**ONLINE APPENDIX**

**Not intended for publication**

This online appendix accompanies the paper entitled:

“On the Nexus between Innovation, Productivity, and Migration of U.S. University Graduates”

**Appendix A: State Rankings**

|  |
| --- |
| **Table A1**: Ranking of U.S. states according to patents and the estimated TFP |
| Ranking | State | Mean TFP | Ranking | State | Mean Patents |
| 1 | California | 15.657 |  1 | California | 87570.75 |
| 2 | New York | 14.744 | 2 | New York | 43610.75 |
| 3 | Texas | 14.519 | 3 | Texas | 26187.88 |
| 4 | Florida | 13.747 | 4 | Illinois | 22913 |
| 5 | Illinois | 13.495 | 5 | New Jersey | 19957.88 |
| 6 | Pennsylvania | 13.143 | 6 | Michigan | 18560.88 |
| 7 | Ohio | 12.887 | 7 | Massachusetts | 18412.25 |
| 8 | New Jersey | 12.780 | 8 | Ohio | 15984.63 |
| 9 | Michigan | 12.437 | 9 | Pennsylvania | 12952.13 |
| 10 | Massachusetts | 12.327 | 10 | Minnesota | 12630.5 |
| 11 | Georgia | 12.297 | 11 | Washington | 12529.75 |
| 12 | North Carolina | 12.187 | 12 | Maryland | 11854.5 |
| 13 | Virginia | 12.067 | 13 | Connecticut | 11580.13 |
| 14 | Washington | 11.687 | 14 | Florida | 9512.375 |
| 15 | Minnesota | 11.486 | 15 | Delaware | 9273.125 |
| 16 | Maryland | 11.449 | 16 | Virginia | 8400.25 |
| 17 | Indiana | 11.393 | 17 | Colorado | 7005.75 |
| 18 | Missouri | 11.342 | 18 | Wisconsin | 6999.625 |
| 19 | Wisconsin | 11.327 | 19 | North Carolina | 6865.75 |
| 20 | Arizona | 11.233 | 20 | Georgia | 5693.625 |
| 21 | Tennessee | 11.232 | 21 | Indiana | 5361.375 |
| 22 | Colorado | 11.218 | 22 | Missouri | 4532.875 |
| 23 | Connecticut | 11.206 | 23 | DC | 4456.875 |
| 24 | Louisiana | 10.753 | 24 | Oregon | 3972.375 |
| 25 | Oregon | 10.327 | 25 | Nevada | 3885.125 |
| 26 | Alabama | 10.315 | 26 | Utah | 3338 |
| 27 | Kentucky | 10.207 | 27 | Arizona | 3209.875 |
| 28 | South Carolina | 10.195 | 28 | Tennessee | 2879.75 |
| 29 | Oklahoma | 10.037 | 29 | Iowa | 2554.625 |
| 30 | Iowa | 9.988 | 30 | Idaho | 2520.375 |
| 31 | Nevada | 9.643 | 31 | Kansas | 1892.875 |
| 32 | Kansas | 9.601 | 32 | South Carolina | 1790 |
| 33 | Utah | 9.436 | 33 | New Hampshire | 1786.5 |
| 34 | Arkansas | 9.221 | 34 | Kentucky | 1695 |
| 35 | Mississippi | 8.956 | 35 | New Mexico | 1466.625 |
| 36 | Nebraska | 8.882 | 36 | Oklahoma | 1422.125 |
| 37 | New Mexico | 8.557 | 37 | Rhode Island | 1216.25 |
| 38 | Delaware | 8.416 | 38 | Alabama | 1124.5 |
| 39 | New Hampshire | 8.223 | 39 | Louisiana | 995.75 |
| 40 | West Virginia | 8.197 | 40 | Nebraska | 832.375 |
| 41 |  Hawaii | 8.160 |  41 |  Arkansas | 531.5 |
| 42 |  Maine | 7.794 |  42 |  Maine | 463.75 |
| 43 |  Idaho | 7.772 |  43 |  Mississippi | 398.75 |
| 44 |  Rhode Island | 7.674 |  44 |  Vermont | 370 |
| 45 |  DC | 7.566 |  45 |  Montana | 314.125 |
| 46 |  Alaska | 7.369 |  46 |  South Dakota | 255.625 |
| 47 |  South Dakota | 7.090 |  47 |  Wyoming | 224.125 |
| 48 |  Montana | 6.923 |  48 |  West Virginia | 214 |
| 49 |  Wyoming | 6.773 |  49 |  Hawaii | 213.875 |
| 50 |  North Dakota | 6.555 |  50 |  North Dakota | 184.5 |
| 51 |  Vermont | 6.312 |  51 |  Alaska | 73.5 |
| Notes: Average values for the years 1993, 1995, 1997, 1999, 2003, 2006, 2008, and 2010 |

|  |
| --- |
| **Table A2**: Ranking of U.S. states according to the number of high-tech firms |
| State | # high-tech firms | Ranking | Per 100,000 | Ranking |
| Massachusetts | 134.63 | 4 | 2.16 | 1 |
| Connecticut | 57.38 | 11 | 1.70 | 2 |
| New Jersey | 131.00 | 5 | 1.58 | 3 |
| California | 480.50 | 1 | 1.42 | 4 |
| Colorado | 56.13 | 12 | 1.36 | 5 |
| Minnesota | 57.50 | 10 | 1.19 | 6 |
| Delaware | 8.50 | 31 | 1.10 | 7 |
| District of Columbia | 5.88 | 35 | 1.05 | 8 |
| New York | 179.00 | 2 | 0.96 | 9 |
| Nevada | 17.75 | 26 | 0.91 | 10 |
| Utah | 20.25 | 23 | 0.91 | 11 |
| New Hampshire | 10.63 | 29 | 0.88 | 12 |
| Maryland | 45.50 | 16 | 0.86 | 13 |
| Virginia | 52.00 | 13 | 0.74 | 14 |
| Texas | 147.50 | 3 | 0.71 | 15 |
| Washington | 40.88 | 17 | 0.69 | 16 |
| Rhode Island | 7.00 | 33 | 0.69 | 17 |
| Pennsylvania | 82.13 | 7 | 0.67 | 18 |
| Illinois | 81.50 | 8 | 0.67 | 19 |
| Wisconsin | 34.25 | 19 | 0.64 | 20 |
| Georgia | 50.38 | 14 | 0.64 | 21 |
| Oregon | 20.25 | 24 | 0.60 | 22 |
| Arizona | 29.63 | 20 | 0.59 | 23 |
| Ohio | 61.13 | 9 | 0.54 | 24 |
| Florida | 85.13 | 6 | 0.54 | 25 |
| Michigan | 49.25 | 15 | 0.50 | 26 |
| Kansas | 12.50 | 27 | 0.47 | 27 |
| North Carolina | 37.88 | 18 | 0.47 | 28 |
| Missouri | 25.50 | 21 | 0.46 | 29 |
| Indiana | 23.00 | 22 | 0.38 | 30 |
| Oklahoma | 11.63 | 28 | 0.34 | 31 |
| Idaho | 4.25 | 40 | 0.32 | 32 |
| Tennessee | 17.88 | 25 | 0.32 | 33 |
| Iowa | 8.50 | 32 | 0.29 | 34 |
| Nebraska | 4.38 | 39 | 0.26 | 35 |
| Alaska | 1.63 | 47 | 0.25 | 36 |
| South Dakota | 1.88 | 46 | 0.24 | 37 |
| Hawaii | 3.00 | 42 | 0.24 | 38 |
| Montana | 2.00 | 45 | 0.22 | 39 |
| Louisiana | 9.25 | 30 | 0.21 | 40 |
| Maine | 2.38 | 44 | 0.19 | 41 |
| Mississippi | 4.50 | 38 | 0.16 | 42 |
| Alabama | 6.75 | 34 | 0.15 | 43 |
| New Mexico | 2.50 | 43 | 0.14 | 44 |
| South Carolina | 5.50 | 36 | 0.14 | 45 |
| Kentucky | 5.50 | 37 | 0.14 | 46 |
| Arkansas | 3.13 | 41 | 0.12 | 47 |
| Wyoming | 0.38 | 49 | 0.07 | 48 |
| Vermont | 0.38 | 50 | 0.06 | 49 |
| West Virginia | 0.88 | 48 | 0.05 | 50 |
| North Dakota | 0.00 | 51 | 0.00 | 51 |
| *NOTES:* This table shows the rankings of U.S. states in terms of the number of high-tech firms (both in absolute numbers and per 100,000 inhabitants). The calculation is based on COMPUSTAT two-digit SIC codes. The industries used are: biotechnology and pharmaceutics, aircraft and space aircraft industry, medical instruments (precision instruments), radio, television, and communication equipment, office accounting and computing machinery, electrical machinery, motor vehicles, railroad and transport equipment, chemical industry, and machinery and equipment. Average values for the years 1993, 1995, 1997, 1999, 2003, 2006, 2008, and 2010 |

|  |
| --- |
| **Table A3:** Amenity scores, entrepreneurs’ educational level, academic R&D expenditures, and taxes per capita. |
| State | Home price index | Air quality index | Entrepreneur’s education | Academic R&D expenditures per capita (in logs) | Taxes per capita |
| Alabama | 1.12 | 61.88 | 2.59 | -2.22 | 18.67 |
| Alaska | 1.18 | 30.88 | 2.84 | -1.82 | 57.96 |
| Arizona | 1.20 | 70.25 | 2.99 | -2.26 | 23.49 |
| Arkansas | 1.14 | 46.38 | 2.52 | -2.88 | 20.60 |
| California | 1.29 | 88.31 | 3.18 | -2.05 | 27.52 |
| Colorado | 1.01 | 42.81 | 3.15 | -1.96 | 25.76 |
| Connecticut | 1.20 | 42.94 | 3.26 | -1.86 | 35.61 |
| DC  | 1.48 | 52.50 | 3.68 | -0.78 | 46.03 |
| Delaware | 1.34 | 61.25 | 2.82 | -2.18 | 26.85 |
| Florida | 1.28 | 42.88 | 2.90 | -2.80 | 31.73 |
| Georgia | 1.04 | 56.88 | 2.78 | -2.12 | 23.98 |
| Hawaii | 1.55 | 25.13 | 3.11 | -2.04 | 31.41 |
| Idaho | 1.23 | 37.56 | 2.93 | -2.76 | 18.96 |
| Illinois | 1.13 | 66.75 | 3.05 | -2.24 | 29.49 |
| Indiana | 1.07 | 60.38 | 2.72 | -2.35 | 21.95 |
| Iowa | 1.08 | 36.63 | 2.75 | -1.90 | 23.25 |
| Kansas | 1.08 | 33.75 | 2.88 | -2.31 | 25.00 |
| Kentucky | 1.08 | 56.00 | 2.59 | -2.64 | 22.89 |
| Louisiana | 1.13 | 50.13 | 2.79 | -2.30 | 25.02 |
| Maine | 1.21 | 34.19 | 2.81 | -3.04 | 27.66 |
| Maryland | 1.38 | 39.25 | 3.17 | -1.09 | 24.23 |
| Massachusetts | 1.10 | 52.38 | 3.35 | -1.34 | 24.44 |
| Michigan | 0.94 | 59.88 | 2.80 | -2.16 | 24.04 |
| Minnesota | 1.08 | 39.75 | 2.92 | -2.33 | 27.25 |
| Mississippi | 1.11 | 41.38 | 2.55 | -2.53 | 20.77 |
| Missouri | 1.09 | 53.13 | 2.66 | -2.19 | 21.69 |
| Montana | 1.24 | 68.13 | 2.94 | -2.13 | 20.15 |
| Nebraska | 1.05 | 44.38 | 2.81 | -1.96 | 24.98 |
| Nevada | 1.24 | 59.13 | 2.98 | -2.79 | 33.43 |
| New Hampshire | 1.10 | 37.63 | 2.92 | -1.95 | 28.21 |
| New Jersey | 1.28 | 43.13 | 3.22 | -2.59 | 38.98 |
| New Mexico | 1.21 | 50.13 | 3.02 | -1.85 | 23.02 |
| New York | 1.23 | 34.00 | 3.24 | -1.95 | 35.25 |
| North Carolina | 1.11 | 52.50 | 2.84 | -1.91 | 23.98 |
| North Dakota | 1.20 | 30.38 | 2.82 | -1.88 | 27.41 |
| Ohio | 1.03 | 61.50 | 2.69 | -2.35 | 23.42 |
| Oklahoma | 1.10 | 43.75 | 2.76 | -2.61 | 20.04 |
| Oregon | 1.22 | 31.25 | 3.00 | -2.17 | 17.08 |
| Pennsylvania | 1.26 | 57.25 | 2.87 | -1.96 | 24.22 |
| Rhode Island | 1.29 | 42.00 | 3.19 | -1.86 | 28.97 |
| South Carolina | 1.11 | 46.13 | 2.81 | -2.46 | 21.65 |
| South Dakota | 1.15 | 28.00 | 2.72 | -2.85 | 26.05 |
| Tennessee | 1.10 | 56.31 | 2.69 | -2.45 | 25.15 |
| Texas | 1.08 | 63.00 | 2.87 | -2.20 | 30.52 |
| Utah | 1.12 | 55.13 | 3.02 | -1.98 | 20.76 |
| Vermont | 1.23 | 34.13 | 2.97 | -1.99 | 29.82 |
| Virginia | 1.27 | 48.00 | 3.04 | -2.38 | 26.05 |
| Washington | 1.19 | 42.88 | 3.05 | -2.10 | 35.78 |
| West Virginia | 1.15 | 43.63 | 2.53 | -2.95 | 21.22 |
| Wisconsin | 1.10 | 42.25 | 2.71 | -1.99 | 26.69 |
| Wyoming | 1.24 | 16.13 | 2.91 | -2.25 | 44.98 |
| Notes: Average values for the years 1993, 1995, 1997, 1999, 2003, 2006, 2008, and 2010. |

|  |
| --- |
| **Table A4**: Top five majors for the most innovative and least innovative states for natives. |
|  | Top 5 in patents | Bottom 5 in patents |
| Major/State | CA | NY | TX | IL | NJ | WY | WV | HI | ND | AK |
| Anthropology and archaeology |  |  |  |  |  | 4 |  |  |  |  |
| Biochemistry and biophysics |  |  |  | 1 |  |  |  |  |  |  |
| Chemical engineering |  |  |  |  | 5 |  | 2 |  |  |  |
| Chemistry | 5 | 4 | 1 |  | 2 |  | 3 |  | 5 |  |
| Civil engineering  |  |  |  |  |  | 1 |  | 3 |  | 2 |
| Clinical psychology | 1 | 1 |  | 2 |  |  | 4 |  | 2 | 4 |
| Economics |  | 5 |  |  |  |  |  |  |  |  |
| Electronics/Communications | 2 |  | 2 |  | 3 | 2 |  |  |  | 5 |
| Environmental science or studies |  | 2 | 4 | 5 |  |  |  |  |  | 3 |
| General psychology |  |  |  |  | 1 |  |  |  |  |  |
| Geological sciences, other |  |  |  |  |  |  |  | 2 |  |  |
| Industry and manufacturing |  |  |  |  |  |  |  |  | 3 |  |
| Mechanical engineering |  |  | 3 | 3 |  |  |  |  |  | 1 |
| Nursing |  |  |  |  |  | 3 |  |  |  |  |
| OTHER biological sciences |  |  |  |  |  |  |  | 1 |  |  |
| OTHER psychology |  | 3 | 5 | 4 |  |  | 1 |  |  |  |
| Physics | 4 |  |  |  |  |  | 5 | 5 |  |  |
| Plant sciences |  |  |  |  |  | 5 |  |  | 1 |  |
| Political science |  |  |  |  |  |  |  | 4 |  |  |
| Sociology | 3 |  |  |  | 4 |  |  |  | 4 |  |
| *NOTES:* This table provides the most frequent majors encountered among the interviewees in SESTAT for the five most innovative and five less innovative states across USA for people born in the state of study. The ranking starts from one and ends in five in descending order; that is with [1] we have the most frequent major, while with [5] the least frequent. |

|  |
| --- |
| **Table A5**: Top five majors for the five most innovative and five less innovative states for graduate migrants. |
|  | Top 5 in patents | Bottom 5 in patents |
| Major/State | CA | NY | TX | IL | NJ | WY | WV | HI | ND | AK |
| Anthropology and archaeology |  |  |  |  |  | 5 |  | 1 |  |  |
| Biochemistry and Biophysics | 4 |  |  | 4 | 5 |  |  |  |  |  |
| Chemical engineering |  |  | 2 |  | 4 |  | 2 |  |  |  |
| Chemistry | 2 | 1 | 1 | 1 | 1 |  | 1 |  | 3 |  |
| Civil engineering |  |  |  |  |  | 3 |  |  |  | 3 |
| Clinical psychology |  |  |  |  |  |  | 3 | 3 |  |  |
| Economics |  | 3 |  | 3 |  |  |  |  |  |  |
| Electronics/Communications | 3 |  | 4 |  | 3 |  |  |  |  | 5 |
| Environmental sciences |  |  |  |  |  |  |  |  |  | 2 |
| General psychology |  |  |  |  |  | 1 |  |  |  |  |
| Geological sciences |  |  |  |  |  | 2 |  |  |  | 1 |
| Mechanical engineering |  |  | 5 |  |  |  |  |  |  | 4 |
| Nursing |  |  |  |  |  | 4 |  |  |  |  |
| Other agricultural sciences |  |  |  |  |  |  |  |  | 2 |  |
| Other biological sciences | 5 | 5 |  |  |  |  |  | 4 |  |  |
| Physics | 1 | 2 | 3 | 2 | 2 |  | 4 | 5 |  |  |
| Plant sciences |  |  |  |  |  |  |  |  | 1 |  |
| Political science |  | 4 |  |  |  |  |  |  |  |  |
| Sociology |  |  |  | 5 |  |  | 5 | 2 | 4 |  |
| Zoology, general |  |  |  |  |  |  |  |  | 5 |  |
| *NOTES:* This table provides the most frequent majors for SESTAT interviewees for the five most innovative and least innovative states for people migrating to there. The ranking starts from one and ends in five in descending order; that is with [1] we have the most frequent major, while with [5] the least frequent.  |

**Appendix B: Auxiliary Models**

|  |
| --- |
| **Table B1**: Instrumental variables approach with *Top1* as instrument |
|   | [1] | [2] | [3] | [4] |
| *Panel A: Main results* |
| $$\hat{InnProd}$$ | 0.056 | 0.056 | 0.124 | 1.908 |
|  | (0.053) | (0.053) | (0.075) | (1.554) |
| Density | -0.055 | -0.060 | -0.285 | -0.260 |
|  | (0.080) | (0.080) | (0.146) | (0.293) |
| Air quality index | -0.001 | -0.001 | -0.001 | -0.002 |
|  | (0.001) | (0.001) | (0.001) | (0.003) |
| Home price index | -0.114\* | -0.122\* | -0.0813 | -0.723 |
|  | (0.057) | (0.061) | (0.058) | (0.572) |
| Tax per capita | -0.021\*\*\* | -0.021\*\*\* | -0.037\*\* | -0.079 |
|   | (0.002) | (0.002) | (0.011) | (0.050) |
| Observations | 384 | 384 | 288 | 288 |
|  | [5] | [6] | [7] | [8] |
| *Panel B: First-stage results* |
| *Top1* | 5.765\*\*\* | 5.692\*\*\* | 4.697\*\*\* | 0.124\* |
|  | (0.790) | (0.812) | (1.336) | (0.075) |
| Density | -0.019  | 0.057  | 0.986\*\*  | 0.081  |
|  | (0.209)  | (0.215)  | (0.470)  | (0.116)  |
| Air quality index | -0.002  | -0.002  | 0.002  | 0.000  |
|  | (0.002)  | (0.002)  | (0.004)  | (0.001)  |
| Home price index | 0.450\*\*\*  | 0.572\*\*\*  | 0.123  | 0.344\*\*\*  |
|  | (0.119)  | (0.122)  | (0.208)  | (0.049)  |
| Tax per capita | 0.009\*  | 0.015\*\*\*  | 0.135\*\*\*  | 0.031\*\*\*  |
|  | (0.005)  | (0.005)  | (0.009)  | (0.002)  |
|  |  |  |  |  |
| Cragg-Donald Wald F | 53.20 | 49.13 | 12.37 | 2.163 |
| Stock-Yogo critical value at 10% | 16.38 | —“— | —“— | —“— |
| *Notes:* **Panel A** columns [1] to [4] have as dependent variable the logarithm of the number of highly educated individuals entering a state (immigrants). The main control variables are the estimated values of various measures for innovation and productivity, $\hat{InnProd}$*.* Specifically, in column [1] the number of patents per 100,000, [2] the aggregated number of patents, [3] labor productivity (multiplied by 10,000), [4] total factor productivity (TFP). **Panel B** columns [5] to [8] have as dependent variablesthe number of patents per 100,000, the aggregated number of patents, labor productivity, and total factor productivity (TFP), respectively. Data from Alaska, the District of Columbia, and Hawaii are absent from these specifications. All models include state fixed effects. Significance levels: \*\*\* 1%, \*\* 5%, \* 10%.  |

|  |
| --- |
| **Table B2** : Instrumental variables approach with *Firms20* as instrument |
|   | [1] | [2] | [3] | [4] |
| *Panel A: Main results* |
| $$\hat{InnProd}$$ | 0.835 | 0.381\*\* | 0.430 | 0.561\*\*\* |
|  | (0.537) | (0.135) | (0.349) | (0.147) |
| Density | -0.093 | -0.132 | -0.601 | -0.162 |
|  | (0.205) | (0.113) | (0.417) | (0.152) |
| Air quality index | 0.0001 | -0.001 | -0.002 | -0.002 |
|  | (0.002) | (0.001) | (0.002) | (0.002) |
| Home price index | -0.632 | -0.366\*\* | -0.180 | -0.236\*\* |
|  | (0.376) | (0.120) | (0.144) | (0.081) |
| Tax per capita | -0.038\*\* | -0.030\*\*\* | -0.081 | -0.036\*\*\* |
|   | (0.013) | (0.004) | (0.051) | (0.006) |
| Observations | 336 | 336 | 288 | 288 |
|  | [5] | [6] | [7] | [8] |
| *Panel B: First-stage results* |
| *Firms20* | 0.524  | 1.148\*\*\*  | 0.722  | 1.657\*\*\*  |
|  | (0.370)  | (0.372)  | (0.572)  | (0.158)  |
| Density | -0.045  | 0.004 | 0.945\*  | 0.012  |
|  | (0.270)  | (0.271)  | (0.485)  | (0.098)  |
| Air quality index | -0.002  | -0.002  | 0.003  | 0.771  |
|  | (0.003)  | (0.003)  | (0.004)  | (0.972)  |
| Home price index | 0.592\*\*\*  | 0.602\*\*\*  | 0.198  | 0.156\*\*\*  |
|  | (0.147)  | (0.148)  | (0.226)  | (0.044)  |
| Tax per capita | 0.021\*\*\*  | 0.026\*\*\*  | 0.145\*\*\*  | 0.032\*\*\*  |
|  | (0.006)  | (0.006)  | (0.009)  | (0.002)  |
|  |  |  |  |  |
| Cragg-Donald Wald F | 2.007 | 9.550 | 1.593 | 109.5 |
| Stock-Yogo critical value at 10% | 16.38 | —“— | —“— | —“— |
| *Notes:* **Panel A** columns [1] to [4] have as dependent variable the logarithm of the number of highly educated individuals entering a state (immigrants). The main control variables are the estimated values of various measures for innovation and productivity, $\hat{InnProd}$*.* Specifically, in column [1] the number of patents per 100,000, [2] the aggregated number of patents, [3] labor productivity (multiplied by 10,000), [4] total factor productivity (TFP). **Panel B** columns [5] to [8] have as dependent variablesthe number of patents per 100,000, the aggregated number of patents, labor productivity, and total factor productivity (TFP), respectively. Data from Alaska, the District of Columbia, and Hawaii are absent from these specifications. All models include state fixed effects. Significance levels: \*\*\* 1%, \*\* 5%, \* 10%.  |

|  |
| --- |
| **Table B3** : Instrumental variables approach with *STEM(x)Firms20* as instrument |
|   | [1] | [2] | [3] | [4] |
| *Panel A: Main results* |
| $$\hat{InnProd}$$ | 0.485\*\*\* | 0.495\*\*\* | 0.396\*\*\* | -44.27 |
|  | (0.085) | (0.090) | (0.091) | (253.3) |
| Density | -0.097 | -0.141 | -0.566\*\* | 3.100 |
|  | (0.128) | (0.133) | (0.220) | (19.2) |
| Air quality index | -0.001 | -0.000 | -0.002 | 0.0197 |
|  | (0.001) | (0.001) | (0.002) | (0.132) |
| Home price index | -0.396\*\*\* | -0.455\*\*\* | -0.169 | 15.97 |
|  | (0.0860) | (0.0970) | (0.089) | (91.62) |
| Tax per capita | -0.030\*\*\* | -0.033\*\*\* | -0.076\*\*\* | 1.392 |
|   | (0.003) | (0.004) | (0.014) | (8.069) |
| Observations | 336 | 336 | 288 | 288 |
|  | [5] | [6] | [7] | [8] |
| *Panel B: First-stage results* |
| *STEM(x)Firms20* | 2.64e-04 \*\*\* | 2.58e-04\*\*\* | 0.495\*\*\* | -3.05e-06 |
|  | (4.44e-05) | (4.54e-05) | (0.090) | (1.77e-0.5) |
| Density | 0.325  | 0.409  | 1.435\*\*\*  | 0.068  |
|  | (0.261)  | (0.267)  | 0.468  | (0.122)  |
| Air quality index | -0.004  | -0.004  | 0.001  | 0.000  |
|  | (0.002)  | (0.003)  | (0.004)  | (0.001)  |
| Home price index | 0.665\*\*\*  | 0.772\*\*\*  | 0.287  | 0.362\*\*\*  |
|  | (0.128)  | (0.131)  | (0.196)  | (0.048)  |
| Tax per capita | 0.029\*\*\*  | 0.035\*\*\*  | 0.154\*\*\*  | 0.032\*\*\*  |
|  | (0.006)  | (0.006)  | (0.009)  | (0.002)  |
|  |  |  |  |  |
| Cragg-Donald Wald F | 34.94 | 32.19 | 22.38 | 0.0298 |
| Stock-Yogo critical value at 10% | 16.38 | —“— | —“— | —“— |
| *Notes:* **Panel A** columns [1] to [4] have as dependent variable the logarithm of the number of highly educated individuals entering a state (immigrants). The main control variables are the estimated values of various measures for innovation and productivity, $\hat{InnProd}$*.* Specifically, in column [1] the number of patents per 100,000, [2] the aggregated number of patents, [3] labor productivity (multiplied by 10,000), [4] total factor productivity (TFP). **Panel B** columns [5] to [8] have as dependent variablesthe number of patents per 100,000, the aggregated number of patents, labor productivity, and total factor productivity (TFP), respectively. Data from Alaska, the District of Columbia, and Hawaii are absent from these specifications. All models include state fixed effects. Significance levels: \*\*\* 1%, \*\* 5%, \* 10%.  |

|  |
| --- |
| **Table B4** : Instrumental variables approach with *STEM(x)Top1* as instrument |
|   | [1] | [2] | [3] | [4] |
| *Panel A: Main results* |
| $$\hat{InnProd}$$ | 0.141\*\* | 0.150\*\* | 0.189\*\* | -2.403 |
|  | (0.052) | (0.055) | (0.071) | (1.579) |
| Density | -0.0536 | -0.065 | -0.352\* | 0.054 |
|  | (0.078) | (0.078) | (0.153) | (0.320) |
| Air quality index | -0.001 | -0.001 | -0.001 | -0.000 |
|  | (0.001) | (0.001) | (0.001) | (0.003) |
| Home price index | -0.172\*\* | -0.196\*\* | -0.102 | 0.835 |
|  | (0.055) | (0.061) | (0.061) | (0.584) |
| Tax per capita | -0.023\*\*\* | -0.024\*\*\* | -0.046\*\*\* | 0.059 |
|   | (0.002) | (0.002) | (0.011) | (0.051) |
| Observations | 384 | 384 | 288 | 288 |
|  | [5] | [6] | [7] | [8] |
| *Panel B: First-stage results* |
| *STEM(x)Top1* | 19.401\*\*\*  | 18.195\*\*\*  | 18.033\*\*\*  | -1.790 |
|  | (2.696)  | (2.788)  | (4.470)  | (1.120)  |
| Density | -0.046  | 0.032  | 0.942\*\*  | 0.062  |
|  | (0. 209)  | (0.217)  | (0.467)  | (0.119)  |
| Air quality index | -0.001  | -0.002  | 0.002  | 0.001  |
|  | (0.002)  | (0.002)  | (0.004)  | (0.001)  |
| Home price index | 0.486\*\*\*  | 0.617\*\*\*  | 0.126  | 0.378\*\*\*  |
|  | (0.118)  | (0.122)  | (0.204)  | (0.049)  |
| Tax per capita | 0.016\*\*\*  | 0.022\*\*\*  | 0.141\*\*\*  | 0.032\*\*\*  |
|  | (0.005)  | (0.005)  | (0.009)  | (0.002)  |
|  |  |  |  |  |
| Cragg-Donald Wald F | 51.80 | 42.58 | 16.27 | 2.557 |
| Stock-Yogo critical value at 10% | 16.38 | —“— | —“— | —“— |
| *Notes:* **Panel A** columns [1] to [4] have as dependent variable the logarithm of the number of highly educated individuals entering a state (immigrants). The main control variables are the estimated values of various measures for innovation and productivity, $\hat{InnProd}$*.* Specifically, in column [1] the number of patents per 100,000, [2] the aggregated number of patents, [3] labor productivity (multiplied by 10,000), [4] total factor productivity (TFP). **Panel B** columns [5] to [8] have as dependent variablesthe number of patents per 100,000, the aggregated number of patents, labor productivity, and total factor productivity (TFP), respectively. Data from Alaska, the District of Columbia, and Hawaii are absent from these specifications. All models include state fixed effects. Significance levels: \*\*\* 1%, \*\* 5%, \* 10%.  |

|  |
| --- |
| **Table B5**: Three Stage Least Squares Estimation – weighted results  |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Equation 1**: the dependent variable is highly-skilled migration to the state |
| InnProd | 0.685\*\*\* | 0.371\*\*\* | 0.248\*\*\* | 0.239\*\* | 0.725\*\*\* | 0.516\*\*\* | 0.364\*\*\* | 0.588\*\*\* |
|  | (0.097) | (0.046) | (0.065) | (0.112) | (0.107) | (0.046) | (0.063) | (0.075) |
| Density | 0.140\*\*\* | 0.155\*\*\* | 0.216\*\*\* | 0.170 | 0.032 | 0.007 | -0.111 | -0.089 |
|  | (0.063) | (0.046) | (0.079) | (0.117) | (0.072) | (0.046) | (0.085) | (0.078) |
| Gini | -0.876 | -1.443\*\*\* | 0.536 | 1.566 | -0.720 | -0.236 | -0.683 | -3.304\*\*\* |
|  | (0.969) | (0.486) | (1.228) | (1.863) | (1.135) | (0.376) | (1.226) | (1.249) |
| Air quality index | 0.017\*\*\* | 0.013\*\*\* | 0.025\*\*\* | 0.016\* | 0.015\*\*\* | 0.002 | 0.021\*\*\* | -0.016\*\* |
|  | (0.002) | (0.002) | (0.003) | (0.008) | (0.004) | (0.003) | (0.003) | (0.007) |
| Home-price index | -0.391\*\*\* | -0.264\*\*\* | -0.291\* | -0.137 | 0.025 | -0.007 | 0.043 | 0.025 |
|  | (0.105) | (0.058) | (0.152) | (0.147) | (0.116) | (0.040) | (0.148) | (0.121) |
| Tax per capita | -0.001 | 0.006 | -0.005 | 0.017 | 0.016\* | 0.001 | 0.024\*\* | -0.024\*\* |
|  | (0.007) | (0.004) | (0.011) | (0.011) | (0.009) | (0.005) | (0.012) | (0.010) |
| Constant | 2.975\*\*\* | 2.963\*\*\* | 2.403\*\*\* | 0.896 | 1.581\*\* | 1.235\*\*\* | 1.001 | 2.351\*\*\* |
|  | (0.634) | (0.324) | (0.731) | (0.663) | (0.744) | (0.292) | (0.789) | (0.579) |
| **Equation 2:** the dependent variables are the different proxies for innovation or productivity |
| Controls\Dependent variables | Ln(patents)per 100,000 | Ln(patents) | Labor productivity  | TFP | Ln(patents)per 100,000 | Ln(patents) | Labor productivity  | TFP |
| Ln (HK graduates) | 0.399\*\*\* | 1.238\*\*\* | 0.008 | 2.040\*\*\* | 0.489\*\*\* | 1.773\*\*\* | 0.367 | 2.806\*\*\* |
|  | (0.075) | (0.085) | (0.152) | (0.162) | (0.156) | (0.165) | (0.242) | (0.184) |
| STEM (x) Top1 | 21.186\*\*\* | 34.150\*\*\* | 57.619\*\*\* | 24.584\*\*\* | 16.045\*\*\* | 5.231 | 36.231\*\*\* | -1.653 |
|  | (3.471) | (3.949) | (7.097) | (7.803) | (5.847) | (5.829) | (9.227) | (7.332) |
| Density | 0.251\*\*\* | 0.183\*\*\* | 0.933\*\*\* | 0.053 | 0.109 | 0.029 | 0.663\*\*\* | 0.064 |
|  | (0.048) | (0.054) | (0.092) | (0.084) | (0.072) | (0.074) | (0.114) | (0.087) |
| Ln (R&D capita) | 0.382\*\*\* | 0.329\*\*\* | 1.456\*\*\* | 0.082 | 0.469\*\*\* | 0.058 | 1.188\*\*\* | -0.880\*\*\* |
|  | (0.056) | (0.051) | (0.130) | (0.110) | (0.140) | (0.127) | (0.230) | (0.165) |
| Entrepreneur average education |  |  |  |  | 0.574\*\* | 0.105 | 1.788\*\*\* | -0.818\*\* |
|  |  |  |  |  | (0.235) | (0.217) | (0.427) | (0.357) |
| Constant | 1.939\*\*\* | 0.610 | 9.361\*\*\* | -0.989 | 0.282 | -1.812\*\*\* | 2.618\*\* | -3.620\*\*\* |
|  | (0.388) | (0.438) | (0.800) | (0.826) | (0.658) | (0.575) | (1.140) | (0.929) |
| N | 384 | 384 | 288 | 288 | 192 | 192 | 192 | 192 |
| $χ^{2}$ for equation 1 | 351.67 | 966.37 | 221.42 | 269.71 | 253.78 | 730.66 | 234.79 | 327.75 |
| R2 for equation 1 | 0.414 | 0.734 | 0.409 | 0.721 | 0.380 | 0.791 | 0.348 | 0.720 |
| $χ^{2}$ for equation 2 | 373.33 | 1017.44 | 561.22 | 708.18 | 0.489 | 605.25 | 353.02 | 799.84 |
| R2 for equation 2 | 0.497 | 0.780 | 0.659 | 0.813 | 0.489 | 0.790 | 0.635 | 0.871 |
| NOTES:The variable representing density is computed based on regions consisting about 75% of the states’ whole population (starting from the most populous region to the least populous). Columns (1) to (8) have the following proxies for innovation or productivity (InnProd): columns (1) and (5) the natural logarithm of patents per 100,000; columns (2) and (6) the raw natural logarithm of patents; columns (3) and (7) the labor productivity per hour; columns (4) and (8) the total factor productivity (TFP). Data from Alaska, the District of Columbia, and Hawaii are absent from these specifications. All regressions have been tested for identification through the order and rank condition and pass the test. Significance levels: \*\*\* 1%, \*\* 5%, \* 10%. |

|  |
| --- |
| **Table B6**: Two Stage Least Squares Estimation – weighted results  |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Equation 1**: the dependent variable is highly-skilled migration to the state |
| InnProd | 0.731\*\*\* | 0.672\*\*\* | 0.301\*\*\* | 0.833\*\*\* | 0.725\*\*\* | 0.572\*\*\* | 0.389\*\*\* | 0.649\*\*\* |
|  | (0.112) | (0.059) | (0.067) | (0.125) | (0.113) | (0.051) | (0.065) | (0.078) |
| Density | 0.174\*\*\* | 0.003 | 0.216\*\*\* | -0.261\*\* | 0.171\*\* | 0.076 | 0.061 | -0.109 |
|  | (0.067) | (0.052) | (0.081) | (0.126) | (0.078) | (0.050) | (0.089) | (0.080) |
| Gini | 4.324\*\*\* | -0.485 | 2.671\*\* | -9.895\*\*\* | 3.956\*\*\* | 0.055 | 2.827\* | -6.388\*\*\* |
|  | (1.173) | (0.759) | (1.274) | (2.273) | (1.489) | (0.826) | (1.476) | (1.372) |
| Air quality index | 0.014\*\*\* | -0.004 | 0.023\*\*\* | -0.032\*\*\* | 0.018\*\*\* | 0.001 | 0.024\*\*\* | -0.021\*\*\* |
|  | (0.003) | (0.003) | (0.003) | (0.009) | (0.004) | (0.003) | (0.004) | (0.007) |
| Home-price index | -0.409\*\*\* | -0.218\*\* | -0.283\* | 0.150 | -0.088 | -0.002 | -0.042 | 0.169 |
|  | (0.138) | (0.091) | (0.159) | (0.178) | (0.183) | (0.106) | -0.186 | (0.138) |
| Tax per capita | -0.031\*\*\* | -0.042\*\*\* | -0.028\*\* | -0.051\*\*\* | -0.015 | -0.025\*\*\* | -0.020 | -0.035\*\*\* |
|  | (0.009) | (0.006) | (0.012) | (0.013) | (0.012) | (0.008) | (0.013) | (0.011) |
| Constant | 0.665 | 1.978\*\*\* | 1.401\* | 4.935\*\*\* | -0.391 | 1.358\*\*\* | -0.180 | 3.892\*\*\* |
|  | (0.703) | (0.394) | (0.750) | (0.813) | (0.882) | (0.469) | (0.898) | (0.641) |
| **Equation 2:** the dependent variables are the different proxies for innovation or productivity |
| Controls\Dependent variables | Ln(patents)per 100,000 | Ln(patents) | Labor productivity  | TFP | Ln(patents)per 100,000 | Ln(patents) | Labor productivity  | TFP |
| Ln (HK graduates) | 0.429\*\*\* | 1.281\*\*\* | 0.022 | 2.040\*\*\* | 0.548\*\*\* | 1.787\*\*\* | 0.422\* | 2.786\*\*\* |
|  | (0.076) | (0.086) | (0.153) | (0.163) | (0.162) | (0.171) | (0.249) | (0.187) |
| STEM (x) Top1 | 12.646\*\*\* | 26.353\*\*\* | 52.559\*\*\* | 24.574\*\*\* | 12.693\* | 10.237 | 31.163\*\*\* | 0.167 |
|  | (3.783) | (4.330) | (7.234) | (7.901) | (6.635) | (7.005) | (10.211) | (7.678) |
| Density | 0.229\*\*\* | 0.148\*\*\* | 0.923\*\*\* | 0.053 | 0.128\* | 0.087 | 0.666\*\*\* | 0.072 |
|  | (0.048) | (0.055) | (0.092) | (0.085) | (0.077) | (0.081) | (0.119) | (0.089) |
| Ln (R&D capita) | 0.594\*\*\* | 0.588\*\*\* | 1.564\*\*\* | 0.083 | 0.585\*\*\* | 0.060 | 1.249\*\*\* | -1.059\*\*\* |
|  | (0.067) | (0.077) | (0.133) | (0.132) | (0.157) | (0.166) | (0.242) | (0.182) |
| Entrepreneur average education |  |  |  |  | 0.267 | -0.323 | 1.646\*\*\* | -0.691\* |
|  |  |  |  |  | (0.327) | (0.345) | (0.503) | (0.378) |
| Constant | 2.597\*\*\* | 1.269\*\*\* | 9.728\*\*\* | -0.987 | 1.182 | -0.905 | 3.042\*\* | -4.295\*\*\* |
|  | (0.406) | (0.465) | (0.810) | (0.850) | (0.870) | (0.918) | (1.339) | (1.007) |
| N | 384 | 384 | 288 | 288 | 192 | 192 | 192 | 192 |
| R2 for equation 1 | 0.435 | 0.751 | 0.400 | 0.208 | 0.436 | 0.799 | 0.406 | 0.642 |
| R2 for equation 2 | 0.512 | 0.788 | 0.661 | 0.813 | 0.482 | 0.792 | 0.630 | 0.873 |
| NOTES:The variable representing density is computed based on regions consisting about 75% of the states’ whole population (starting from the most populous region to the least populous). Columns (1) to (8) have the following proxies for innovation or productivity (InnProd): columns (1) and (5) the natural logarithm of patents per 100,000; columns (2) and (6) the raw natural logarithm of patents; columns (3) and (7) the labor productivity per hour; columns (4) and (8) the total factor productivity (TFP). Data from Alaska, the District of Columbia, and Hawaii are absent from these specifications. All regressions have been tested for identification through the order and rank condition and pass the test. Significance levels: \*\*\* 1%, \*\* 5%, \* 10%. |

|  |
| --- |
| **Table B7**: Instrumental variables approach with *STEM* as instrument - weighted |
|   | [1] | [2] | [3] | [4] |
| *Panel A: Main results* |
| $$\hat{InnProd}$$ | 0.428\*\*\* | 0.435\*\*\* | 0.469\*\*\* | -7.871 |
|  | (0.0470) | (0.0497) | (0.0988) | (6.292) |
| Density | -0.019 | -0.052 | -0.653\*\* | 1.900 |
|  | (0.083) | (0.086) | (0.238) | (1.830) |
| Air quality index | -0.000 | -0.000 | 0.001 | 0.007 |
|  | (0.001) | (0.001) | (0.002) | (0.010) |
| Home price index | -0.159\*\*\* | -0.179\*\*\* | -0.137 | 2.291 |
|  | (0.044) | (0.047) | (0.081) | (1.830) |
| Tax per capita | -0.035\*\*\* | -0.0391\*\*\* | -0.083\*\*\* | 0.193 |
|   | (0.002) | (0.003) | (0.014) | (0.169) |
| Observations | 384 | 384 | 288 | 288 |
|  | [5] | [6] | [7] | [8] |
| *Panel B: First-stage results* |
| *STEM* | 0.003\*\*\* | 0.003\*\*\* | 0.002\*\*\* | -0.000 |
|  | (0.000) | (0.000) | (0.000) | (0.000) |
| Density | 0.162 | 0.234 | 1.370\*\*\* | 0.240\*\* |
|  | (0.180) | (0.185) | (0.431) | (0.107) |
| Air quality index | -0.004\*\* | -0.004\* | -0.003 | 0.001 |
|  | (0.002) | (0.002) | (0.004) | (0.001) |
| Home price index | 0.472\*\*\* | 0.511\*\*\* | 0.352\*\* | 0.286\*\*\* |
|  | (0.082) | (0.085) | (0.148) | (0.034) |
| Tax per capita | 0.041\*\*\* | 0.050\*\*\* | 0.145\*\*\* | 0.026\*\*\* |
|  | (0.004) | (0.004) | (0.008) | (0.002) |
|  |  |  |  |  |
| Cragg-Donald Wald F | 98.10 | 89.68 | 25.26 | 1.503 |
| Stock-Yogo critical value at 10% | 16.38 | —“— | —“— | —“— |
| *Notes:* **Panel A** columns [1] to [4] have as dependent variable the logarithm of the number of highly educated individuals entering a state (immigrants). The main control variables are the estimated values of various measures for innovation and productivity, $\hat{InnProd}$*.* Specifically, in column [1] the number of patents per 100,000, [2] the aggregated number of patents, [3] labor productivity (multiplied by 10,000), [4] total factor productivity (TFP). **Panel B** columns [5] to [8] have as dependent variablesthe number of patents per 100,000, the aggregated number of patents, labor productivity, and total factor productivity (TFP), respectively. Data from Alaska, the District of Columbia, and Hawaii are absent from these specifications. All models include state fixed effects. Significance levels: \*\*\* 1%, \*\* 5%, \* 10%.  |