**Online Appendix**

In the main text, due to word limit, we omit the control variates and only report the results for the core variables. In this Online Appendix, we present the regression results of all variables, with tables reporting two alternative versions: one reporting standard errors and another reporting p-values in parentheses.

Table A1: Baseline Results (All Variables, Standard Errors)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|  | ln\_ManipulationSO2 | ln\_ManipulationSO2 | ln\_ManipulationSO2 | ln\_SatelliteSO2 | ln\_SatelliteSO2 | ln\_SatelliteSO2 | ln\_OfficialSO2 | ln\_OfficialSO2 | ln\_OfficialSO2 |
| Connect | -0.048\*\* | -0.046\* | -0.046\*\* | 0.015\*\*\* | 0.013\*\*\* | 0.012\*\*\* | -0.038\* | -0.037\* | -0.038\* |
|  | (0.024) | (0.024) | (0.023) | (0.005) | (0.005) | (0.003) | (0.022) | (0.022) | (0.022) |
| ln\_GDPper |  | -0.055 | -0.087 |  | -0.038 | -0.002 |  | -0.097 | -0.089 |
|  |  | (0.084) | (0.087) |  | (0.038) | (0.016) |  | (0.086) | (0.087) |
| GDPgrowth |  | 0.010\*\* | 0.009\*\* |  | -0.002\*\* | -0.001 |  | 0.010\*\* | 0.010\*\* |
|  |  | (0.005) | (0.005) |  | (0.001) | (0.001) |  | (0.004) | (0.004) |
| Ratio\_Second |  | 0.003 | 0.003 |  | -0.003\*\*\* | -0.003\*\*\* |  | -0.000 | -0.000 |
|  |  | (0.007) | (0.007) |  | (0.001) | (0.001) |  | (0.006) | (0.006) |
| ln\_Industry |  | 0.062 | 0.085 |  | 0.070\*\*\* | 0.046\*\*\* |  | 0.115 | 0.114 |
|  |  | (0.106) | (0.106) |  | (0.022) | (0.017) |  | (0.099) | (0.099) |
| ln\_Retail |  | -0.214\*\* | -0.183\*\* |  | 0.035\* | -0.006 |  | -0.176\*\* | -0.185\*\* |
|  |  | (0.085) | (0.083) |  | (0.020) | (0.009) |  | (0.082) | (0.084) |
| ln\_Populatoin |  |  | -0.899\*\* |  |  | 1.037\*\*\* |  |  | 0.240 |
|  |  |  | (0.393) |  |  | (0.058) |  |  | (0.352) |
| ln\_Popdensity |  |  | 0.662 |  |  | -1.069\*\*\* |  |  | -0.298 |
|  |  |  | (0.526) |  |  | (0.083) |  |  | (0.457) |
| Temperature |  |  | 0.039 |  |  | -0.015\*\*\* |  |  | 0.027 |
|  |  |  | (0.028) |  |  | (0.005) |  |  | (0.024) |
| Precipitation |  |  | 0.001 |  |  | 0.000\*\* |  |  | 0.001 |
|  |  |  | (0.001) |  |  | (0.000) |  |  | (0.001) |
| Cloud |  |  | -0.002 |  |  | -0.000 |  |  | -0.002 |
|  |  |  | (0.005) |  |  | (0.001) |  |  | (0.005) |
| Constant | 9.496\*\*\* | 10.992\*\*\* | 11.553\*\* | 1.170\*\*\* | 0.390 | 1.177\* | 10.668\*\*\* | 11.553\*\*\* | 11.576\*\*\* |
|  | (0.013) | (1.336) | (4.970) | (0.003) | (0.299) | (0.667) | (0.012) | (1.227) | (4.427) |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Adjusted R2 | 0.977 | 0.977 | 0.978 | 0.999 | 0.999 | 0.999 | 0.841 | 0.843 | 0.843 |
| Number of Cities | 253 | 252 | 252 | 253 | 252 | 252 | 268 | 267 | 267 |
| Observations | 2509 | 2495 | 2495 | 2530 | 2516 | 2516 | 2659 | 2645 | 2645 |

*Note*: All controls are included. Robust standard errors (in parentheses) are clustered at the city level.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A2: Baseline Results (All Variables, p-values)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|  | ln\_ManipulationSO2 | ln\_ManipulationSO2 | ln\_ManipulationSO2 | ln\_SatelliteSO2 | ln\_SatelliteSO2 | ln\_SatelliteSO2 | ln\_OfficialSO2 | ln\_OfficialSO2 | ln\_OfficialSO2 |
| Connect | -0.048\*\* | -0.046\* | -0.046\*\* | 0.015\*\*\* | 0.013\*\*\* | 0.012\*\*\* | -0.038\* | -0.037\* | -0.038\* |
|  | (0.045) | (0.056) | (0.045) | (0.002) | (0.004) | (0.001) | (0.087) | (0.095) | (0.082) |
| ln\_GDPper |  | -0.055 | -0.087 |  | -0.038 | -0.002 |  | -0.097 | -0.089 |
|  |  | (0.515) | (0.320) |  | (0.328) | (0.884) |  | (0.261) | (0.304) |
| GDPgrowth |  | 0.010\*\* | 0.009\*\* |  | -0.002\*\* | -0.001 |  | 0.010\*\* | 0.010\*\* |
|  |  | (0.033) | (0.047) |  | (0.037) | (0.144) |  | (0.020) | (0.022) |
| Ratio\_Second |  | 0.003 | 0.003 |  | -0.003\*\*\* | -0.003\*\*\* |  | -0.000 | -0.000 |
|  |  | (0.655) | (0.655) |  | (0.002) | (0.001) |  | (0.978) | (0.989) |
| ln\_Industry |  | 0.062 | 0.085 |  | 0.070\*\*\* | 0.046\*\*\* |  | 0.115 | 0.114 |
|  |  | (0.562) | (0.423) |  | (0.002) | (0.006) |  | (0.247) | (0.252) |
| ln\_Retail |  | -0.214\*\* | -0.183\*\* |  | 0.035\* | -0.006 |  | -0.176\*\* | -0.185\*\* |
|  |  | (0.013) | (0.029) |  | (0.075) | (0.510) |  | (0.033) | (0.028) |
| ln\_Populatoin |  |  | -0.899\*\* |  |  | 1.037\*\*\* |  |  | 0.240 |
|  |  |  | (0.023) |  |  | (0.000) |  |  | (0.496) |
| ln\_Popdensity |  |  | 0.662 |  |  | -1.069\*\*\* |  |  | -0.298 |
|  |  |  | (0.209) |  |  | (0.000) |  |  | (0.515) |
| Temperature |  |  | 0.039 |  |  | -0.015\*\*\* |  |  | 0.027 |
|  |  |  | (0.153) |  |  | (0.003) |  |  | (0.253) |
| Precipitation |  |  | 0.001 |  |  | 0.000\*\* |  |  | 0.001 |
|  |  |  | (0.342) |  |  | (0.044) |  |  | (0.254) |
| Cloud |  |  | -0.002 |  |  | -0.000 |  |  | -0.002 |
|  |  |  | (0.685) |  |  | (0.611) |  |  | (0.742) |
| Constant | 9.496\*\*\* | 10.992\*\*\* | 11.553\*\* | 1.170\*\*\* | 0.390 | 1.177\* | 10.668\*\*\* | 11.553\*\*\* | 11.576\*\*\* |
|  | (0.000) | (0.000) | (0.021) | (0.000) | (0.194) | (0.079) | (0.000) | (0.000) | (0.009) |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Adjusted R2 | 0.977 | 0.977 | 0.978 | 0.999 | 0.999 | 0.999 | 0.841 | 0.843 | 0.843 |
| Number of Cities | 253 | 252 | 252 | 253 | 252 | 252 | 268 | 267 | 267 |
| Observations | 2509 | 2495 | 2495 | 2530 | 2516 | 2516 | 2659 | 2645 | 2645 |

*Note*: All controls are included and p-values are in parentheses.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A3-1: The Impact of Connections to Provincial Environmental Administrators (All Variables, Standard Errors)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  | ln\_ManipulationSO2 | ln\_ManipulationSO2 | ln\_SatelliteSO2 | ln\_SatelliteSO2 | ln\_OfficialSO2 | ln\_OfficialSO2 |
| Connect\_Csec\_Environ | -0.077\*\*\* | -0.076\*\*\* | 0.009\*\* | 0.010\*\*\* | -0.064\*\*\* | -0.063\*\* |
|  | (0.025) | (0.025) | (0.004) | (0.004) | (0.024) | (0.024) |
| ln\_GDPper |  | -0.076 |  | -0.005 |  | -0.079 |
|  |  | (0.087) |  | (0.017) |  | (0.087) |
| GDPgrowth |  | 0.009\*\* |  | -0.001 |  | 0.010\*\* |
|  |  | (0.005) |  | (0.001) |  | (0.004) |
| Ratio\_Second |  | 0.003 |  | -0.003\*\*\* |  | -0.000 |
|  |  | (0.007) |  | (0.001) |  | (0.006) |
| ln\_Industry |  | 0.080 |  | 0.047\*\*\* |  | 0.110 |
|  |  | (0.106) |  | (0.017) |  | (0.099) |
| ln\_Retail |  | -0.180\*\* |  | -0.006 |  | -0.183\*\* |
|  |  | (0.084) |  | (0.009) |  | (0.084) |
| ln\_Populatoin |  | -0.907\*\* |  | 1.035\*\*\* |  | 0.233 |
|  |  | (0.388) |  | (0.058) |  | (0.348) |
| ln\_Popdensity |  | 0.682 |  | -1.077\*\*\* |  | -0.284 |
|  |  | (0.526) |  | (0.083) |  | (0.458) |
| Temperature |  | 0.047\* |  | -0.015\*\*\* |  | 0.034 |
|  |  | (0.027) |  | (0.005) |  | (0.024) |
| Precipitation |  | 0.001 |  | 0.000\*\* |  | 0.001 |
|  |  | (0.001) |  | (0.000) |  | (0.001) |
| Cloud |  | -0.002 |  | -0.000 |  | -0.001 |
|  |  | (0.005) |  | (0.001) |  | (0.005) |
| Constant | 9.491\*\*\* | 11.338\*\* | 1.175\*\*\* | 1.255\* | 10.665\*\*\* | 11.412\*\* |
|  | (0.007) | (4.995) | (0.001) | (0.671) | (0.007) | (4.450) |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Adjusted R2 | 0.977 | 0.978 | 0.999 | 0.999 | 0.841 | 0.843 |
| Number of Cities | 253 | 252 | 253 | 252 | 268 | 267 |
| Observations | 2509 | 2495 | 2530 | 2516 | 2659 | 2645 |

*Note*: All controls are included. Robust standard errors (in parentheses) are clustered at the city level.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A3-2: The Impact of Connections to Provincial Environmental Administrators (All Variables, p-values)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
|  | ln\_ManipulationSO2 | ln\_ManipulationSO2 | ln\_SatelliteSO2 | ln\_SatelliteSO2 | ln\_OfficialSO2 | ln\_OfficialSO2 |
| Connect\_Csec\_Environ | -0.077\*\*\* | -0.076\*\*\* | 0.009\*\* | 0.010\*\*\* | -0.064\*\*\* | -0.063\*\* |
|  | (0.002) | (0.003) | (0.034) | (0.005) | (0.007) | (0.011) |
| ln\_GDPper |  | -0.076 |  | -0.005 |  | -0.079 |
|  |  | (0.385) |  | (0.766) |  | (0.360) |
| GDPgrowth |  | 0.009\*\* |  | -0.001 |  | 0.010\*\* |
|  |  | (0.048) |  | (0.137) |  | (0.021) |
| Ratio\_Second |  | 0.003 |  | -0.003\*\*\* |  | -0.000 |
|  |  | (0.680) |  | (0.000) |  | (0.963) |
| ln\_Industry |  | 0.080 |  | 0.047\*\*\* |  | 0.110 |
|  |  | (0.447) |  | (0.005) |  | (0.269) |
| ln\_Retail |  | -0.180\*\* |  | -0.006 |  | -0.183\*\* |
|  |  | (0.032) |  | (0.457) |  | (0.030) |
| ln\_Populatoin |  | -0.907\*\* |  | 1.035\*\*\* |  | 0.233 |
|  |  | (0.020) |  | (0.000) |  | (0.503) |
| ln\_Popdensity |  | 0.682 |  | -1.077\*\*\* |  | -0.284 |
|  |  | (0.196) |  | (0.000) |  | (0.536) |
| Temperature |  | 0.047\* |  | -0.015\*\*\* |  | 0.034 |
|  |  | (0.088) |  | (0.002) |  | (0.160) |
| Precipitation |  | 0.001 |  | 0.000\*\* |  | 0.001 |
|  |  | (0.385) |  | (0.043) |  | (0.281) |
| Cloud |  | -0.002 |  | -0.000 |  | -0.001 |
|  |  | (0.725) |  | (0.586) |  | (0.775) |
| Constant | 9.491\*\*\* | 11.338\*\* | 1.175\*\*\* | 1.255\* | 10.665\*\*\* | 11.412\*\* |
|  | (0.000) | (0.024) | (0.000) | (0.063) | (0.000) | (0.011) |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Adjusted R2 | 0.977 | 0.978 | 0.999 | 0.999 | 0.841 | 0.843 |
| Number of Cities | 253 | 252 | 253 | 252 | 268 | 267 |
| Observations | 2509 | 2495 | 2530 | 2516 | 2659 | 2645 |

*Note*: All controls are included and p-values are in parentheses.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A4-1: The Impact of Age Effect (All Variables, Standard Errors)

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
|  | ln\_ManipulationSO2 | ln\_SatelliteSO2 | ln\_OfficialSO2 |
| Connect | -7.298\* | -1.352\*\* | -8.352\*\* |
|  | (4.163) | (0.598) | (4.060) |
| CitysecAge | -0.151 | -0.039\* | -0.180 |
|  | (0.131) | (0.021) | (0.131) |
| CitysecAge2 | 0.002 | 0.000\* | 0.002 |
|  | (0.001) | (0.000) | (0.001) |
| ConnectxCitysecAge | 0.288\* | 0.050\*\* | 0.327\*\* |
|  | (0.162) | (0.023) | (0.158) |
| ConnectxCitysecAge2 | -0.003\* | -0.000\*\* | -0.003\*\* |
|  | (0.002) | (0.000) | (0.002) |
| ln\_GDPper | -0.085 | -0.002 | -0.088 |
|  | (0.087) | (0.016) | (0.086) |
| GDPgrowth | 0.009\*\* | -0.001 | 0.009\*\* |
|  | (0.005) | (0.001) | (0.004) |
| Ratio\_Second | 0.003 | -0.003\*\*\* | -0.000 |
|  | (0.007) | (0.001) | (0.006) |
| ln\_Industry | 0.086 | 0.048\*\*\* | 0.115 |
|  | (0.105) | (0.017) | (0.098) |
| ln\_Retail | -0.196\*\* | -0.007 | -0.199\*\* |
|  | (0.085) | (0.009) | (0.085) |
| ln\_Populatoin | -0.886\*\* | 1.038\*\*\* | 0.257 |
|  | (0.390) | (0.059) | (0.347) |
| ln\_Popdensity | 0.640 | -1.069\*\*\* | -0.325 |
|  | (0.525) | (0.083) | (0.457) |
| Temperature | 0.039 | -0.014\*\*\* | 0.027 |
|  | (0.027) | (0.005) | (0.024) |
| Precipitation | 0.001 | 0.000\*\* | 0.001 |
|  | (0.001) | (0.000) | (0.001) |
| Cloud | -0.002 | -0.000 | -0.001 |
|  | (0.005) | (0.001) | (0.005) |
| Constant | 15.426\*\* | 2.246\*\* | 16.242\*\*\* |
|  | (5.960) | (0.878) | (5.477) |
| Year FE | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes |
| Adjusted R2 | 0.978 | 0.999 | 0.843 |
| Number of Cities | 252 | 252 | 267 |
| Observations | 2485 | 2506 | 2634 |

*Note*: All controls are included. Robust standard errors (in parentheses) are clustered at the city level.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A4-2: The Impact of Age Effect (All Variables, p-values)

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
|  | ln\_ManipulationSO2 | ln\_SatelliteSO2 | ln\_OfficialSO2 |
| Connect | -7.298\* | -1.352\*\* | -8.352\*\* |
|  | (0.081) | (0.025) | (0.041) |
| CitysecAge | -0.151 | -0.039\* | -0.180 |
|  | (0.249) | (0.067) | (0.169) |
| CitysecAge2 | 0.002 | 0.000\* | 0.002 |
|  | (0.230) | (0.083) | (0.158) |
| ConnectxCitysecAge | 0.288\* | 0.050\*\* | 0.327\*\* |
|  | (0.077) | (0.034) | (0.039) |
| ConnectxCitysecAge2 | -0.003\* | -0.000\*\* | -0.003\*\* |
|  | (0.072) | (0.047) | (0.038) |
| ln\_GDPper | -0.085 | -0.002 | -0.088 |
|  | (0.326) | (0.881) | (0.306) |
| GDPgrowth | 0.009\*\* | -0.001 | 0.009\*\* |
|  | (0.049) | (0.126) | (0.024) |
| Ratio\_Second | 0.003 | -0.003\*\*\* | -0.000 |
|  | (0.662) | (0.000) | (0.996) |
| ln\_Industry | 0.086 | 0.048\*\*\* | 0.115 |
|  | (0.414) | (0.004) | (0.243) |
| ln\_Retail | -0.196\*\* | -0.007 | -0.199\*\* |
|  | (0.021) | (0.414) | (0.021) |
| ln\_Populatoin | -0.886\*\* | 1.038\*\*\* | 0.257 |
|  | (0.024) | (0.000) | (0.460) |
| ln\_Popdensity | 0.640 | -1.069\*\*\* | -0.325 |
|  | (0.223) | (0.000) | (0.478) |
| Temperature | 0.039 | -0.014\*\*\* | 0.027 |
|  | (0.156) | (0.005) | (0.260) |
| Precipitation | 0.001 | 0.000\*\* | 0.001 |
|  | (0.316) | (0.035) | (0.241) |
| Cloud | -0.002 | -0.000 | -0.001 |
|  | (0.735) | (0.859) | (0.824) |
| Constant | 15.426\*\* | 2.246\*\* | 16.242\*\*\* |
|  | (0.010) | (0.011) | (0.003) |
| Year FE | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes |
| Adjusted R2 | 0.978 | 0.999 | 0.843 |
| Number of Cities | 252 | 252 | 267 |
| Observations | 2485 | 2506 | 2634 |

*Note*: All controls are included and p-values are in parentheses.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A5-1: Robustness Test by PM2.5 (All Variables, Standard Errors)

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
|  | ln\_ManipulationPM2.5 | ln\_SatellitePM2.5 | ln\_OfficialPM2.5 |
| Connect | -0.056\*\*\* | 0.001 | -0.066\*\*\* |
|  | (0.019) | (0.022) | (0.021) |
| ln\_GDPper | -0.171\*\* | 0.007 | -0.155\* |
|  | (0.065) | (0.081) | (0.088) |
| GDPgrowth | 0.010 | 0.001 | 0.006 |
|  | (0.008) | (0.005) | (0.006) |
| Ratio\_Second | 0.009\*\*\* | -0.001 | 0.008\*\*\* |
|  | (0.002) | (0.003) | (0.002) |
| ln\_Industry | -0.063 | 0.077 | 0.019 |
|  | (0.049) | (0.063) | (0.034) |
| ln\_Retail | 0.107\* | -0.023 | 0.069 |
|  | (0.059) | (0.071) | (0.053) |
| ln\_Populatoin | -0.031 | 0.033 | 0.015 |
|  | (0.046) | (0.065) | (0.058) |
| ln\_Popdensity | -0.038 | 0.130\*\*\* | 0.091\*\* |
|  | (0.037) | (0.045) | (0.037) |
| Temperature | -0.022 | 0.028 | 0.006 |
|  | (0.014) | (0.022) | (0.024) |
| Precipitation | 0.001 | -0.001\*\*\* | -0.001 |
|  | (0.001) | (0.000) | (0.001) |
| Cloud | 0.005 | -0.004 | 0.004 |
|  | (0.005) | (0.005) | (0.004) |
| Constant | 0.701\*\* | 2.055\*\*\* | 2.558\*\*\* |
|  | (0.329) | (0.542) | (0.573) |
| Province FE | Yes | Yes | Yes |
| Adjusted R2 | 0.452 | 0.757 | 0.728 |
| Number of Provinces | 26 | 26 | 26 |
| Observations | 419 | 533 | 419 |

*Note*: All controls are included. Robust standard errors (in parentheses) are clustered at the city level.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A5-2: Robustness Test by PM2.5 (All Variables, p-values)

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
|  | ln\_ManipulationPM2.5 | ln\_SatellitePM2.5 | ln\_OfficialPM2.5 |
| Connect | -0.056\*\*\* | 0.001 | -0.066\*\*\* |
|  | (0.007) | (0.950) | (0.004) |
| ln\_GDPper | -0.171\*\* | 0.007 | -0.155\* |
|  | (0.015) | (0.933) | (0.091) |
| GDPgrowth | 0.010 | 0.001 | 0.006 |
|  | (0.232) | (0.876) | (0.393) |
| Ratio\_Second | 0.009\*\*\* | -0.001 | 0.008\*\*\* |
|  | (0.001) | (0.755) | (0.001) |
| ln\_Industry | -0.063 | 0.077 | 0.019 |
|  | (0.210) | (0.233) | (0.585) |
| ln\_Retail | 0.107\* | -0.023 | 0.069 |
|  | (0.084) | (0.745) | (0.202) |
| ln\_Populatoin | -0.031 | 0.033 | 0.015 |
|  | (0.505) | (0.614) | (0.794) |
| ln\_Popdensity | -0.038 | 0.130\*\*\* | 0.091\*\* |
|  | (0.319) | (0.008) | (0.023) |
| Temperature | -0.022 | 0.028 | 0.006 |
|  | (0.131) | (0.220) | (0.798) |
| Precipitation | 0.001 | -0.001\*\*\* | -0.001 |
|  | (0.189) | (0.004) | (0.297) |
| Cloud | 0.005 | -0.004 | 0.004 |
|  | (0.319) | (0.465) | (0.285) |
| Constant | 0.701\*\* | 2.055\*\*\* | 2.558\*\*\* |
|  | (0.043) | (0.001) | (0.000) |
| Province FE | Yes | Yes | Yes |
| Adjusted R2 | 0.452 | 0.757 | 0.728 |
| Number of Provinces | 26 | 26 | 26 |
| Observations | 419 | 533 | 419 |

*Note*: All controls are included and p-values are in parentheses.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A6-1: Personal Characteristic Effect (All Variables, Standard Errors)

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
|  | ln\_ManipulationSO2 | ln\_SatelliteSO2 | ln\_OfficialSO2 |
| Connect | -0.047\*\* | 0.013\*\*\* | -0.038\* |
|  | (0.023) | (0.003) | (0.022) |
| ln\_GDPper | -0.094 | -0.001 | -0.094 |
|  | (0.085) | (0.016) | (0.084) |
| GDPgrowth | 0.009\* | -0.001 | 0.009\*\* |
|  | (0.005) | (0.001) | (0.004) |
| Ratio\_Second | 0.003 | -0.003\*\*\* | 0.000 |
|  | (0.007) | (0.001) | (0.006) |
| ln\_Industry | 0.084 | 0.047\*\*\* | 0.112 |
|  | (0.107) | (0.016) | (0.100) |
| ln\_Retail | -0.186\*\* | -0.007 | -0.190\*\* |
|  | (0.081) | (0.009) | (0.082) |
| ln\_Populatoin | -0.864\*\* | 1.027\*\*\* | 0.249 |
|  | (0.352) | (0.056) | (0.319) |
| ln\_Popdensity | 0.617 | -1.060\*\*\* | -0.342 |
|  | (0.513) | (0.081) | (0.451) |
| Temperature | 0.038 | -0.015\*\*\* | 0.025 |
|  | (0.027) | (0.005) | (0.024) |
| Precipitation | 0.001 | 0.000\* | 0.001 |
|  | (0.001) | (0.000) | (0.001) |
| Cloud | -0.002 | -0.000 | -0.002 |
|  | (0.005) | (0.001) | (0.005) |
| Edu\_Bachelor | -0.014 | 0.006 | -0.005 |
|  | (0.033) | (0.004) | (0.031) |
| Exp\_University | 0.064 | -0.026 | 0.040 |
|  | (0.079) | (0.017) | (0.078) |
| Exp\_Central | 0.077 | -0.019\*\* | 0.052 |
|  | (0.068) | (0.009) | (0.067) |
| Exp\_Youth | -0.033 | 0.006 | -0.024 |
|  | (0.035) | (0.006) | (0.035) |
| Exp\_County | 0.059\* | -0.001 | 0.062\*\* |
|  | (0.030) | (0.005) | (0.029) |
| Exp\_Enterprise | 0.040 | 0.000 | 0.038 |
|  | (0.033) | (0.006) | (0.032) |
| Exp\_Finance | 0.046 | -0.020\*\* | 0.016 |
|  | (0.054) | (0.008) | (0.050) |
| Constant | 11.682\*\* | 1.167\* | 11.857\*\*\* |
|  | (4.735) | (0.650) | (4.281) |
| Year FE | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes |
| Adjusted R2 | 0.978 | 0.999 | 0.843 |
| Number of Provinces | 252 | 252 | 267 |
| Observations | 2477 | 2498 | 2626 |

*Note*: All controls are included. Robust standard errors (in parentheses) are clustered at the city level.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A6-2: Personal Characteristic Effect (All Variables, p-values)

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
|  | ln\_ManipulationSO2 | ln\_SatelliteSO2 | ln\_OfficialSO2 |
| Connect | -0.047\*\* | 0.013\*\*\* | -0.038\* |
|  | (0.044) | (0.000) | (0.089) |
| ln\_GDPper | -0.094 | -0.001 | -0.094 |
|  | (0.268) | (0.975) | (0.261) |
| GDPgrowth | 0.009\* | -0.001 | 0.009\*\* |
|  | (0.051) | (0.116) | (0.027) |
| Ratio\_Second | 0.003 | -0.003\*\*\* | 0.000 |
|  | (0.659) | (0.001) | (0.988) |
| ln\_Industry | 0.084 | 0.047\*\*\* | 0.112 |
|  | (0.435) | (0.004) | (0.263) |
| ln\_Retail | -0.186\*\* | -0.007 | -0.190\*\* |
|  | (0.023) | (0.446) | (0.022) |
| ln\_Populatoin | -0.864\*\* | 1.027\*\*\* | 0.249 |
|  | (0.015) | (0.000) | (0.435) |
| ln\_Popdensity | 0.617 | -1.060\*\*\* | -0.342 |
|  | (0.230) | (0.000) | (0.449) |
| Temperature | 0.038 | -0.015\*\*\* | 0.025 |
|  | (0.166) | (0.002) | (0.289) |
| Precipitation | 0.001 | 0.000\* | 0.001 |
|  | (0.332) | (0.058) | (0.266) |
| Cloud | -0.002 | -0.000 | -0.002 |
|  | (0.668) | (0.742) | (0.736) |
| Edu\_Bachelor | -0.014 | 0.006 | -0.005 |
|  | (0.672) | (0.215) | (0.869) |
| Exp\_University | 0.064 | -0.026 | 0.040 |
|  | (0.418) | (0.124) | (0.612) |
| Exp\_Central | 0.077 | -0.019\*\* | 0.052 |
|  | (0.258) | (0.028) | (0.437) |
| Exp\_Youth | -0.033 | 0.006 | -0.024 |
|  | (0.352) | (0.330) | (0.483) |
| Exp\_County | 0.059\* | -0.001 | 0.062\*\* |
|  | (0.052) | (0.897) | (0.032) |
| Exp\_Enterprise | 0.040 | 0.000 | 0.038 |
|  | (0.234) | (0.968) | (0.248) |
| Exp\_Finance | 0.046 | -0.020\*\* | 0.016 |
|  | (0.392) | (0.017) | (0.755) |
| Constant | 11.682\*\* | 1.167\* | 11.857\*\*\* |
|  | (0.014) | (0.074) | (0.006) |
| Year FE | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes |
| Adjusted R2 | 0.978 | 0.999 | 0.843 |
| Number of Cities | 252 | 252 | 267 |
| Observations | 2477 | 2498 | 2626 |

*Note*: All controls are included and p-values are in parentheses.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A7-1: Robustness Test of High Dimension FE (All Variables, Standard Errors)

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
|  | ln\_ManipulationSO2 | ln\_SatelliteSO2 | ln\_OfficialSO2 |
| Connect | -0.056\*\* | 0.005 | -0.051\*\* |
|  | (0.025) | (0.004) | (0.024) |
| ln\_GDPper | -0.059 | 0.015 | -0.057 |
|  | (0.071) | (0.010) | (0.072) |
| GDPgrowth | 0.010\* | -0.001 | 0.009\* |
|  | (0.006) | (0.001) | (0.006) |
| Ratio\_Second | -0.001 | -0.000 | -0.001 |
|  | (0.007) | (0.001) | (0.007) |
| ln\_Industry | 0.260\*\* | 0.019 | 0.241\*\* |
|  | (0.123) | (0.016) | (0.115) |
| ln\_Retail | -0.226\*\*\* | 0.005 | -0.225\*\*\* |
|  | (0.077) | (0.007) | (0.075) |
| ln\_Populatoin | -1.319\*\*\* | 1.033\*\*\* | -0.229 |
|  | (0.469) | (0.047) | (0.432) |
| ln\_Popdensity | 0.368 | -0.932\*\*\* | -0.473 |
|  | (0.547) | (0.057) | (0.511) |
| Temperature | 0.088 | -0.005 | 0.080 |
|  | (0.078) | (0.012) | (0.074) |
| Precipitation | 0.001 | 0.000 | 0.001 |
|  | (0.001) | (0.000) | (0.001) |
| Cloud | -0.003 | 0.000 | -0.002 |
|  | (0.005) | (0.001) | (0.005) |
| Constant | 13.582\*\* | 0.190 | 13.420\*\*\* |
|  | (5.436) | (0.543) | (4.978) |
| Year FE | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes |
| Province×Year FE | Yes | Yes | Yes |
| Adjusted R2 | 0.980 | 1.000 | 0.860 |
| Number of Cities | 251 | 251 | 266 |
| Observations | 2483 | 2506 | 2633 |

*Note*: All controls are included. Robust standard errors (in parentheses) are clustered at the city level.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A7-2: Robustness Test of High Dimension FE (All Variables, p-values

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
|  | ln\_ManipulationSO2 | ln\_SatelliteSO2 | ln\_OfficialSO2 |
| Connect | -0.056\*\* | 0.005 | -0.051\*\* |
|  | (0.026) | (0.205) | (0.035) |
| ln\_GDPper | -0.059 | 0.015 | -0.057 |
|  | (0.408) | (0.126) | (0.428) |
| GDPgrowth | 0.010\* | -0.001 | 0.009\* |
|  | (0.094) | (0.201) | (0.099) |
| Ratio\_Second | -0.001 | -0.000 | -0.001 |
|  | (0.891) | (0.977) | (0.881) |
| ln\_Industry | 0.260\*\* | 0.019 | 0.241\*\* |
|  | (0.035) | (0.258) | (0.038) |
| ln\_Retail | -0.226\*\*\* | 0.005 | -0.225\*\*\* |
|  | (0.004) | (0.437) | (0.003) |
| ln\_Populatoin | -1.319\*\*\* | 1.033\*\*\* | -0.229 |
|  | (0.005) | (0.000) | (0.596) |
| ln\_Popdensity | 0.368 | -0.932\*\*\* | -0.473 |
|  | (0.501) | (0.000) | (0.355) |
| Temperature | 0.088 | -0.005 | 0.080 |
|  | (0.264) | (0.689) | (0.282) |
| Precipitation | 0.001 | 0.000 | 0.001 |
|  | (0.237) | (0.712) | (0.218) |
| Cloud | -0.003 | 0.000 | -0.002 |
|  | (0.513) | (0.712) | (0.755) |
| Constant | 13.582\*\* | 0.190 | 13.420\*\*\* |
|  | (0.013) | (0.727) | (0.007) |
| Year FE | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes |
| Province×Year FE | Yes | Yes | Yes |
| Adjusted R2 | 0.980 | 1.000 | 0.860 |
| Number of Cities | 251 | 251 | 266 |
| Observations | 2483 | 2506 | 2633 |

*Note*: All controls are included and p-values are in parentheses.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A8-1: Other Types of Connections (All Variables, Standard Errors)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|  | ln\_ManipulationSO2 | ln\_ManipulationSO2 | ln\_ManipulationSO2 | ln\_SatelliteSO2 | ln\_SatelliteSO2 | ln\_SatelliteSO2 | ln\_OfficialSO2 | ln\_OfficialSO2 | ln\_OfficialSO2 |
| ln\_GDPper | -0.080 | -0.079 | -0.076 | -0.005 | -0.005 | -0.004 | -0.083 | -0.083 | -0.080 |
|  | (0.087) | (0.087) | (0.086) | (0.017) | (0.017) | (0.017) | (0.086) | (0.086) | (0.085) |
| GDPgrowth | 0.010\*\* | 0.009\*\* | 0.010\*\* | -0.001 | -0.001 | -0.001 | 0.010\*\* | 0.010\*\* | 0.010\*\* |
|  | (0.005) | (0.005) | (0.005) | (0.001) | (0.001) | (0.001) | (0.004) | (0.004) | (0.004) |
| Ratio\_Second | 0.003 | 0.004 | 0.003 | -0.003\*\*\* | -0.003\*\*\* | -0.003\*\*\* | 0.000 | 0.000 | 0.000 |
|  | (0.007) | (0.007) | (0.007) | (0.001) | (0.001) | (0.001) | (0.006) | (0.006) | (0.006) |
| ln\_Industry | 0.080 | 0.079 | 0.081 | 0.047\*\*\* | 0.048\*\*\* | 0.048\*\*\* | 0.110 | 0.110 | 0.112 |
|  | (0.107) | (0.106) | (0.107) | (0.017) | (0.017) | (0.017) | (0.100) | (0.100) | (0.100) |
| ln\_Retail | -0.179\*\* | -0.177\*\* | -0.179\*\* | -0.007 | -0.007 | -0.007 | -0.182\*\* | -0.180\*\* | -0.182\*\* |
|  | (0.083) | (0.083) | (0.083) | (0.009) | (0.009) | (0.009) | (0.084) | (0.083) | (0.083) |
| ln\_Populatoin | -0.879\*\* | -0.904\*\* | -0.873\*\* | 1.032\*\*\* | 1.042\*\*\* | 1.035\*\*\* | 0.257 | 0.242 | 0.263 |
|  | (0.389) | (0.385) | (0.390) | (0.058) | (0.057) | (0.057) | (0.349) | (0.347) | (0.350) |
| ln\_Popdensity | 0.704 | 0.705 | 0.703 | -1.080\*\*\* | -1.080\*\*\* | -1.080\*\*\* | -0.266 | -0.265 | -0.268 |
|  | (0.537) | (0.533) | (0.537) | (0.085) | (0.085) | (0.084) | (0.466) | (0.462) | (0.466) |
| Temperature | 0.036 | 0.035 | 0.037 | -0.014\*\*\* | -0.013\*\*\* | -0.014\*\*\* | 0.025 | 0.024 | 0.026 |
|  | (0.027) | (0.027) | (0.027) | (0.005) | (0.005) | (0.005) | (0.024) | (0.024) | (0.024) |
| Precipitation | 0.001 | 0.001 | 0.001 | 0.000\* | 0.000\* | 0.000\* | 0.001 | 0.001 | 0.001 |
|  | (0.001) | (0.001) | (0.001) | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) |
| Cloud | -0.002 | -0.002 | -0.002 | -0.000 | -0.000 | -0.000 | -0.002 | -0.002 | -0.002 |
|  | (0.005) | (0.005) | (0.005) | (0.001) | (0.001) | (0.001) | (0.005) | (0.005) | (0.005) |
| work | 0.012 |  |  | 0.002 |  |  | 0.013 |  |  |
|  | (0.043) |  |  | (0.008) |  |  | (0.039) |  |  |
| school |  | -0.076 |  |  | 0.033\*\*\* |  |  | -0.040 |  |
|  |  | (0.054) |  |  | (0.011) |  |  | (0.053) |  |
| hometown |  |  | 0.031 |  |  | 0.010 |  |  | 0.038 |
|  |  |  | (0.043) |  |  | (0.007) |  |  | (0.039) |
| Constant | 11.163\*\* | 11.326\*\* | 11.088\*\* | 1.276\* | 1.209\* | 1.250\* | 11.250\*\* | 11.335\*\* | 11.179\*\* |
|  | (5.026) | (5.018) | (5.026) | (0.674) | (0.661) | (0.678) | (4.465) | (4.471) | (4.470) |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Adjusted R2 | 0.978 | 0.978 | 0.978 | 0.999 | 0.999 | 0.999 | 0.843 | 0.843 | 0.843 |
| Number of Cities | 252 | 252 | 252 | 252 | 252 | 252 | 267 | 267 | 267 |
| Observations | 2495 | 2495 | 2495 | 2516 | 2516 | 2516 | 2645 | 2645 | 2645 |

*Note*: All controls are included. Robust standard errors (in parentheses) are clustered at the city level.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*

Table A8-2: Other Types of Connections (All Variables, p-values)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|  | ln\_ManipulationSO2 | ln\_ManipulationSO2 | ln\_ManipulationSO2 | ln\_SatelliteSO2 | ln\_SatelliteSO2 | ln\_SatelliteSO2 | ln\_OfficialSO2 | ln\_OfficialSO2 | ln\_OfficialSO2 |
| ln\_GDPper | -0.080 | -0.079 | -0.076 | -0.005 | -0.005 | -0.004 | -0.083 | -0.083 | -0.080 |
|  | (0.363) | (0.368) | (0.380) | (0.787) | (0.783) | (0.832) | (0.335) | (0.338) | (0.351) |
| GDPgrowth | 0.010\*\* | 0.009\*\* | 0.010\*\* | -0.001 | -0.001 | -0.001 | 0.010\*\* | 0.010\*\* | 0.010\*\* |
|  | (0.043) | (0.048) | (0.040) | (0.119) | (0.162) | (0.129) | (0.020) | (0.021) | (0.019) |
| Ratio\_Second | 0.003 | 0.004 | 0.003 | -0.003\*\*\* | -0.003\*\*\* | -0.003\*\*\* | 0.000 | 0.000 | 0.000 |
|  | (0.609) | (0.592) | (0.603) | (0.000) | (0.000) | (0.000) | (0.971) | (0.964) | (0.961) |
| ln\_Industry | 0.080 | 0.079 | 0.081 | 0.047\*\*\* | 0.048\*\*\* | 0.048\*\*\* | 0.110 | 0.110 | 0.112 |
|  | (0.455) | (0.462) | (0.449) | (0.005) | (0.004) | (0.005) | (0.271) | (0.272) | (0.266) |
| ln\_Retail | -0.179\*\* | -0.177\*\* | -0.179\*\* | -0.007 | -0.007 | -0.007 | -0.182\*\* | -0.180\*\* | -0.182\*\* |
|  | (0.033) | (0.034) | (0.031) | (0.432) | (0.389) | (0.418) | (0.031) | (0.031) | (0.030) |
| ln\_Populatoin | -0.879\*\* | -0.904\*\* | -0.873\*\* | 1.032\*\*\* | 1.042\*\*\* | 1.035\*\*\* | 0.257 | 0.242 | 0.263 |
|  | (0.025) | (0.020) | (0.026) | (0.000) | (0.000) | (0.000) | (0.461) | (0.486) | (0.452) |
| ln\_Popdensity | 0.704 | 0.705 | 0.703 | -1.080\*\*\* | -1.080\*\*\* | -1.080\*\*\* | -0.266 | -0.265 | -0.268 |
|  | (0.192) | (0.187) | (0.192) | (0.000) | (0.000) | (0.000) | (0.568) | (0.567) | (0.566) |
| Temperature | 0.036 | 0.035 | 0.037 | -0.014\*\*\* | -0.013\*\*\* | -0.014\*\*\* | 0.025 | 0.024 | 0.026 |
|  | (0.182) | (0.204) | (0.178) | (0.007) | (0.009) | (0.008) | (0.286) | (0.307) | (0.280) |
| Precipitation | 0.001 | 0.001 | 0.001 | 0.000\* | 0.000\* | 0.000\* | 0.001 | 0.001 | 0.001 |
|  | (0.319) | (0.300) | (0.319) | (0.062) | (0.072) | (0.064) | (0.241) | (0.230) | (0.244) |
| Cloud | -0.002 | -0.002 | -0.002 | -0.000 | -0.000 | -0.000 | -0.002 | -0.002 | -0.002 |
|  | (0.686) | (0.664) | (0.690) | (0.615) | (0.688) | (0.621) | (0.752) | (0.743) | (0.757) |
| work | 0.012 |  |  | 0.002 |  |  | 0.013 |  |  |
|  | (0.775) |  |  | (0.805) |  |  | (0.744) |  |  |
| school |  | -0.076 |  |  | 0.033\*\*\* |  |  | -0.040 |  |
|  |  | (0.161) |  |  | (0.003) |  |  | (0.451) |  |
| hometown |  |  | 0.031 |  |  | 0.010 |  |  | 0.038 |
|  |  |  | (0.477) |  |  | (0.168) |  |  | (0.342) |
| Constant | 11.163\*\* | 11.326\*\* | 11.088\*\* | 1.276\* | 1.209\* | 1.250\* | 11.250\*\* | 11.335\*\* | 11.179\*\* |
|  | (0.027) | (0.025) | (0.028) | (0.059) | (0.069) | (0.066) | (0.012) | (0.012) | (0.013) |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Adjusted R2 | 0.978 | 0.978 | 0.978 | 0.999 | 0.999 | 0.999 | 0.843 | 0.843 | 0.843 |
| Number of Cities | 252 | 252 | 252 | 252 | 252 | 252 | 267 | 267 | 267 |
| Observations | 2495 | 2495 | 2495 | 2516 | 2516 | 2516 | 2645 | 2645 | 2645 |

*Note*: All controls are included and p-values are in parentheses.

*\*p<.10; \*\*p<.05; \*\*\*p<.01.*