**Appendix 1.** Pairwise correlation

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | CO2 | EFP | GDPpc | ENE | REN | ECI | EPU |
| CO2 | 1.000 |  |  |  |  |  |  |
| EFP | 0.822\*\*\* | 1.000 |  |  |  |  |  |
| GDPpc | 0.339\*\*\* | 0.530\*\*\* | 1.000 |  |  |  |  |
| ENE | 0.810\*\*\* | 0.979\*\*\* | 0.609\*\*\* | 1.000 |  |  |  |
| REN | 0.083 | 0.440\*\*\* | 0.273\*\*\* | 0.372\*\*\* | 1.000 |  |  |
| ECI | -0.184\*\* | -0.512\*\*\* | -0.159\* | -0.418\*\*\* | -0.600\*\*\* | 1.000 |  |
| EPU | -0.217\*\* | -0.084 | 0.279\*\*\* | -0.074 | 0.217\*\* | -0.144\* | 1 |

Note: \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**Appendix 2.** Cross-sectional dependency test

|  |  |  |
| --- | --- | --- |
|  | Carbon dioxide emissions | Ecological footprint |
| Pesaran's test | 1.913\* | 2.048\*\* |
| Friedman's test | 22.028\*\*\* | 19.507\*\*\* |
| Frees' test | 1.256\*\*\* | 0.758\*\*\* |

Note: Null hypothesis of cross-sectional independence. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**Appendix 3.** Panel unit root test

Panel A. Pesaran

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Z[t-bar] | CO2 | EFP | GDPpc | ENE | REN | EPU | ECI |
| Level, 0 lag | -0.626 | -1.407\* | -0.349 | -2.935\*\*\* | -1.215 | -3.624\*\*\* | -1.275 |
| Level, 1 lag | -0.141 | -0.670 | -1.001 | -0.848 | -0.321 | -1.232 | -0.688 |
| Level, 2 lag | 3.678 | 1.444 | 0.050 | 0.918 | 1.519 | -1.136 | -1.937\*\* |
| First difference, 0 lag | -5.246\*\*\* | -7.483\*\*\* | -2.442\*\*\* | -8.455\*\*\* | -7.433\*\*\* | -10.084\*\*\* | -5.437\*\*\* |
| First difference, 1 lag | -3.907\*\*\* | -4.234\*\*\* | -1.359\* | -6.482\*\*\* | -4.722\*\*\* | -5.222\*\*\* | -2.275\*\*\* |
| First difference, 2 lag | 1.032 | -1.560\* | -0.871 | -0.865 | -1.282\* | -2.501\*\*\* | -1.903\*\* |

Note: Null hypothesis of all series are non-stationary. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel B. Levin-Lin-Chu

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Z[t-bar] | CO2 | EFP | GDPpc | ENE | REN | EPU | ECI |
| Level | -0.378 | 1.671 | 1.667 | 0.497 | 2.301 | -4.144\*\*\* | -0.006 |
| First difference, Constant | -7.866\*\*\* | -9.629\*\*\* | -6.217\*\*\* | -7.160\*\*\* | -9.955\*\*\* | -13.250\*\*\* | -8.786\*\*\* |

Note: Null hypothesis of all series are non-stationary. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel C. Im-Pesaran-Shin

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Z[t-bar] | CO2 | EFP | GDPpc | ENE | REN | EPU | ECI |
| Level | -0.937 | 2.190 | 1.396 | 0.209 | 3.508 | -2.422\*\*\* | 0.606 |
| First difference, Constant | -8.417\*\*\* | -8.748\*\*\* | -4.884\*\*\* | -8.339\*\*\* | -7.966\*\*\* | -11.281\*\*\* | -7.765\*\*\* |

Note: Null hypothesis of all series are non-stationary. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**Appendix 4.** Cointegration test

Panel A. Westerlund test

|  |  |  |
| --- | --- | --- |
| Variance ratio | Carbon dioxide emissions | Ecological footprint |
| Some panels | 1.465\* | -1.461\*\* |
| All panels | 21.637\* | -0.854 |
| Trend | 1.752\*\* | 1.332\* |
| Demean | 1.497\* | 1.999\*\* |

Note: Alternative hypothesis that the panels are cointegrated. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel B. Pedroni test

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Carbon dioxide emissions | | Ecological footprint | |
| Test statistics | Panel | Group | Panel | Group |
| *v* | -0.5561 |  | -1.272 |  |
| *rho* | 2.129\*\* | 2.946\*\*\* | 1.74\* | 2.709\*\*\* |
| *t* | -0.2147 | -0.346 | -2.302\*\* | -2.523\*\* |
| *adf* | 2.941\*\*\* | 2.961\*\*\* | -.5217 | -.9452 |

Note: Null hypothesis of no cointegration. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**Appendix 5.** Heteroskedasticity test

|  |  |  |
| --- | --- | --- |
|  | Carbon dioxide emissions | Ecological footprint |
| *Chi2* | 271.45\*\*\* | 118.30\*\*\* |

Note: Null hypothesis of no heteroskedasticity. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**Appendix 6.** Serrial correlation test

|  |  |  |
| --- | --- | --- |
|  | Carbon dioxide emissions | Ecological footprint |
| *Chi2* | 46.799\*\*\* | 21.206\*\*\* |

Note: Null hypothesis of no serrial correlation. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels, respectively.

**Appendix 7.** Hausman test

|  |  |  |
| --- | --- | --- |
|  | Carbon dioxide emissions | Ecological footprint |
| *Chi2* | 119.81\*\*\* | 96.07\*\*\* |

Note: Null hypothesis of no fixed effect. \*\*\*, \*\*, \* indicate significance at the 1%, 5%, and 10% levels, respectively.