485 | 0.927 | 0.523 | irs | 0.404 | 1 | 0.404 | irs | 0.417 | 0.986 | 0.423 | irs |
| Qinghai | 0.272 | 0.993 | 0.274 | irs | 0.344 | 1 | 0.344 | irs | 0.345 | 0.931 | 0.371 | irs | 0.116 | 1 | 0.116 | irs | 0.191 | 1 | 0.191 | irs |
| Ningxia | 0.373 | 0.933 | 0.4 | irs | 0.388 | 0.9 | 0.432 | irs | 0.608 | 0.93 | 0.653 | irs | 0.35 | 0.978 | 0.358 | irs | 0.382 | 0.958 | 0.399 | irs |
| Xinjiang | 0.887 | 1 | 0.887 | irs | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 0.875 | 1 | 0.875 | irs | 0.626 | 0.996 | 0.628 | irs |
| Mean | 0.673 | 0.9 | 0.747 |  | 0.672 | 0.887 | 0.752 |  | 0.709 | 0.915 | 0.776 |  | 0.646 | 0.955 | 0.678 |  | 0.622 | 0.939 | 0.665 |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2019 |  |  |  | 2020 |  |  |  | 2021 |  |  |  |
| Province | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale | TE | PTE | SE | Returns to scale |
| Peking | 0.448 | 0.631 | 0.71 | irs | 0.489 | 0.606 | 0.806 | irs | 0.447 | 0.658 | 0.679 | irs |
| Tianjin | 0.421 | 0.91 | 0.463 | irs | 0.62 | 0.983 | 0.631 | irs | 0.518 | 0.994 | 0.521 | irs |
| Hebei | 0.653 | 0.852 | 0.767 | irs | 0.816 | 0.82 | 0.995 | irs | 0.832 | 0.876 | 0.95 | irs |
| Shanxi | 0.997 | 1 | 0.997 | drs | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Inner Mongolia | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Liaoning | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Jilin | 0.548 | 0.975 | 0.563 | irs | 0.648 | 0.996 | 0.651 | irs | 0.783 | 1 | 0.783 | irs |
| Heilongjiang | 0.436 | 0.947 | 0.461 | irs | 0.591 | 0.919 | 0.644 | irs | 0.553 | 0.916 | 0.604 | irs |
| Shanghai | 0.544 | 0.794 | 0.685 | irs | 0.795 | 0.942 | 0.844 | irs | 0.653 | 0.847 | 0.77 | irs |
| Jiangsu | 0.876 | 0.922 | 0.951 | drs | 0.977 | 0.99 | 0.987 | irs | 0.92 | 0.921 | 0.999 | irs |
| Zhejiang | 0.867 | 0.888 | 0.976 | irs | 0.93 | 0.962 | 0.966 | irs | 0.987 | 1 | 0.987 | irs |
| Anhui | 0.545 | 0.819 | 0.666 | irs | 0.761 | 0.916 | 0.831 | irs | 0.762 | 0.948 | 0.804 | irs |
| Fujian | 0.598 | 0.818 | 0.731 | irs | 0.805 | 0.917 | 0.877 | irs | 0.644 | 0.824 | 0.781 | irs |
| Jiangxi | 0.605 | 0.949 | 0.637 | irs | 0.662 | 0.846 | 0.783 | irs | 0.683 | 0.925 | 0.739 | irs |
| Shandong | 0.846 | 1 | 0.846 | drs | 0.838 | 1 | 0.838 | drs | 1 | 1 | 1 | - |
| Henan | 0.599 | 0.712 | 0.841 | irs | 0.56 | 0.614 | 0.911 | irs | 0.533 | 0.607 | 0.878 | irs |
| Hubei | 0.562 | 0.718 | 0.783 | irs | 0.827 | 0.936 | 0.884 | irs | 0.785 | 0.931 | 0.844 | irs |
| Hunan | 0.946 | 0.951 | 0.994 | irs | 0.723 | 0.855 | 0.845 | irs | 0.703 | 0.875 | 0.804 | irs |
| Guangdong | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - |
| Guangxi | 0.63 | 0.861 | 0.732 | irs | 0.697 | 0.851 | 0.819 | irs | 0.874 | 0.96 | 0.911 | irs |
| Hainan | 0.249 | 0.927 | 0.269 | irs | 0.354 | 1 | 0.354 | irs | 0.308 | 1 | 0.308 | irs |
| Chongqing | 0.502 | 0.935 | 0.536 | irs | 0.779 | 1 | 0.779 | irs | 0.707 | 1 | 0.707 | irs |
| Sichuan | 0.827 | 0.951 | 0.87 | irs | 0.852 | 0.893 | 0.955 | irs | 0.984 | 1 | 0.984 | irs |
| Guizhou | 0.44 | 0.954 | 0.462 | irs | 0.518 | 0.905 | 0.572 | irs | 0.523 | 0.912 | 0.573 | irs |
| Yunnan | 0.689 | 0.924 | 0.745 | irs | 1 | 1 | 1 | - | 0.738 | 0.933 | 0.792 | irs |
| Tibet | 0.111 | 1 | 0.111 | irs | 0.195 | 1 | 0.195 | irs | 0.144 | 1 | 0.144 | irs |
| Shaanxi | 0.564 | 0.736 | 0.767 | irs | 0.543 | 0.667 | 0.814 | irs | 0.619 | 0.779 | 0.795 | irs |
| Gansu | 0.379 | 0.921 | 0.411 | irs | 0.501 | 0.83 | 0.604 | irs | 0.531 | 0.922 | 0.575 | irs |
| Qinghai | 0.204 | 0.971 | 0.21 | irs | 0.431 | 1 | 0.431 | irs | 0.437 | 1 | 0.437 | irs |
| Ningxia | 0.279 | 0.952 | 0.293 | irs | 0.526 | 0.995 | 0.529 | irs | 0.488 | 1 | 0.488 | irs |
| Xinjiang | 0.631 | 0.998 | 0.632 | irs | 0.597 | 0.792 | 0.754 | irs | 0.741 | 0.934 | 0.793 | irs |
| Mean | 0.613 | 0.904 | 0.681 |  | 0.711 | 0.911 | 0.784 |  | 0.706 | 0.928 | 0.763 |  |

Note: - means that the returns to scale are constant, drs means that the returns to scale are decreasing, and irs means that the returns to scale are increasing.

# Table S.6 Malmquist productivity index results

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2004-2005 | | | | | 2005-2006 | | | | | 2006-2007 | | | | |
| Province | EFFch | TECHch | PEch | SEch | TFPch | EFFch | TECHch | PEch | SEch | TFPch | EFFch | TECHch | PEch | SEch | TFPch |
| Peking | 1.073 | 0.933 | 1.030 | 1.041 | 1.001 | 1.021 | 0.860 | 1.002 | 1.019 | 0.878 | 1.095 | 1.271 | 1.092 | 1.003 | 1.393 |
| Tianjin | 1.070 | 0.974 | 1.048 | 1.020 | 1.042 | 0.850 | 0.975 | 1.159 | 0.733 | 0.829 | 1.113 | 1.280 | 0.924 | 1.204 | 1.424 |
| Hebei | 0.930 | 1.090 | 1.000 | 0.930 | 1.014 | 0.915 | 0.917 | 0.853 | 1.073 | 0.839 | 1.083 | 1.193 | 1.151 | 0.941 | 1.292 |
| Shanxi | 1.000 | 0.953 | 1.000 | 1.000 | 0.953 | 1.000 | 1.008 | 1.000 | 1.000 | 1.008 | 1.000 | 1.005 | 1.000 | 1.000 | 1.005 |
| Inner Mongolia | 0.938 | 0.939 | 0.970 | 0.968 | 0.881 | 1.704 | 0.863 | 1.310 | 1.300 | 1.471 | 0.859 | 1.187 | 0.939 | 0.914 | 1.020 |
| Liaoning | 0.946 | 1.036 | 1.000 | 0.946 | 0.980 | 1.161 | 0.934 | 1.000 | 1.161 | 1.084 | 0.964 | 1.100 | 1.000 | 0.964 | 1.061 |
| Jilin | 0.778 | 0.813 | 0.970 | 0.802 | 0.632 | 0.974 | 0.701 | 0.937 | 1.040 | 0.683 | 1.182 | 1.150 | 0.958 | 1.234 | 1.360 |
| Heilongjiang | 1.354 | 0.903 | 1.280 | 1.058 | 1.222 | 0.586 | 1.030 | 0.926 | 0.632 | 0.603 | 1.298 | 1.170 | 1.047 | 1.240 | 1.518 |
| Shanghai | 1.000 | 0.954 | 1.000 | 1.000 | 0.954 | 1.000 | 0.895 | 1.000 | 1.000 | 0.895 | 1.000 | 1.272 | 1.000 | 1.000 | 1.272 |
| Jiangsu | 1.000 | 0.966 | 1.000 | 1.000 | 0.966 | 0.999 | 0.887 | 1.000 | 0.999 | 0.886 | 0.953 | 1.293 | 0.998 | 0.955 | 1.232 |
| Zhejiang | 1.070 | 0.971 | 1.008 | 1.062 | 1.039 | 1.000 | 0.884 | 1.000 | 1.000 | 0.884 | 1.000 | 1.279 | 1.000 | 1.000 | 1.279 |
| Anhui | 0.904 | 0.877 | 0.976 | 0.926 | 0.793 | 0.935 | 1.032 | 1.059 | 0.882 | 0.965 | 1.073 | 1.154 | 0.925 | 1.159 | 1.238 |
| Fujian | 0.947 | 0.920 | 1.000 | 0.947 | 0.871 | 0.839 | 0.935 | 0.989 | 0.849 | 0.785 | 1.194 | 1.225 | 0.998 | 1.197 | 1.463 |
| Jiangxi | 1.000 | 0.973 | 1.000 | 1.000 | 0.973 | 0.933 | 0.938 | 0.969 | 0.963 | 0.875 | 1.072 | 1.118 | 1.032 | 1.038 | 1.199 |
| Shandong | 0.757 | 0.907 | 0.758 | 0.999 | 0.687 | 1.242 | 0.855 | 1.242 | 1.000 | 1.063 | 1.063 | 1.321 | 1.062 | 1.001 | 1.404 |
| Henan | 1.251 | 0.763 | 1.212 | 1.032 | 0.955 | 0.751 | 1.057 | 0.872 | 0.861 | 0.793 | 1.111 | 1.244 | 0.958 | 1.160 | 1.382 |
| Hubei | 1.000 | 0.847 | 1.000 | 1.000 | 0.847 | 0.756 | 1.098 | 0.958 | 0.789 | 0.830 | 1.027 | 1.234 | 0.984 | 1.044 | 1.267 |
| Hunan | 0.972 | 0.876 | 1.000 | 0.972 | 0.852 | 0.600 | 1.225 | 0.952 | 0.630 | 0.735 | 0.928 | 1.194 | 0.844 | 1.099 | 1.108 |
| Guangdong | 1.025 | 1.015 | 1.000 | 1.025 | 1.041 | 1.000 | 1.076 | 1.000 | 1.000 | 1.076 | 1.000 | 1.204 | 1.000 | 1.000 | 1.204 |
| Guangxi | 0.824 | 0.932 | 1.011 | 0.815 | 0.768 | 1.197 | 0.854 | 1.039 | 1.153 | 1.022 | 1.133 | 1.179 | 0.926 | 1.224 | 1.336 |
| Hainan | 0.889 | 0.941 | 1.012 | 0.878 | 0.836 | 0.673 | 0.947 | 1.006 | 0.669 | 0.637 | 1.278 | 1.313 | 0.881 | 1.451 | 1.678 |
| Chongqing | 1.144 | 0.944 | 1.034 | 1.107 | 1.079 | 0.939 | 0.861 | 1.128 | 0.832 | 0.808 | 1.141 | 1.297 | 0.939 | 1.215 | 1.480 |
| Sichuan | 1.279 | 0.945 | 1.216 | 1.052 | 1.209 | 1.150 | 1.007 | 1.166 | 0.986 | 1.158 | 0.937 | 1.213 | 0.889 | 1.054 | 1.137 |
| Guizhou | 1.000 | 1.190 | 1.000 | 1.000 | 1.190 | 1.000 | 0.332 | 1.000 | 1.000 | 0.332 | 1.000 | 1.182 | 1.000 | 1.000 | 1.182 |
| Yunnan | 1.177 | 0.830 | 0.975 | 1.207 | 0.977 | 0.760 | 1.034 | 1.026 | 0.742 | 0.787 | 1.524 | 1.178 | 1.000 | 1.524 | 1.796 |
| Tibet | 0.011 | 1.226 | 1.000 | 0.011 | 0.013 | 3480.717 | 0.365 | 1.000 | 3480.717 | 1269.192 | 1.346 | 1.274 | 1.000 | 1.346 | 1.714 |
| Shaanxi | 1.210 | 0.850 | 1.189 | 1.017 | 1.028 | 1.127 | 1.018 | 1.066 | 1.057 | 1.147 | 0.792 | 1.177 | 0.834 | 0.949 | 0.932 |
| Gansu | 0.598 | 0.898 | 0.947 | 0.632 | 0.537 | 2.947 | 1.081 | 1.116 | 2.640 | 3.185 | 0.558 | 0.926 | 0.903 | 0.618 | 0.517 |
| Qinghai | 0.907 | 0.888 | 1.000 | 0.907 | 0.806 | 0.707 | 0.867 | 1.000 | 0.707 | 0.613 | 1.331 | 1.274 | 0.973 | 1.368 | 1.695 |
| Ningxia | 1.065 | 1.054 | 1.118 | 0.952 | 1.122 | 0.762 | 0.920 | 0.965 | 0.790 | 0.701 | 1.263 | 1.254 | 0.918 | 1.376 | 1.584 |
| Xinjiang | 0.821 | 1.029 | 1.005 | 0.817 | 0.845 | 0.680 | 1.059 | 1.207 | 0.563 | 0.720 | 1.285 | 1.218 | 0.861 | 1.492 | 1.565 |
| Mean | 0.851 | 0.945 | 1.020 | 0.835 | 0.805 | 1.239 | 0.894 | 1.026 | 1.208 | 1.108 | 1.067 | 1.203 | 0.966 | 1.104 | 1.283 |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2007-2008 | | | | | 2008-2009 | | | | | 2009-2010 | | | | |
| Province | EFFch | TECHch | PEch | SEch | TFPch | EFFch | TECHch | PEch | SEch | TFPch | EFFch | TECHch | PEch | SEch | TFPch |
| Peking | 1.025 | 1.080 | 0.997 | 1.028 | 1.106 | 0.865 | 1.118 | 0.888 | 0.973 | 0.966 | 1.052 | 0.877 | 1.023 | 1.028 | 0.922 |
| Tianjin | 1.070 | 1.086 | 0.926 | 1.155 | 1.162 | 1.046 | 1.044 | 0.994 | 1.052 | 1.092 | 1.055 | 1.017 | 1.046 | 1.008 | 1.072 |
| Hebei | 1.011 | 1.063 | 1.018 | 0.993 | 1.074 | 1.020 | 0.989 | 0.946 | 1.077 | 1.009 | 1.078 | 1.262 | 1.057 | 1.020 | 1.361 |
| Shanxi | 1.000 | 0.886 | 1.000 | 1.000 | 0.886 | 1.000 | 0.819 | 1.000 | 1.000 | 0.819 | 0.935 | 0.991 | 1.000 | 0.935 | 0.926 |
| Inner Mongolia | 1.420 | 1.053 | 1.432 | 0.992 | 1.495 | 1.116 | 0.897 | 0.982 | 1.136 | 1.001 | 0.897 | 1.170 | 0.936 | 0.959 | 1.050 |
| Liaoning | 1.002 | 0.976 | 1.000 | 1.002 | 0.978 | 1.149 | 0.960 | 1.000 | 1.149 | 1.103 | 0.981 | 1.009 | 1.000 | 0.981 | 0.991 |
| Jilin | 0.734 | 1.002 | 1.157 | 0.634 | 0.736 | 1.351 | 0.736 | 0.932 | 1.449 | 0.994 | 0.926 | 1.099 | 0.784 | 1.181 | 1.018 |
| Heilongjiang | 0.635 | 0.977 | 0.796 | 0.798 | 0.620 | 1.292 | 0.786 | 0.934 | 1.383 | 1.015 | 1.107 | 1.074 | 1.091 | 1.015 | 1.189 |
| Shanghai | 1.000 | 1.126 | 1.000 | 1.000 | 1.126 | 1.000 | 1.041 | 1.000 | 1.000 | 1.041 | 1.000 | 0.911 | 1.000 | 1.000 | 0.911 |
| Jiangsu | 0.981 | 1.171 | 0.967 | 1.014 | 1.148 | 1.006 | 1.002 | 0.999 | 1.007 | 1.008 | 1.065 | 1.094 | 1.037 | 1.026 | 1.165 |
| Zhejiang | 1.000 | 1.063 | 1.000 | 1.000 | 1.063 | 1.000 | 1.137 | 1.000 | 1.000 | 1.137 | 1.000 | 0.926 | 1.000 | 1.000 | 0.926 |
| Anhui | 0.936 | 1.115 | 0.915 | 1.023 | 1.043 | 1.019 | 1.024 | 0.951 | 1.071 | 1.043 | 1.067 | 0.977 | 1.095 | 0.975 | 1.042 |
| Fujian | 1.069 | 1.085 | 1.013 | 1.055 | 1.159 | 0.954 | 1.002 | 1.000 | 0.954 | 0.956 | 0.982 | 0.953 | 1.000 | 0.982 | 0.937 |
| Jiangxi | 1.000 | 0.836 | 1.000 | 1.000 | 0.836 | 1.000 | 0.875 | 1.000 | 1.000 | 0.875 | 0.853 | 1.043 | 0.947 | 0.901 | 0.889 |
| Shandong | 0.918 | 1.206 | 1.000 | 0.918 | 1.108 | 1.089 | 0.875 | 1.000 | 1.089 | 0.952 | 0.910 | 0.947 | 0.955 | 0.952 | 0.861 |
| Henan | 1.168 | 0.770 | 1.193 | 0.979 | 0.899 | 1.080 | 0.791 | 1.053 | 1.026 | 0.854 | 0.889 | 1.129 | 0.891 | 0.998 | 1.003 |
| Hubei | 0.963 | 0.998 | 0.963 | 1.000 | 0.961 | 1.115 | 0.788 | 0.932 | 1.196 | 0.879 | 0.961 | 0.929 | 0.984 | 0.977 | 0.893 |
| Hunan | 0.934 | 0.947 | 0.934 | 1.000 | 0.885 | 1.100 | 0.812 | 0.862 | 1.275 | 0.893 | 1.495 | 0.940 | 1.412 | 1.058 | 1.404 |
| Guangdong | 1.000 | 0.953 | 1.000 | 1.000 | 0.953 | 1.000 | 0.804 | 1.000 | 1.000 | 0.804 | 1.000 | 0.999 | 1.000 | 1.000 | 0.999 |
| Guangxi | 0.802 | 1.114 | 0.996 | 0.805 | 0.893 | 0.912 | 0.911 | 0.833 | 1.095 | 0.830 | 1.156 | 0.910 | 1.068 | 1.082 | 1.052 |
| Hainan | 1.019 | 1.071 | 1.060 | 0.962 | 1.092 | 0.969 | 1.080 | 0.967 | 1.002 | 1.046 | 1.123 | 0.901 | 1.002 | 1.121 | 1.012 |
| Chongqing | 1.118 | 1.073 | 1.056 | 1.059 | 1.199 | 0.988 | 1.059 | 0.962 | 1.027 | 1.046 | 1.119 | 0.927 | 1.037 | 1.079 | 1.037 |
| Sichuan | 1.230 | 0.913 | 1.199 | 1.026 | 1.122 | 1.027 | 0.875 | 1.016 | 1.011 | 0.900 | 1.000 | 1.219 | 1.000 | 1.000 | 1.219 |
| Guizhou | 1.000 | 1.199 | 1.000 | 1.000 | 1.199 | 1.000 | 0.622 | 1.000 | 1.000 | 0.622 | 1.000 | 1.218 | 1.000 | 1.000 | 1.218 |
| Yunnan | 1.000 | 0.739 | 1.000 | 1.000 | 0.739 | 0.903 | 0.875 | 0.905 | 0.998 | 0.790 | 1.107 | 1.277 | 1.105 | 1.002 | 1.414 |
| Tibet | 0.001 | 1.501 | 1.000 | 0.001 | 0.001 | 2.566 | 0.386 | 1.000 | 2.566 | 0.989 | 0.508 | 1.602 | 1.000 | 0.508 | 0.813 |
| Shaanxi | 1.313 | 0.949 | 1.132 | 1.160 | 1.246 | 0.798 | 0.945 | 0.791 | 1.008 | 0.753 | 1.104 | 0.978 | 1.084 | 1.019 | 1.080 |
| Gansu | 1.109 | 0.994 | 1.021 | 1.086 | 1.102 | 1.408 | 0.710 | 1.016 | 1.386 | 1.000 | 0.696 | 1.269 | 0.903 | 0.770 | 0.883 |
| Qinghai | 0.848 | 1.079 | 0.993 | 0.854 | 0.914 | 0.939 | 1.129 | 1.035 | 0.908 | 1.060 | 1.075 | 0.840 | 0.984 | 1.092 | 0.903 |
| Ningxia | 1.003 | 1.089 | 1.061 | 0.945 | 1.092 | 0.885 | 1.007 | 1.094 | 0.809 | 0.891 | 1.504 | 0.984 | 0.955 | 1.576 | 1.480 |
| Xinjiang | 1.147 | 1.014 | 0.999 | 1.148 | 1.163 | 1.120 | 1.030 | 0.964 | 1.162 | 1.154 | 1.267 | 0.858 | 1.068 | 1.187 | 1.087 |
| Mean | 0.788 | 1.027 | 1.022 | 0.771 | 0.809 | 1.061 | 0.890 | 0.967 | 1.097 | 0.944 | 1.012 | 1.032 | 1.011 | 1.001 | 1.044 |

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|  | 2010-2011 | | | | | 2011-2012 | | | | | 2012-2013 | | | | |
| Province | EFFch | TECHch | PEch | SEch | TFPch | EFFch | TECHch | PEch | SEch | TFPch | EFFch | TECHch | PEch | SEch | TFPch |
| Peking | 0.866 | 1.127 | 0.991 | 0.873 | 0.976 | 0.783 | 1.111 | 0.821 | 0.954 | 0.870 | 1.083 | 0.814 | 1.026 | 1.055 | 0.881 |
| Tianjin | 0.867 | 1.135 | 1.033 | 0.839 | 0.984 | 0.769 | 1.095 | 0.949 | 0.810 | 0.842 | 0.882 | 0.811 | 1.095 | 0.805 | 0.715 |
| Hebei | 0.898 | 0.912 | 0.911 | 0.986 | 0.819 | 0.964 | 0.979 | 0.981 | 0.982 | 0.944 | 1.156 | 1.447 | 1.119 | 1.033 | 1.673 |
| Shanxi | 1.070 | 0.849 | 1.000 | 1.070 | 0.908 | 0.892 | 0.811 | 0.950 | 0.939 | 0.723 | 0.748 | 1.310 | 0.949 | 0.789 | 0.980 |
| Inner Mongolia | 1.169 | 1.034 | 1.127 | 1.037 | 1.209 | 1.024 | 1.033 | 1.014 | 1.010 | 1.058 | 0.761 | 0.951 | 0.918 | 0.829 | 0.724 |
| Liaoning | 1.019 | 0.819 | 1.000 | 1.019 | 0.835 | 1.000 | 0.833 | 1.000 | 1.000 | 0.833 | 1.000 | 1.226 | 1.000 | 1.000 | 1.226 |
| Jilin | 0.838 | 0.931 | 1.492 | 0.561 | 0.780 | 0.589 | 0.991 | 0.944 | 0.624 | 0.584 | 2.542 | 0.771 | 1.141 | 2.228 | 1.959 |
| Heilongjiang | 0.832 | 0.868 | 1.354 | 0.615 | 0.723 | 0.823 | 1.105 | 0.725 | 1.136 | 0.910 | 1.065 | 0.826 | 1.151 | 0.925 | 0.880 |
| Shanghai | 0.834 | 1.139 | 1.000 | 0.834 | 0.950 | 0.908 | 1.060 | 0.937 | 0.969 | 0.962 | 0.908 | 0.805 | 1.026 | 0.886 | 0.731 |
| Jiangsu | 0.910 | 1.357 | 0.935 | 0.973 | 1.235 | 1.099 | 0.817 | 1.069 | 1.028 | 0.898 | 1.000 | 0.878 | 1.000 | 1.000 | 0.878 |
| Zhejiang | 0.855 | 0.952 | 0.969 | 0.883 | 0.814 | 0.963 | 1.037 | 0.908 | 1.060 | 0.999 | 1.214 | 0.824 | 1.137 | 1.069 | 1.001 |
| Anhui | 0.949 | 1.102 | 1.006 | 0.944 | 1.046 | 0.864 | 1.030 | 0.948 | 0.912 | 0.890 | 0.992 | 0.888 | 0.936 | 1.061 | 0.881 |
| Fujian | 0.898 | 1.109 | 0.997 | 0.901 | 0.996 | 0.884 | 1.082 | 0.957 | 0.924 | 0.956 | 0.885 | 0.838 | 0.909 | 0.974 | 0.742 |
| Jiangxi | 0.655 | 0.996 | 0.836 | 0.784 | 0.653 | 0.804 | 1.089 | 0.877 | 0.916 | 0.875 | 0.911 | 0.830 | 1.105 | 0.825 | 0.756 |
| Shandong | 1.099 | 1.796 | 1.047 | 1.050 | 1.974 | 0.928 | 0.536 | 0.951 | 0.976 | 0.497 | 0.888 | 0.833 | 0.891 | 0.997 | 0.740 |
| Henan | 0.960 | 0.764 | 1.089 | 0.881 | 0.733 | 0.911 | 1.113 | 0.837 | 1.089 | 1.014 | 0.933 | 1.020 | 1.091 | 0.855 | 0.951 |
| Hubei | 0.801 | 1.013 | 0.903 | 0.886 | 0.811 | 0.909 | 1.059 | 0.972 | 0.935 | 0.963 | 1.151 | 0.840 | 1.184 | 0.972 | 0.967 |
| Hunan | 0.997 | 0.985 | 1.072 | 0.930 | 0.982 | 0.915 | 1.021 | 0.853 | 1.072 | 0.934 | 0.872 | 0.784 | 1.036 | 0.842 | 0.684 |
| Guangdong | 1.000 | 1.089 | 1.000 | 1.000 | 1.089 | 1.000 | 1.271 | 1.000 | 1.000 | 1.271 | 1.000 | 0.906 | 1.000 | 1.000 | 0.906 |
| Guangxi | 0.701 | 0.971 | 0.978 | 0.717 | 0.681 | 1.184 | 0.990 | 1.058 | 1.120 | 1.172 | 0.707 | 0.898 | 1.028 | 0.688 | 0.635 |
| Hainan | 1.328 | 1.013 | 1.088 | 1.221 | 1.346 | 0.715 | 1.100 | 0.962 | 0.743 | 0.787 | 0.786 | 0.813 | 1.011 | 0.777 | 0.639 |
| Chongqing | 0.999 | 1.403 | 1.040 | 0.961 | 1.401 | 0.788 | 0.776 | 0.902 | 0.874 | 0.611 | 0.897 | 0.814 | 1.056 | 0.850 | 0.730 |
| Sichuan | 1.000 | 0.638 | 1.000 | 1.000 | 0.638 | 1.000 | 1.010 | 1.000 | 1.000 | 1.010 | 0.774 | 0.980 | 0.994 | 0.778 | 0.759 |
| Guizhou | 0.619 | 0.623 | 0.988 | 0.626 | 0.385 | 1.025 | 0.919 | 0.989 | 1.036 | 0.942 | 0.677 | 1.046 | 1.001 | 0.677 | 0.709 |
| Yunnan | 1.000 | 0.715 | 1.000 | 1.000 | 0.715 | 1.000 | 1.077 | 1.000 | 1.000 | 1.077 | 1.000 | 0.693 | 1.000 | 1.000 | 0.693 |
| Tibet | 102.760 | 1.223 | 1.000 | 102.760 | 125.653 | 1.186 | 0.967 | 1.000 | 1.186 | 1.147 | 0.336 | 1.608 | 1.000 | 0.336 | 0.540 |
| Shaanxi | 0.897 | 0.974 | 1.182 | 0.759 | 0.874 | 0.801 | 1.036 | 0.865 | 0.925 | 0.829 | 1.076 | 0.886 | 1.173 | 0.917 | 0.953 |
| Gansu | 0.985 | 0.825 | 1.165 | 0.845 | 0.812 | 0.852 | 0.967 | 0.839 | 1.016 | 0.824 | 0.894 | 0.841 | 1.109 | 0.807 | 0.752 |
| Qinghai | 1.123 | 1.202 | 1.016 | 1.106 | 1.350 | 0.533 | 0.978 | 0.968 | 0.551 | 0.521 | 1.443 | 0.799 | 1.033 | 1.397 | 1.153 |
| Ningxia | 0.903 | 0.993 | 1.059 | 0.852 | 0.897 | 0.750 | 1.001 | 0.989 | 0.758 | 0.750 | 0.666 | 0.964 | 0.976 | 0.682 | 0.642 |
| Xinjiang | 1.120 | 1.007 | 1.119 | 1.001 | 1.128 | 1.023 | 1.086 | 1.068 | 0.958 | 1.111 | 1.119 | 0.855 | 1.000 | 1.119 | 0.957 |
| Mean | 1.080 | 0.994 | 1.039 | 1.040 | 1.074 | 0.887 | 0.989 | 0.943 | 0.940 | 0.877 | 0.932 | 0.911 | 1.032 | 0.903 | 0.850 |

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|  | 2013-2014 | | | | | 2014-2015 | | | | | 2015-2016 | | | | |
| Province | EFFch | TECHch | PEch | SEch | TFPch | EFFch | TECHch | PEch | SEch | TFPch | EFFch | TECHch | PEch | SEch | TFPch |
| Peking | 1.140 | 1.216 | 1.171 | 0.974 | 1.387 | 0.758 | 1.093 | 0.834 | 0.908 | 0.828 | 1.245 | 1.147 | 1.081 | 1.152 | 1.427 |
| Tianjin | 1.444 | 1.180 | 0.932 | 1.549 | 1.705 | 1.026 | 1.036 | 1.036 | 0.990 | 1.062 | 0.894 | 1.217 | 1.159 | 0.771 | 1.089 |
| Hebei | 1.000 | 1.145 | 1.000 | 1.000 | 1.145 | 1.000 | 0.748 | 1.000 | 1.000 | 0.748 | 0.706 | 0.917 | 0.794 | 0.889 | 0.647 |
| Shanxi | 1.037 | 1.215 | 0.955 | 1.086 | 1.261 | 1.360 | 0.865 | 1.162 | 1.170 | 1.177 | 1.062 | 1.036 | 1.000 | 1.062 | 1.101 |
| Inner Mongolia | 1.227 | 1.166 | 1.061 | 1.156 | 1.430 | 1.030 | 1.050 | 1.014 | 1.016 | 1.082 | 0.971 | 1.826 | 0.970 | 1.001 | 1.773 |
| Liaoning | 1.000 | 1.147 | 1.000 | 1.000 | 1.147 | 1.000 | 1.105 | 1.000 | 1.000 | 1.105 | 0.986 | 0.809 | 1.000 | 0.986 | 0.797 |
| Jilin | 1.041 | 1.294 | 1.009 | 1.031 | 1.346 | 0.895 | 1.452 | 0.912 | 0.981 | 1.299 | 1.020 | 1.333 | 1.097 | 0.930 | 1.359 |
| Heilongjiang | 1.158 | 1.274 | 1.064 | 1.089 | 1.476 | 0.914 | 1.123 | 1.005 | 0.909 | 1.027 | 1.199 | 0.850 | 1.139 | 1.052 | 1.019 |
| Shanghai | 1.115 | 1.245 | 1.016 | 1.098 | 1.388 | 0.945 | 1.076 | 0.910 | 1.039 | 1.017 | 0.986 | 0.968 | 1.084 | 0.910 | 0.955 |
| Jiangsu | 1.000 | 1.203 | 1.000 | 1.000 | 1.203 | 0.879 | 1.169 | 1.000 | 0.879 | 1.028 | 1.007 | 1.709 | 1.000 | 1.007 | 1.720 |
| Zhejiang | 1.000 | 1.314 | 1.000 | 1.000 | 1.314 | 1.000 | 1.164 | 1.000 | 1.000 | 1.164 | 1.000 | 1.637 | 1.000 | 1.000 | 1.637 |
| Anhui | 1.020 | 1.220 | 1.055 | 0.967 | 1.245 | 0.980 | 1.028 | 0.997 | 0.983 | 1.008 | 1.232 | 1.475 | 1.058 | 1.165 | 1.817 |
| Fujian | 1.253 | 1.216 | 1.139 | 1.100 | 1.524 | 0.970 | 1.054 | 0.989 | 0.981 | 1.022 | 1.063 | 1.304 | 0.985 | 1.079 | 1.387 |
| Jiangxi | 1.048 | 1.274 | 0.923 | 1.136 | 1.335 | 0.846 | 1.074 | 0.889 | 0.952 | 0.909 | 1.515 | 1.461 | 1.125 | 1.347 | 2.214 |
| Shandong | 0.798 | 1.290 | 0.828 | 0.964 | 1.029 | 1.157 | 1.159 | 1.319 | 0.877 | 1.341 | 1.000 | 1.717 | 1.081 | 0.925 | 1.717 |
| Henan | 0.904 | 1.225 | 0.859 | 1.052 | 1.107 | 1.010 | 1.012 | 0.967 | 1.045 | 1.022 | 1.060 | 0.935 | 1.071 | 0.989 | 0.991 |
| Hubei | 1.012 | 1.253 | 0.914 | 1.108 | 1.268 | 0.993 | 1.036 | 0.984 | 1.010 | 1.029 | 0.983 | 0.975 | 0.932 | 1.055 | 0.958 |
| Hunan | 1.014 | 1.224 | 0.922 | 1.099 | 1.241 | 1.086 | 1.015 | 1.096 | 0.991 | 1.102 | 1.373 | 1.659 | 1.141 | 1.204 | 2.277 |
| Guangdong | 1.000 | 1.104 | 1.000 | 1.000 | 1.104 | 1.000 | 1.344 | 1.000 | 1.000 | 1.344 | 1.000 | 0.740 | 1.000 | 1.000 | 0.740 |
| Guangxi | 1.292 | 1.179 | 0.951 | 1.357 | 1.523 | 0.861 | 1.151 | 0.900 | 0.957 | 0.991 | 1.532 | 1.482 | 1.287 | 1.191 | 2.270 |
| Hainan | 1.494 | 1.216 | 1.014 | 1.474 | 1.817 | 1.057 | 1.090 | 0.931 | 1.135 | 1.152 | 1.004 | 1.149 | 1.034 | 0.971 | 1.154 |
| Chongqing | 1.281 | 1.249 | 0.980 | 1.307 | 1.599 | 0.884 | 1.070 | 0.915 | 0.966 | 0.946 | 1.061 | 1.235 | 1.102 | 0.963 | 1.310 |
| Sichuan | 1.292 | 1.157 | 1.006 | 1.285 | 1.495 | 0.832 | 1.199 | 0.899 | 0.925 | 0.997 | 1.039 | 1.027 | 1.014 | 1.025 | 1.067 |
| Guizhou | 1.227 | 1.229 | 0.909 | 1.349 | 1.508 | 1.069 | 0.956 | 0.993 | 1.076 | 1.021 | 0.941 | 1.241 | 1.073 | 0.877 | 1.168 |
| Yunnan | 0.796 | 1.193 | 1.000 | 0.796 | 0.949 | 1.257 | 1.139 | 1.000 | 1.257 | 1.431 | 1.000 | 1.201 | 1.000 | 1.000 | 1.201 |
| Tibet | 9.846 | 1.117 | 1.000 | 9.846 | 10.994 | 1.306 | 0.922 | 1.000 | 1.306 | 1.204 | 5.179 | 1.151 | 1.000 | 5.179 | 5.961 |
| Shaanxi | 1.206 | 1.279 | 0.953 | 1.266 | 1.542 | 0.974 | 1.024 | 0.923 | 1.055 | 0.997 | 0.900 | 1.157 | 0.939 | 0.958 | 1.041 |
| Gansu | 1.256 | 1.204 | 1.001 | 1.254 | 1.512 | 0.872 | 1.201 | 0.958 | 0.910 | 1.048 | 0.974 | 1.451 | 1.054 | 0.924 | 1.414 |
| Qinghai | 1.051 | 1.333 | 0.994 | 1.058 | 1.401 | 1.262 | 1.340 | 1.006 | 1.254 | 1.690 | 1.007 | 2.176 | 0.933 | 1.080 | 2.191 |
| Ningxia | 1.757 | 1.228 | 0.988 | 1.779 | 2.157 | 1.043 | 0.957 | 0.965 | 1.081 | 0.997 | 1.565 | 1.622 | 1.034 | 1.514 | 2.538 |
| Xinjiang | 1.172 | 1.208 | 1.000 | 1.172 | 1.416 | 1.126 | 1.713 | 1.000 | 1.126 | 1.930 | 1.000 | 2.636 | 1.000 | 1.000 | 2.636 |
| Mean | 1.199 | 1.218 | 0.986 | 1.216 | 1.461 | 1.003 | 1.096 | 0.984 | 1.020 | 1.100 | 1.118 | 1.275 | 1.035 | 1.080 | 1.425 |

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|  | 2016-2017 | | | | | 2017-2018 | | | | | 2018-2019 | | | | |
| Province | EFFch | TECHch | PEch | SEch | TFPch | EFFch | TECHch | PEch | SEch | TFPch | EFFch | TECHch | PEch | SEch | TFPch |
| Peking | 0.955 | 2.038 | 1.182 | 0.808 | 1.945 | 0.831 | 1.336 | 0.823 | 1.010 | 1.110 | 0.842 | 0.504 | 0.865 | 0.974 | 0.425 |
| Tianjin | 0.702 | 2.908 | 0.992 | 0.707 | 2.041 | 1.365 | 1.214 | 0.975 | 1.400 | 1.658 | 0.988 | 0.453 | 0.941 | 1.050 | 0.448 |
| Hebei | 1.061 | 2.915 | 1.050 | 1.010 | 3.092 | 0.810 | 1.490 | 0.923 | 0.878 | 1.208 | 1.076 | 0.445 | 1.107 | 0.972 | 0.479 |
| Shanxi | 1.000 | 4.127 | 1.000 | 1.000 | 4.127 | 1.000 | 1.403 | 1.000 | 1.000 | 1.403 | 0.997 | 0.368 | 1.000 | 0.997 | 0.367 |
| Inner Mongolia | 1.071 | 3.435 | 1.044 | 1.026 | 3.678 | 1.000 | 1.936 | 1.000 | 1.000 | 1.936 | 1.000 | 0.481 | 1.000 | 1.000 | 0.481 |
| Liaoning | 0.829 | 4.541 | 0.971 | 0.853 | 3.764 | 0.935 | 1.283 | 1.030 | 0.908 | 1.200 | 1.308 | 0.366 | 1.000 | 1.308 | 0.479 |
| Jilin | 0.690 | 4.131 | 1.000 | 0.690 | 2.852 | 1.002 | 1.350 | 1.000 | 1.002 | 1.353 | 1.114 | 0.359 | 0.975 | 1.143 | 0.401 |
| Heilongjiang | 0.935 | 3.835 | 1.128 | 0.829 | 3.587 | 0.789 | 1.411 | 1.001 | 0.788 | 1.113 | 1.199 | 0.349 | 0.947 | 1.266 | 0.419 |
| Shanghai | 0.842 | 3.154 | 1.039 | 0.810 | 2.654 | 1.064 | 1.221 | 0.963 | 1.104 | 1.299 | 0.851 | 0.368 | 0.824 | 1.032 | 0.313 |
| Jiangsu | 1.107 | 3.102 | 1.000 | 1.107 | 3.434 | 0.969 | 1.330 | 1.000 | 0.968 | 1.288 | 0.923 | 0.452 | 0.921 | 1.002 | 0.417 |
| Zhejiang | 0.925 | 2.762 | 0.963 | 0.961 | 2.556 | 1.026 | 1.333 | 1.029 | 0.997 | 1.367 | 0.914 | 0.452 | 0.897 | 1.018 | 0.413 |
| Anhui | 0.819 | 2.450 | 1.053 | 0.778 | 2.007 | 1.110 | 1.325 | 1.132 | 0.980 | 1.471 | 0.851 | 0.563 | 0.862 | 0.987 | 0.479 |
| Fujian | 0.756 | 3.006 | 0.950 | 0.796 | 2.272 | 1.038 | 1.374 | 0.975 | 1.065 | 1.426 | 0.920 | 0.511 | 0.918 | 1.002 | 0.470 |
| Jiangxi | 0.959 | 2.715 | 1.181 | 0.813 | 2.604 | 1.092 | 1.412 | 1.098 | 0.994 | 1.542 | 1.050 | 0.551 | 1.034 | 1.015 | 0.578 |
| Shandong | 1.177 | 3.152 | 1.000 | 1.177 | 3.711 | 0.852 | 1.342 | 1.000 | 0.852 | 1.143 | 1.109 | 0.409 | 1.000 | 1.109 | 0.454 |
| Henan | 1.161 | 2.583 | 1.120 | 1.037 | 2.999 | 0.777 | 1.451 | 0.859 | 0.904 | 1.127 | 0.947 | 0.479 | 0.940 | 1.007 | 0.453 |
| Hubei | 1.013 | 2.723 | 1.186 | 0.854 | 2.757 | 0.800 | 1.354 | 0.837 | 0.956 | 1.084 | 1.048 | 0.413 | 0.999 | 1.049 | 0.432 |
| Hunan | 1.000 | 3.777 | 1.000 | 1.000 | 3.777 | 1.000 | 1.222 | 1.000 | 1.000 | 1.222 | 0.946 | 0.310 | 0.951 | 0.994 | 0.294 |
| Guangdong | 1.000 | 3.780 | 1.000 | 1.000 | 3.780 | 1.000 | 1.078 | 1.000 | 1.000 | 1.078 | 1.000 | 0.324 | 1.000 | 1.000 | 0.324 |
| Guangxi | 0.940 | 3.313 | 1.089 | 0.863 | 3.113 | 0.997 | 1.388 | 0.965 | 1.034 | 1.384 | 0.946 | 0.399 | 0.933 | 1.014 | 0.378 |
| Hainan | 0.655 | 2.986 | 1.026 | 0.638 | 1.957 | 1.100 | 1.353 | 0.982 | 1.120 | 1.489 | 1.045 | 0.447 | 0.983 | 1.063 | 0.467 |
| Chongqing | 0.776 | 2.843 | 1.056 | 0.735 | 2.206 | 1.021 | 1.346 | 0.893 | 1.143 | 1.374 | 1.066 | 0.465 | 1.119 | 0.953 | 0.496 |
| Sichuan | 0.946 | 3.559 | 1.013 | 0.934 | 3.367 | 1.004 | 1.374 | 1.013 | 0.991 | 1.379 | 1.007 | 0.451 | 1.017 | 0.991 | 0.454 |
| Guizhou | 0.772 | 3.317 | 1.041 | 0.742 | 2.560 | 1.103 | 1.466 | 0.979 | 1.127 | 1.618 | 0.975 | 0.469 | 0.987 | 0.988 | 0.457 |
| Yunnan | 0.910 | 4.361 | 1.000 | 0.910 | 3.968 | 0.897 | 1.499 | 1.000 | 0.897 | 1.345 | 0.843 | 0.465 | 0.923 | 0.913 | 0.393 |
| Tibet | 0.250 | 2.748 | 1.000 | 0.250 | 0.688 | 1.842 | 1.376 | 1.000 | 1.842 | 2.535 | 1.074 | 0.563 | 1.000 | 1.074 | 0.604 |
| Shaanxi | 1.198 | 3.193 | 1.301 | 0.921 | 3.823 | 0.900 | 1.532 | 1.008 | 0.893 | 1.378 | 0.965 | 0.356 | 0.809 | 1.192 | 0.344 |
| Gansu | 0.833 | 3.546 | 1.079 | 0.772 | 2.955 | 1.032 | 1.402 | 0.986 | 1.047 | 1.447 | 0.908 | 0.402 | 0.934 | 0.972 | 0.365 |
| Qinghai | 0.335 | 3.183 | 1.072 | 0.312 | 1.066 | 1.651 | 1.411 | 1.000 | 1.651 | 2.330 | 1.062 | 0.530 | 0.971 | 1.094 | 0.563 |
| Ningxia | 0.575 | 3.641 | 1.052 | 0.547 | 2.095 | 1.093 | 1.601 | 0.979 | 1.117 | 1.750 | 0.729 | 0.542 | 0.994 | 0.733 | 0.395 |
| Xinjiang | 0.875 | 2.562 | 1.000 | 0.875 | 2.241 | 0.715 | 1.520 | 0.995 | 0.718 | 1.087 | 1.008 | 0.448 | 1.002 | 1.006 | 0.452 |
| Mean | 0.836 | 3.187 | 1.049 | 0.797 | 2.664 | 1.005 | 1.385 | 0.980 | 1.026 | 1.392 | 0.984 | 0.436 | 0.961 | 1.025 | 0.429 |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2019-2020 | | | | | 2020-2021 | | | | |
| Province | EFFch | TECHch | PEch | SEch | TFPch | EFFch | TECHch | PEch | SEch | TFPch |
| Peking | 1.091 | 0.898 | 0.961 | 1.136 | 0.980 | 0.914 | 0.958 | 1.085 | 0.842 | 0.875 |
| Tianjin | 1.472 | 1.004 | 1.079 | 1.364 | 1.478 | 0.835 | 0.981 | 1.011 | 0.825 | 0.819 |
| Hebei | 1.250 | 0.953 | 0.963 | 1.298 | 1.191 | 1.019 | 0.877 | 1.068 | 0.955 | 0.894 |
| Shanxi | 1.003 | 0.918 | 1.000 | 1.003 | 0.921 | 1.000 | 1.129 | 1.000 | 1.000 | 1.129 |
| Inner Mongolia | 1.000 | 0.887 | 1.000 | 1.000 | 0.887 | 1.000 | 0.994 | 1.000 | 1.000 | 0.994 |
| Liaoning | 1.000 | 1.013 | 1.000 | 1.000 | 1.013 | 1.000 | 0.947 | 1.000 | 1.000 | 0.947 |
| Jilin | 1.182 | 1.043 | 1.021 | 1.158 | 1.233 | 1.207 | 0.883 | 1.004 | 1.202 | 1.066 |
| Heilongjiang | 1.356 | 0.884 | 0.970 | 1.398 | 1.199 | 0.935 | 0.981 | 0.997 | 0.938 | 0.917 |
| Shanghai | 1.461 | 0.847 | 1.186 | 1.232 | 1.238 | 0.822 | 1.081 | 0.900 | 0.913 | 0.888 |
| Jiangsu | 1.116 | 1.038 | 1.075 | 1.038 | 1.158 | 0.941 | 0.913 | 0.930 | 1.012 | 0.860 |
| Zhejiang | 1.072 | 0.982 | 1.083 | 0.990 | 1.053 | 1.061 | 0.903 | 1.039 | 1.021 | 0.958 |
| Anhui | 1.394 | 1.000 | 1.117 | 1.248 | 1.394 | 1.002 | 0.952 | 1.036 | 0.968 | 0.954 |
| Fujian | 1.346 | 0.909 | 1.122 | 1.199 | 1.224 | 0.800 | 0.925 | 0.898 | 0.890 | 0.740 |
| Jiangxi | 1.096 | 0.968 | 0.892 | 1.229 | 1.061 | 1.031 | 0.907 | 1.093 | 0.944 | 0.936 |
| Shandong | 0.990 | 1.052 | 1.000 | 0.990 | 1.042 | 1.194 | 0.864 | 1.000 | 1.194 | 1.032 |
| Henan | 0.935 | 0.923 | 0.863 | 1.084 | 0.863 | 0.952 | 0.923 | 0.988 | 0.963 | 0.879 |
| Hubei | 1.471 | 1.016 | 1.304 | 1.129 | 1.495 | 0.949 | 0.957 | 0.994 | 0.955 | 0.909 |
| Hunan | 0.764 | 1.096 | 0.899 | 0.850 | 0.837 | 0.973 | 0.953 | 1.023 | 0.952 | 0.927 |
| Guangdong | 1.000 | 0.872 | 1.000 | 1.000 | 0.872 | 1.000 | 1.021 | 1.000 | 1.000 | 1.021 |
| Guangxi | 1.106 | 1.119 | 0.989 | 1.119 | 1.238 | 1.255 | 0.842 | 1.129 | 1.112 | 1.057 |
| Hainan | 1.420 | 0.840 | 1.079 | 1.315 | 1.192 | 0.871 | 1.060 | 1.000 | 0.871 | 0.923 |
| Chongqing | 1.552 | 0.933 | 1.068 | 1.453 | 1.448 | 0.907 | 0.931 | 1.000 | 0.907 | 0.845 |
| Sichuan | 1.031 | 0.980 | 0.940 | 1.098 | 1.010 | 1.154 | 0.891 | 1.120 | 1.031 | 1.028 |
| Guizhou | 1.178 | 0.964 | 0.950 | 1.240 | 1.136 | 1.009 | 0.924 | 1.008 | 1.001 | 0.932 |
| Yunnan | 1.453 | 1.275 | 1.083 | 1.341 | 1.852 | 0.738 | 0.751 | 0.933 | 0.792 | 0.554 |
| Tibet | 1.762 | 0.907 | 1.000 | 1.762 | 1.598 | 0.739 | 0.931 | 1.000 | 0.739 | 0.688 |
| Shaanxi | 0.963 | 0.950 | 0.908 | 1.061 | 0.915 | 1.139 | 0.913 | 1.166 | 0.977 | 1.040 |
| Gansu | 1.322 | 1.001 | 0.901 | 1.466 | 1.323 | 1.060 | 0.888 | 1.111 | 0.954 | 0.941 |
| Qinghai | 2.118 | 1.043 | 1.030 | 2.057 | 2.209 | 1.015 | 0.825 | 1.000 | 1.015 | 0.837 |
| Ningxia | 1.890 | 0.954 | 1.046 | 1.807 | 1.802 | 0.927 | 0.883 | 1.004 | 0.923 | 0.819 |
| Xinjiang | 0.947 | 1.046 | 0.794 | 1.193 | 0.990 | 1.241 | 0.838 | 1.180 | 1.052 | 1.040 |
| Mean | 1.217 | 0.974 | 1.006 | 1.210 | 1.186 | 0.981 | 0.927 | 1.021 | 0.961 | 0.909 |

# Table S.7 Mean values of Malmquist index of OEoUEI for 31 Chinese provinces

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Province | EFFch | TECHch | PEch | SEch | TFPch | Rank of TFPch |
| Tibet | 1.279 | 1.046 | 1.000 | 1.279 | 1.338 | 1 |
| Inner Mongolia | 1.051 | 1.119 | 1.035 | 1.016 | 1.177 | 2 |
| Xinjiang | 1.023 | 1.140 | 1.011 | 1.012 | 1.166 | 3 |
| Ningxia | 1.021 | 1.115 | 1.010 | 1.011 | 1.138 | 4 |
| Qinghai | 1.004 | 1.126 | 1.000 | 1.004 | 1.130 | 5 |
| Jiangsu | 0.995 | 1.110 | 0.995 | 1.000 | 1.104 | 6 |
| Zhejiang | 1.003 | 1.080 | 1.000 | 1.003 | 1.083 | 7 |
| Chongqing | 1.025 | 1.056 | 1.014 | 1.011 | 1.082 | 8 |
| Anhui | 1.000 | 1.081 | 1.004 | 0.996 | 1.081 | 9 |
| Tianjin | 1.005 | 1.073 | 1.015 | 0.990 | 1.078 | 10 |
| Shandong | 1.000 | 1.073 | 1.000 | 1.000 | 1.073 | 11 |
| Sichuan | 1.032 | 1.040 | 1.026 | 1.006 | 1.073 | 12 |
| Guangxi | 1.009 | 1.058 | 1.006 | 1.003 | 1.067 | 13 |
| Hainan | 0.996 | 1.060 | 1.001 | 0.995 | 1.056 | 14 |
| Hebei | 0.991 | 1.058 | 0.992 | 0.998 | 1.048 | 15 |
| Fujian | 0.977 | 1.072 | 0.989 | 0.988 | 1.047 | 16 |
| Liaoning | 1.012 | 1.034 | 1.000 | 1.012 | 1.046 | 17 |
| Yunnan | 1.000 | 1.045 | 0.996 | 1.005 | 1.046 | 18 |
| Shaanxi | 1.009 | 1.036 | 1.008 | 1.001 | 1.045 | 19 |
| Jilin | 1.004 | 1.033 | 1.010 | 0.994 | 1.038 | 20 |
| Gansu | 0.996 | 1.042 | 0.999 | 0.998 | 1.038 | 21 |
| Jiangxi | 0.978 | 1.058 | 0.995 | 0.982 | 1.034 | 22 |
| Guangdong | 1.001 | 1.029 | 1.000 | 1.001 | 1.031 | 23 |
| Hunan | 0.980 | 1.049 | 0.992 | 0.987 | 1.027 | 24 |
| Shaanxi | 1.000 | 1.024 | 1.000 | 1.000 | 1.024 | 25 |
| Heilongjiang | 0.998 | 1.021 | 1.021 | 0.977 | 1.019 | 26 |
| Shanghai | 0.975 | 1.038 | 0.990 | 0.985 | 1.013 | 27 |
| Peking | 0.969 | 1.041 | 0.986 | 0.983 | 1.009 | 28 |
| Hubei | 0.986 | 1.021 | 0.996 | 0.990 | 1.006 | 29 |
| Henan | 0.979 | 1.003 | 0.985 | 0.994 | 0.983 | 30 |
| Guizhou | 0.963 | 0.983 | 0.995 | 0.968 | 0.947 | 31 |
| Mean | 1.007 | 1.056 | 1.002 | 1.005 | 1.064 | / |