**Supplemental Material 3.** The analysis of placebo tests and the results of the synthetic control methods in detail by country.

|  |  |
| --- | --- |
| a | b |
| c | d |
| e | f |

Figure S1. Cumulative number of confirmed cases in synthetic countries and placebo cases (discard countries with pre-intervention MSPE three times higher than treated countries’)

**Table S1.** Factors considered for the spread of the COVID-19, Australia

|  |  |
| --- | --- |
|  | **Australia** |
| Variables | Real | Synthetic |
| **Demographic factors** |
| Log Population (total) | 17.03 | 17.03 |
| Aged population (% of total population) | 15.66 | 18.51 |
| **Economic factors** |
| Log GNI per capita(US$) | 10.88 | 10.86 |
| **Health condition and Health care environments** |
| Life expectancy | 82.50 | 82.23 |
| Health expenditure(% of GDP) | 9.25 | 9.27 |
| Physicians(per 1,000 people) | 3.59 | 3.13 |
| **Chinese visitors** |
| Log Chinese arrivals | 14.17 | 14.37 |

**Table S2.** Country weights in the synthetic Australia

|  |  |
| --- | --- |
| Country | Weight |
| Japan | 0.448 |
| Norway | 0.348 |
| United Arab Emirates | 0.204 |

**Table S3.** Effects of entry ban on the COVOD-19 epidemic. Cumulative number of confirmed cases of real Australia (with entry ban), synthetic Australia (without entry ban), and avoidable infected cases. Avoidable infected cases are calculated by subtracting real Australia (without entry ban) from Synthetic (with entry ban) cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| DATE | RealAustralia | Synthetic Australia | Avoidableinfectedcases | DATE | RealAustralia | Synthetic Australia | Avoidableinfectedcases |
| 2020-01-21 | 0 | 0.448 | 0.448 | 2020-02-10 | 15 | 44.436 | 29.436 |
| 2020-01-22 | 0 | 0.448 | 0.448 | 2020-02-11 | 15 | 73.76 | 58.76 |
| 2020-01-23 | 0 | 0.448 | 0.448 | 2020-02-12 | 15 | 92.576 | 77.576 |
| 2020-01-24 | 0 | 0.448 | 0.448 | 2020-02-13 | 15 | 92.576 | 77.576 |
| 2020-01-25 | 3 | 1.344 | -1.656 | 2020-02-14 | 15 | 114.08 | 99.08 |
| 2020-01-26 | 4 | 1.344 | -2.656 | 2020-02-15 | 15 | 117.664 | 102.664 |
| 2020-01-27 | 4 | 1.792 | -2.208 | 2020-02-16 | 15 | 184.416 | 169.416 |
| 2020-01-28 | 5 | 2.688 | -2.312 | 2020-02-17 | 15 | 231.66 | 216.66 |
| 2020-01-29 | 7 | 3.952 | -3.048 | 2020-02-18 | 15 | 234.348 | 219.348 |
| 2020-01-30 | 7 | 5.744 | -1.256 | 2020-02-19 | 15 | 277.356 | 262.356 |
| 2020-01-31 | 9 | 7.088 | -1.912 | 2020-02-20 | 15 | 318.124 | 303.124 |
| 2020-02-01 | 12 | 8.432 | -3.568 | 2020-02-21 | 17 | 327.532 | 310.532 |
| 2020-02-02 | 12 | 9.98 | -2.02 | 2020-02-22 | 21 | 333.316 | 312.316 |
| 2020-02-03 | 12 | 9.98 | -2.02 | 2020-02-23 | 22 | 345.82 | 323.82 |
| 2020-02-04 | 12 | 9.98 | -2.02 | 2020-02-24 | 22 | 378.524 | 356.524 |
| 2020-02-05 | 13 | 15.804 | 2.804 | 2020-02-25 | 22 | 382.556 | 360.556 |
| 2020-02-06 | 14 | 21.18 | 7.18 | 2020-02-26 | 23 | 385.692 | 362.692 |
| 2020-02-07 | 15 | 39.548 | 24.548 | 2020-02-27 | 23 | 402.168 | 379.168 |
| 2020-02-08 | 15 | 41.3 | 26.3 | 2020-02-28 | 23 | 415.188 | 392.188 |
| 2020-02-09 | 15 | 41.748 | 26.748 | 2020-02-29 | 24 | 424.844 | 400.844 |

**Table S4.** Factors considered for the spread of the COVID-19, Singapore

|  |  |
| --- | --- |
|  | **Singapore** |
| Variables | Real | Synthetic |
| **Demographic factors** |
| Log Population (total) | 15.55 | 16.73 |
| Aged population (% of total population) | 11.46 | 14.14 |
| **Economic factors** |
| Log GNI per capita(US$) | 10.98 | 9.64 |
| **Health condition and Health care environments** |
| Life expectancy | 82.90 | 80.21 |
| Health expenditure(% of GDP) | 4.47 | 5.44 |
| Physicians(per 1,000 people) | 2.31 | 2.03 |
| **Chinese visitors** |
| Log Chinese arrivals | 15.04 | 15.05 |

**Table S5.** Country weights in the synthetic Singapore

|  |  |
| --- | --- |
| Country | Weight |
| Thailand | 0.481 |
| South Korea | 0.359 |
| San Marino | 0.160 |

**Table S6.** Effects of entry ban on the COVOD-19 epidemic. Cumulative number of confirmed cases of real Singapore (with entry ban), synthetic Singapore (without entry ban), and avoidable infected cases. Avoidable infected cases are calculated by subtracting real Singapore (without entry ban) from Synthetic (with entry ban) cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| DATE | RealSingapore | Synthetic Singapore | Avoidableinfectedcases | DATE | RealSingapore | Synthetic Singapore | Avoidableinfectedcases |
| 2020-01-21 | 0 | 1.321 | 1.321 | 2020-02-10 | 43 | 25.085 | -17.915 |
| 2020-01-22 | 0 | 1.321 | 1.321 | 2020-02-11 | 45 | 25.925 | -19.075 |
| 2020-01-23 | 0 | 2.283 | 2.283 | 2020-02-12 | 47 | 25.925 | -21.075 |
| 2020-01-24 | 1 | 2.642 | 1.642 | 2020-02-13 | 50 | 25.925 | -24.075 |
| 2020-01-25 | 3 | 2.642 | -0.358 | 2020-02-14 | 58 | 25.925 | -32.075 |
| 2020-01-26 | 4 | 3.123 | -0.877 | 2020-02-15 | 67 | 26.406 | -40.594 |
| 2020-01-27 | 4 | 3.841 | -0.159 | 2020-02-16 | 72 | 26.765 | -45.235 |
| 2020-01-28 | 7 | 8.17 | 1.17 | 2020-02-17 | 75 | 27.605 | -47.395 |
| 2020-01-29 | 7 | 8.17 | 1.17 | 2020-02-18 | 77 | 27.964 | -49.036 |
| 2020-01-30 | 10 | 8.17 | -1.83 | 2020-02-19 | 81 | 35.144 | -45.856 |
| 2020-01-31 | 13 | 10.683 | -2.317 | 2020-02-20 | 84 | 54.171 | -29.829 |
| 2020-02-01 | 16 | 13.447 | -2.553 | 2020-02-21 | 85 | 90.071 | 5.071 |
| 2020-02-02 | 18 | 14.524 | -3.476 | 2020-02-22 | 86 | 141.049 | 55.049 |
| 2020-02-03 | 18 | 14.524 | -3.476 | 2020-02-23 | 89 | 232.953 | 143.953 |
| 2020-02-04 | 18 | 14.883 | -3.117 | 2020-02-24 | 89 | 290.752 | 201.752 |
| 2020-02-05 | 24 | 18.487 | -5.513 | 2020-02-25 | 90 | 368.54 | 278.54 |
| 2020-02-06 | 28 | 20.282 | -7.718 | 2020-02-26 | 91 | 471.939 | 380.939 |
| 2020-02-07 | 30 | 20.641 | -9.359 | 2020-02-27 | 93 | 653.234 | 560.234 |
| 2020-02-08 | 33 | 24.008 | -8.992 | 2020-02-28 | 96 | 858.223 | 762.223 |
| 2020-02-09 | 40 | 25.085 | -14.915 | 2020-02-29 | 98 | 1,151.212 | 1,053.212 |

**Table S7.** Factors considered for the spread of the COVID-19, USA

|  |  |
| --- | --- |
|  | **USA** |
| Variables | Real | Synthetic |
| **Demographic factors** |
| Log Population (total) | 19.60 | 18.23 |
| Aged population (% of total population) | 15.81 | 15.90 |
| **Economic factors** |
| Log GNI per capita(US$) | 11.05 | 9.99 |
| **Health condition and Health care environments** |
| Life expectancy | 78.54 | 80.13 |
| Health expenditure(% of GDP) | 17.07 | 9.90 |
| Physicians(per 1,000 people) | 2.59 | 2.47 |
| **Chinese visitors** |
| Log Chinese arrivals | 14.91 | 14.20 |

**Table S8.** Country weights in the synthetic USA

|  |  |
| --- | --- |
| Country | Weight |
| France | 0.538 |
| Brazil | 0.204 |
| Thailand | 0.165 |
| South Korea | 0.093 |

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**Table S9.** Effects of entry ban on the COVOD-19 epidemic. Cumulative number of confirmed cases of real United States of America (with entry ban), synthetic United States of America (without entry ban), and avoidable infected cases. Avoidable infected cases are calculated by subtracting real United States of America (without entry ban) from Synthetic (with entry ban) cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| DATE | RealUSA | Synthetic USA | Avoidableinfectedcases | DATE | RealUSA | Synthetic USA | Avoidableinfectedcases |
| 2020-01-21 | 0 | 0.423 | 0.423 | 2020-02-10 | 12 | 13.709 | 1.709 |
| 2020-01-22 | 0 | 0.423 | 0.423 | 2020-02-11 | 13 | 13.967 | 0.967 |
| 2020-01-23 | 1 | 0.753 | -0.247 | 2020-02-12 | 13 | 13.967 | 0.967 |
| 2020-01-24 | 1 | 0.846 | -0.154 | 2020-02-13 | 14 | 13.967 | -0.033 |
| 2020-01-25 | 2 | 2.46 | 0.46 | 2020-02-14 | 15 | 13.967 | -1.033 |
| 2020-01-26 | 2 | 2.625 | 0.625 | 2020-02-15 | 15 | 14.132 | -0.868 |
| 2020-01-27 | 5 | 2.811 | -2.189 | 2020-02-16 | 15 | 14.763 | -0.237 |
| 2020-01-28 | 5 | 4.296 | -0.704 | 2020-02-17 | 15 | 15.021 | 0.021 |
| 2020-01-29 | 5 | 4.834 | -0.166 | 2020-02-18 | 15 | 15.114 | 0.114 |
| 2020-01-30 | 5 | 5.372 | 0.372 | 2020-02-19 | 15 | 16.974 | 1.974 |
| 2020-01-31 | 6 | 6.561 | 0.561 | 2020-02-20 | 15 | 21.903 | 6.903 |
| 2020-02-01 | 7 | 7.479 | 0.479 | 2020-02-21 | 15 | 31.203 | 16.203 |
| 2020-02-02 | 8 | 7.758 | -0.242 | 2020-02-22 | 35 | 44.409 | 9.409 |
| 2020-02-03 | 11 | 7.758 | -3.242 | 2020-02-23 | 35 | 68.217 | 33.217 |
| 2020-02-04 | 11 | 7.851 | -3.149 | 2020-02-24 | 35 | 83.19 | 48.19 |
| 2020-02-05 | 11 | 9.027 | -1.973 | 2020-02-25 | 53 | 103.422 | 50.422 |
| 2020-02-06 | 12 | 9.492 | -2.508 | 2020-02-26 | 53 | 130.329 | 77.329 |
| 2020-02-07 | 12 | 9.585 | -2.415 | 2020-02-27 | 59 | 180.726 | 121.726 |
| 2020-02-08 | 12 | 10.74 | -1.26 | 2020-02-28 | 59 | 244.589 | 185.589 |
| 2020-02-09 | 12 | 13.709 | 1.709 | 2020-02-29 | 62 | 330.75 | 268.75 |

**Table S10**. Factors considered for the spread of the COVID-19,Vietnam

|  |  |
| --- | --- |
|  | **Vietnam** |
| Variables | Real | Synthetic |
| **Demographic factors** |
| Log Population (total) | 18.38 | 17.94 |
| Aged population (% of total population) | 7.27 | 7.97 |
| **Economic factors** |
| Log GNI per capita(US$) | 7.77 | 8.20 |
| **Health condition and Health care environments** |
| Life expectancy | 75.24 | 73.15 |
| Health expenditure(% of GDP) | 5.66 | 5.62 |
| Physicians(per 1,000 people) | 0.82 | 0.82 |
| **Chinese visitors** |
| Log Chinese arrivals | 15.42 | 14.54 |

**Table S11**. Country weights in the synthetic Vietnam

|  |  |
| --- | --- |
| Country | Weight |
| Cambodia | 0.455 |
| South Korea | 0.233 |
| India | 0.206 |
| Thailand | 0.106 |

**Table S12.** Effects of entry ban on the COVOD-19 epidemic. Cumulative number of confirmed cases of real Vietnam (with entry ban), synthetic Vietnam (without entry ban), and avoidable infected cases. Avoidable infected cases are calculated by subtracting real Vietnam (without entry ban) from Synthetic (with entry ban) cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| DATE | RealVietnam | Synthetic Vietnam | Avoidableinfectedcases | DATE | RealVietnam | Synthetic Vietnam | Avoidableinfectedcases |
| 2020-01-21 | 0 | 0.445 | 0.445 | 2020-02-10 | 14 | 10.756 | -3.244 |
| 2020-01-22 | 0 | 0.445 | 0.445 | 2020-02-11 | 15 | 11.095 | -3.905 |
| 2020-01-23 | 0 | 0.657 | 0.657 | 2020-02-12 | 15 | 11.095 | -3.905 |
| 2020-01-24 | 2 | 0.89 | -1.11 | 2020-02-13 | 16 | 11.095 | -4.905 |
| 2020-01-25 | 2 | 0.89 | -1.11 | 2020-02-14 | 16 | 11.095 | -4.905 |
| 2020-01-26 | 2 | 0.996 | -1.004 | 2020-02-15 | 16 | 11.201 | -4.799 |
| 2020-01-27 | 2 | 1.462 | -0.538 | 2020-02-16 | 16 | 11.434 | -4.566 |
| 2020-01-28 | 2 | 2.871 | 0.871 | 2020-02-17 | 16 | 11.773 | -4.227 |
| 2020-01-29 | 2 | 2.871 | 0.871 | 2020-02-18 | 16 | 12.006 | -3.994 |
| 2020-01-30 | 2 | 3.077 | 1.077 | 2020-02-19 | 16 | 16.666 | 0.666 |
| 2020-01-31 | 5 | 4.708 | -0.292 | 2020-02-20 | 16 | 29.015 | 13.015 |
| 2020-02-01 | 6 | 5.471 | -0.529 | 2020-02-21 | 16 | 52.315 | 36.315 |
| 2020-02-02 | 7 | 6.376 | -0.624 | 2020-02-22 | 16 | 85.401 | 69.401 |
| 2020-02-03 | 8 | 6.582 | -1.418 | 2020-02-23 | 16 | 145.049 | 129.049 |
| 2020-02-04 | 9 | 6.815 | -2.185 | 2020-02-24 | 16 | 182.562 | 166.562 |
| 2020-02-05 | 10 | 7.917 | -2.083 | 2020-02-25 | 16 | 232.636 | 216.636 |
| 2020-02-06 | 10 | 9.082 | -0.918 | 2020-02-26 | 16 | 299.126 | 283.126 |
| 2020-02-07 | 12 | 9.315 | -2.685 | 2020-02-27 | 16 | 416.791 | 400.791 |
| 2020-02-08 | 13 | 10.057 | -2.943 | 2020-02-28 | 16 | 549.834 | 533.834 |
| 2020-02-09 | 14 | 10.756 | -3.244 | 2020-02-29 | 16 | 739.475 | 723.475 |

**Table S13.** Factors considered for the spread of the COVID-19,Taiwan

|  |  |
| --- | --- |
|  | **Taiwan** |
| Variables | Real | Synthetic |
| **Demographic factors** |
| Log Population (total) | 16.98 | 16.98 |
| Aged population (% of total population) | 14.56 | 11.45 |
| **Economic factors** |
| Log GNI per capita(US$) | 10.18 | 10.18 |
| **Health condition and Health care environments** |
| Life expectancy | 80.49 | 80.16 |
| Health expenditure(% of GDP) | 6.30 | 6.30 |
| Physicians(per 1,000 people) | 2.18 | 2.18 |
| **Chinese visitors** |
| Log Chinese arrivals | 14.70 | 14.64 |

**Table S14.** Country weights in the synthetic Taiwan

|  |  |
| --- | --- |
| Country | Weight |
| South Korea | 0.26 |
| United Arab Emirates | 0.252 |
| Canada | 0.23 |
| Thailand | 0.211 |
| San Marino | 0.047 |

**Table S15.** Effects of entry ban on the COVOD-19 epidemic. Cumulative number of confirmed cases of real Taiwan (with entry ban), synthetic Taiwan (without entry ban), and avoidable infected cases. Avoidable infected cases are calculated by subtracting real Taiwan (without entry ban) from Synthetic (with entry ban) cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| DATE | RealTaiwan | Synthetic Taiwan | Avoidableinfectedcases | DATE | RealTaiwan | Synthetic Taiwan | Avoidableinfectedcases |
| 2020-01-21 | 0 | 0.682 | 0.682 | 2020-02-10 | 18 | 17.146 | -0.854 |
| 2020-01-22 | 1 | 0.682 | -0.318 | 2020-02-11 | 18 | 17.869 | -0.131 |
| 2020-01-23 | 1 | 1.104 | 0.104 | 2020-02-12 | 18 | 17.869 | -0.131 |
| 2020-01-24 | 1 | 1.364 | 0.364 | 2020-02-13 | 18 | 17.869 | -0.131 |
| 2020-01-25 | 3 | 1.364 | -1.636 | 2020-02-14 | 18 | 17.869 | -0.131 |
| 2020-01-26 | 3 | 1.575 | -1.425 | 2020-02-15 | 18 | 18.08 | 0.08 |
| 2020-01-27 | 4 | 2.325 | -1.675 | 2020-02-16 | 18 | 18.34 | 0.34 |
| 2020-01-28 | 7 | 4.454 | -2.546 | 2020-02-17 | 20 | 19.063 | -0.937 |
| 2020-01-29 | 8 | 5.692 | -2.308 | 2020-02-18 | 22 | 19.553 | -2.447 |
| 2020-01-30 | 8 | 5.692 | -2.308 | 2020-02-19 | 23 | 24.753 | 1.753 |
| 2020-01-31 | 9 | 7.512 | -1.488 | 2020-02-20 | 24 | 38.533 | 14.533 |
| 2020-02-01 | 10 | 9.057 | -0.943 | 2020-02-21 | 26 | 64.533 | 38.533 |
| 2020-02-02 | 10 | 10.089 | 0.089 | 2020-02-22 | 26 | 101.957 | 75.957 |
| 2020-02-03 | 10 | 10.089 | 0.089 | 2020-02-23 | 26 | 169.251 | 143.251 |
| 2020-02-04 | 10 | 10.349 | 0.349 | 2020-02-24 | 28 | 211.111 | 183.111 |
| 2020-02-05 | 11 | 12.365 | 1.365 | 2020-02-25 | 31 | 267.403 | 236.403 |
| 2020-02-06 | 11 | 13.665 | 2.665 | 2020-02-26 | 32 | 341.876 | 309.876 |
| 2020-02-07 | 16 | 14.385 | -1.615 | 2020-02-27 | 32 | 473.406 | 441.406 |
| 2020-02-08 | 16 | 16.366 | 0.366 | 2020-02-28 | 34 | 623.378 | 589.378 |
| 2020-02-09 | 17 | 17.146 | 0.146 | 2020-02-29 | 39 | 835.917 | 796.917 |

**Table S16.** Factors considered for the spread of the COVID-19, Hong Kong

|  |  |
| --- | --- |
|  | **Hong Kong** |
| Variables | Real | Synthetic |
| **Demographic factors** |
| Log Population (total) | 15.82 | 17.06 |
| Aged population (% of total population) | 16.88 | 14.81 |
| **Economic factors** |
| Log GNI per capita(US$) | 10.83 | 9.69 |
| **Health condition and Health care environments** |
| Life expectancy | 84.68 | 80.20 |
| Health expenditure(% of GDP) | 5.80 | 5.95 |
| Physicians(per 1,000 people) | 1.96 | 1.93 |
| **Chinese visitors** |
| Log Chinese arrivals | 16.81 | 15.32 |

**Table S17.** Country weights in the synthetic Hong Kong

|  |  |
| --- | --- |
| Country | Weight |
| Thailand | 0.498 |
| South Korea | 0.275 |
| San Marino | 0.109 |
| Switzerland | 0.064 |
| Japan | 0.055 |

**Table S18.** Effects of entry ban on the COVOD-19 epidemic. Cumulative number of confirmed cases of real Hong Kong (with entry ban), synthetic Hong Kong (without entry ban), and avoidable infected cases. Avoidable infected cases are calculated by subtracting real Hong Kong (without entry ban) from Synthetic (with entry ban) cases.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| DATE | RealHong Kong | Synthetic Hong Kong | Avoidableinfectedcases | DATE | RealHong Kong | Synthetic Hong Kong | Avoidableinfectedcases |
| 2020-01-21 | 0 | 1.326 | 1.326 | 2020-02-10 | 36 | 28.641 | -7.359 |
| 2020-01-22 | 0 | 1.326 | 1.326 | 2020-02-11 | 42 | 32.989 | -9.011 |
| 2020-01-23 | 1 | 2.322 | 1.322 | 2020-02-12 | 49 | 35.299 | -13.701 |
| 2020-01-24 | 2 | 2.597 | 0.597 | 2020-02-13 | 50 | 35.299 | -14.701 |
| 2020-01-25 | 5 | 2.707 | -2.293 | 2020-02-14 | 53 | 37.939 | -15.061 |
| 2020-01-26 | 5 | 3.205 | -1.795 | 2020-02-15 | 56 | 38.877 | -17.123 |
| 2020-01-27 | 8 | 3.81 | -4.19 | 2020-02-16 | 56 | 47.347 | -8.653 |
| 2020-01-28 | 8 | 8.402 | 0.402 | 2020-02-17 | 57 | 53.895 | -3.105 |
| 2020-01-29 | 8 | 8.457 | 0.457 | 2020-02-18 | 60 | 54.5 | -5.5 |
| 2020-01-30 | 10 | 8.677 | -1.323 | 2020-02-19 | 62 | 65.28 | 3.28 |
| 2020-01-31 | 12 | 10.767 | -1.233 | 2020-02-20 | 65 | 84.86 | 19.86 |
| 2020-02-01 | 13 | 13.697 | 0.697 | 2020-02-21 | 68 | 113.515 | 45.515 |
| 2020-02-02 | 14 | 14.687 | 0.687 | 2020-02-22 | 68 | 153.225 | 85.225 |
| 2020-02-03 | 15 | 14.687 | -0.313 | 2020-02-23 | 70 | 225.11 | 155.11 |
| 2020-02-04 | 15 | 14.962 | -0.038 | 2020-02-24 | 74 | 273.4 | 199.4 |
| 2020-02-05 | 18 | 19.215 | 1.215 | 2020-02-25 | 81 | 333.741 | 252.741 |
| 2020-02-06 | 21 | 21.25 | 0.25 | 2020-02-26 | 85 | 413.784 | 328.784 |
| 2020-02-07 | 24 | 23.78 | -0.22 | 2020-02-27 | 91 | 554.639 | 463.639 |
| 2020-02-08 | 26 | 27.431 | 1.431 | 2020-02-28 | 93 | 713.304 | 620.304 |
| 2020-02-09 | 26 | 28.311 | 2.311 | 2020-02-29 | 94 | 939.34 | 845.34 |