**Standing alongside your friends. Network centrality and providing troops to UN peacekeeping operations. Online Appendix**

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**Note on Existence of Equilibrium**

In our game on networks, an equilibrium only exists if the positive feedback effects are not too great relative to the costs of contributing to peacekeeping; in other words, λ must not be too great. The condition relates to the size of the largest eigenvalue of the matrix **G** of normed complementarities. In the context of public good provision without co-produced private benefits dependent on others’ contributions, recent work shows that results are extremely sensitive to this assumption. Further, Bramoullé, Kranton & D’Amours (2014) show that equilibrium contributions are not generally proportionate to Bonacich centrality. There are often multiple equilibriums in each of which some group contributes nothing and members of the other group make positive contributions. However, among the latter group contributions are proportionate to Bonacich centrality on the sub-graph restricted to that group. The size of the smallest eigenvalue governs whether equilibriums are unique and whether all contribute. It is important to be aware that Bramoullé, Kranton, & D’Amours (2014) and Bramoullé & Kranton (2007) analyze public goods games on networks where benefits from the public good are concave in total contributions but costs are linear, but contrary to us their model does not allow for co-produced private benefits that depend on others’ contributions

**Alternative Measures of Peacekeeping Personnel Contributions**

Number of Troops The theoretical model relates to the proportion of troops contributed to a peacekeeping mission. Table A.1 replicates the models in Table I using the number of troops sent rather than the proportion. The bivariate correlation between *prop\_troops* and the number of troops sent (*troops*) is .454 (n=63,513). Models for *troops* suggest a similar, significant but slightly weaker, quadratic relationship with eigen-centrality to the one suggested by our theory.

Zero Contributions The theoretical model does not predict zero contributions. The models presented in the main article, however, maintain cases as long as a country either contributed to any peacekeeping mission (Table I), or at least one year to a particular mission (Table II). Table A.2 replicates Table I excluding all zero contributions. Table A.3 does the same for Table II. The log transformation of prop\_troop also corrects for the skewness of the disturbances. Excluding zero contributions results in a large reduction of degrees of freedom, but the main findings are robust.

In all Tables, the convention is that s\_var measures the within effect and var\_i the between effect. Also, + *p*<0.1; \* *p*<0.05; \*\* *p*<0.01

Table A.I Contribution of troops to UN peacekeeping operations, 1990 – 2011. GLS with AR(1) disturbances

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | troop | troop / Country FE | troop | Troop |
| eigen | 1.57e+03 | 2.86e+03 | 3.94e+03 |  |
|  | (1.86)+ | (2.79)\*\* | (2.69)\*\* |  |
| eigen\_sq | -1.28e+04 | -2.22e+04 | -2.67e+04 |  |
|  | (2.08)\* | (3.03)\*\* | (2.60)\*\* |  |
| s\_eigen |  |  |  | 4.19e+03 |
|  |  |  |  | (2.24)\* |
| s\_eigen\_sq |  |  |  | -2.84e+04 |
|  |  |  |  | (2.21)\* |
| eigen\_i |  |  |  | 2.25e+03 |
|  |  |  |  | (0.86) |
| eigen\_sq\_i |  |  |  | -1.40e+04 |
|  |  |  |  | (0.74) |
| rgdppcB | -1.99e-04 | 5.74e-05 | -2.78e-04 |  |
|  | (2.02)\* | (0.31) | (2.42)\* |  |
| s\_rgdppcB |  |  |  | 1.08e-04 |
|  |  |  |  | (0.49) |
| rgdppcB\_i |  |  |  | -5.19e-04 |
|  |  |  |  | (3.66)\*\* |
| num\_missions |  |  | 1.32e+01 |  |
|  |  |  | (19.91)\*\* |  |
| s\_num\_missions |  |  |  | 9.21e+00 |
|  |  |  |  | (12.77)\*\* |
| num\_missions\_i |  |  |  | 3.37e+01 |
|  |  |  |  | (20.14)\*\* |
| polity2B |  |  | 3.83e-01 |  |
|  |  |  | (2.31)\* |  |
| s\_polity2B |  |  |  | 2.16e-01 |
|  |  |  |  | (0.92) |
| polity2B\_i |  |  |  | -1.61e-02 |
|  |  |  |  | (0.07) |
| ratio\_pop |  |  | 3.71e-02 |  |
|  |  |  | (1.21) |  |
| s\_ratio\_pop |  |  |  | -9.48e-01 |
|  |  |  |  | (4.90)\*\* |
| ratio\_pop\_i |  |  |  | 1.19e-02 |
|  |  |  |  | (0.38) |
| distw | -1.23e-03 | -1.34e-03 | -1.05e-03 | -9.19e-04 |
|  | (4.03)\*\* | (3.55)\*\* | (2.94)\*\* | (2.52)\* |
| US |  |  | 7.03e+01 | 5.47e+01 |
|  |  |  | (2.97)\*\* | (1.77)+ |
| comcol |  |  | 4.17e+01 | 3.87e+01 |
|  |  |  | (7.46)\*\* | (6.93)\*\* |
| col45 |  |  | 7.71e+01 | 6.05e+01 |
|  |  |  | (3.51)\*\* | (2.76)\*\* |
| \_cons | -2.11e+01 | -6.82e+01 | -1.30e+02 | -8.13e+01 |
|  | (0.72) | (1.70)+ | (2.47)\* | (0.91) |
| *N* | 53,669 | 53,669 | 45,678 | 45,678 |

Table A.II Proportionate contribution of troops to UN peacekeeping operations, 1990 – 2011, GLS with AR(1) disturbances, excluding zero contributions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | prop\_troop | prop\_troop (Country FE) | prop\_troop | prop\_troop |
| eigen | 5.35e+00 | 2.08e+01 | 2.17e+01 |  |
|  | (1.35) | (2.92)\*\* | (3.35)\*\* |  |
| eigen\_sq | -3.98e+01 | -1.37e+02 | -1.50e+02 |  |
|  | (1.28) | (2.62)\*\* | (3.15)\*\* |  |
| s\_eigen |  |  |  | 1.96e+01 |
|  |  |  |  | (2.76)\*\* |
| s\_eigen\_sq |  |  |  | -1.26e+02 |
|  |  |  |  | (2.40)\* |
| eigen\_i |  |  |  | 2.11e+01 |
|  |  |  |  | (1.41) |
| eigen\_sq\_i |  |  |  | -1.51e+02 |
|  |  |  |  | (1.38) |
| rgdppcB | -1.37e-06 | -4.76e-06 | -1.73e-06 |  |
|  | (3.10)\*\* | (5.17)\*\* | (3.72)\*\* |  |
| s\_rgdppcB |  |  |  | -4.38e-06 |
|  |  |  |  | (4.57)\*\* |
| rgdppcB\_i |  |  |  | -6.32e-07 |
|  |  |  |  | (0.99) |
| distw | 1.65e-06 | -6.01e-06 | 4.90e-07 | 5.90e-07 |
|  | (1.12) | (2.98)\*\* | (0.32) | (0.39) |
| US |  |  | 2.57e-01 | 2.18e-01 |
|  |  |  | (3.44)\*\* | (1.48) |
| polity2B |  |  | 3.01e-03 |  |
|  |  |  | (3.57)\*\* |  |
| s\_polity2B |  |  |  | 4.06e-03 |
|  |  |  |  | (3.68)\*\* |
| polity2B\_i |  |  |  | -2.22e-04 |
|  |  |  |  | (0.17) |
| comcol |  |  | 9.38e-03 | 2.05e-03 |
|  |  |  | (0.49) | (0.11) |
| col45 |  |  | 8.58e-02 | 7.09e-02 |
|  |  |  | (2.19)\* | (1.78)+ |
| ratio\_pop |  |  | 9.03e-05 |  |
|  |  |  | (1.15) |  |
| s\_ratio\_pop |  |  |  | 2.61e-03 |
|  |  |  |  | (3.72)\*\* |
| ratio\_pop\_i |  |  |  | 2.49e-04 |
|  |  |  |  | (2.75)\*\* |
| num\_missions |  |  | 1.48e-03 |  |
|  |  |  | (0.88) |  |
| s\_num\_missions |  |  |  | 2.62e-04 |
|  |  |  |  | (0.14) |
| num\_missions\_i |  |  |  | 1.20e-02 |
|  |  |  |  | (2.84)\*\* |
| \_cons | -1.05e-01 | -5.16e-01 | -7.18e-01 | -6.82e-01 |
|  | (0.81) | (2.12)\* | (3.25)\*\* | (1.33) |
| *N* | 2,493 | 2,493 | 2,462 | 2,462 |

Table A.III Proportionate contribution of troops to UN peacekeeping operations (log), 1990 – 2011, GLS with AR(1) disturbances, excluding zero contributions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | ln\_prop\_troop | ln\_prop\_troop (Country FE) | ln\_prop\_troop | ln\_prop\_troop |
| eigen | 2.31e+02 | 4.55e+02 | 5.23e+02 |  |
|  | (3.29)\*\* | (4.20)\*\* | (5.15)\*\* |  |
| eigen\_sq | -1.60e+03 | -2.90e+03 | -3.60e+03 |  |
|  | (2.95)\*\* | (3.63)\*\* | (4.81)\*\* |  |
| s\_eigen |  |  |  | 4.78e+02 |
|  |  |  |  | (4.46)\*\* |
| s\_eigen\_sq |  |  |  | -3.11e+03 |
|  |  |  |  | (3.91)\*\* |
| eigen\_i |  |  |  | 3.85e+02 |
|  |  |  |  | (1.31) |
| eigen\_sq\_i |  |  |  | -2.62e+03 |
|  |  |  |  | (1.22) |
| rgdppcB | -3.78e-05 | -1.26e-04 | -4.19e-05 |  |
|  | (4.75)\*\* | (8.82)\*\* | (5.05)\*\* |  |
| s\_rgdppcB |  |  |  | -1.22e-04 |
|  |  |  |  | (8.26)\*\* |
| rgdppcB\_i |  |  |  | -7.25e-06 |
|  |  |  |  | (0.58) |
| distw | -3.00e-05 | -2.06e-04 | -4.84e-05 | -5.45e-05 |
|  | (1.04) | (5.55)\*\* | (1.63) | (1.84)+ |
| US |  |  | 5.38e+00 | 3.37e+00 |
|  |  |  | (4.25)\*\* | (1.16) |
| polity2B |  |  | 3.79e-02 |  |
|  |  |  | (2.69)\*\* |  |
| s\_polity2B |  |  |  | 2.95e-02 |
|  |  |  |  | (1.76)+ |
| polity2B\_i |  |  |  | 1.30e-02 |
|  |  |  |  | (0.51) |
| comcol |  |  | 2.38e-01 | 3.43e-01 |
|  |  |  | (0.64) | (0.92) |
| col45 |  |  | 1.89e+00 | 1.38e+00 |
|  |  |  | (2.48)\* | (1.77)+ |
| ratio\_pop |  |  | 1.52e-03 |  |
|  |  |  | (1.02) |  |
| s\_ratio\_pop |  |  |  | -1.06e-03 |
|  |  |  |  | (0.10) |
| ratio\_pop\_i |  |  |  | 1.55e-03 |
|  |  |  |  | (0.96) |
| num\_missions |  |  | 4.09e-03 |  |
|  |  |  | (0.15) |  |
| s\_num\_missions |  |  |  | -1.00e-02 |
|  |  |  |  | (0.36) |
| num\_missions\_i |  |  |  | 2.29e-01 |
|  |  |  |  | (2.75)\*\* |
| \_cons | -1.27e+01 | -2.19e+01 | -2.35e+01 | -1.92e+01 |
|  | (5.48)\*\* | (5.62)\*\* | (6.78)\*\* | (1.92)+ |
| *N* | 2,493 | 2,493 | 2,462 | 2,462 |

**Additional Control Variables**

Interaction Eigenvalue Centrality and Real Income We also consider possible interaction between the effects of eigenvalue centrality and real income. Possibly, rich countries with low centrality scores are particularly reluctant to contribute to peacekeeping, or poor countries with high policy complementarities are especially supportive. The first model in Table A.4 includes the interaction term *rgdp\_pc\*eigen*, and Figure A.1 plots the marginal effect of *rgdp\_pc* on *prop\_troop* for different values of *eigen*. For low to medium values of *eigen,* *rgdp\_pc* does indeed have a negative effect on proportionate contributions, although the effect in only marginally significant for low values of *eigen*. This provides some support for the idea that foreign policy goals mediate the financial incentives of poorer countries.

Table A.IV Proportionate contribution of troops to UN peacekeeping operations 1990 – 2011, GLS with AR(1) disturbances - additional models

|  |  |  |  |
| --- | --- | --- | --- |
|  | prop\_troop | prop\_troop | prop\_troop |
| eigen | 1.44e+00 | 1.76e+00 | 1.41e+00 |
|  | (2.79)\*\* | (3.21)\*\* | (3.29)\*\* |
| eigen\_sq | -1.08e+01 | -1.18e+01 | -9.56e+00 |
|  | (3.10)\*\* | (3.07)\*\* | (3.18)\*\* |
| rgdppcB | -5.70e-07 | -7.23e-08 | -5.64e-08 |
|  | (1.85)+ | (1.78)+ | (1.73)+ |
| c.rgdppcB#c.eigen | 7.56e-06 |  |  |
|  | (1.72)+ |  |  |
| Distw | -2.70e-07 | -3.00e-07 | -2.24e-07 |
|  | (2.65)\*\* | (2.36)\* | (2.20)\* |
| US | 3.46e-02 | 3.26e-02 | 2.67e-02 |
|  | (4.86)\*\* | (4.01)\*\* | (3.98)\*\* |
| polity2B | 2.34e-04 | 1.82e-04 | 1.30e-04 |
|  | (4.81)\*\* | (2.89)\*\* | (2.73)\*\* |
| Comcol | 4.87e-03 | 4.76e-03 | 4.17e-03 |
|  | (3.07)\*\* | (2.51)\* | (2.70)\*\* |
| col45 | 4.00e-02 | 3.83e-02 | 3.65e-02 |
|  | (6.41)\*\* | (5.51)\*\* | (6.04)\*\* |
| ratio\_pop | 2.57e-05 | 1.68e-05 | 1.76e-05 |
|  | (2.96)\*\* | (1.74)+ | (2.09)\* |
| num\_missions |  | 4.27e-03 | 4.02e-03 |
|  |  | (17.83)\*\* | (20.41)\*\* |
| r\_dyadic\_trade |  | -3.37e-07 |  |
|  |  | (1.18) |  |
| Defense |  |  | 1.20e-03 |
|  |  |  | (0.78) |
| \_cons | -4.26e-02 | -6.12e-02 | -4.85e-02 |
|  | (2.20)\* | (3.13)\*\* | (3.17)\*\* |
| *N* | 45,678 | 33,676 | 45,678 |



Figure A.1. Marginal effects on Wealth (*rgdp\_pc*) on Proportion of Troop Provided (*prop\_troop*) conditional of Policy Centrality (*eigen*) with 90% Confidence Intervals.

Trade and Alliance Linkages Apart from historical linkages, trade and alliances provide links between countries providing peacekeepers and the countries where the missions take place. Date on trade are from the Correlates of War (COW) project Trade Dataset V.3 (Barbieri, Keshk & Pollins, 2009) The COW Project Formal Alliance Dataset V4.1 (Gibler, 2009) is used to construct dummies for different types of formal alliances. The second and third models in Table A.4 include total dyadic trade (measures in year 2005 USD) (Barbieri, Keshk & Pollins, 2009), but it is not significant when added to the basic model. Otherwise the results are quite robust, although there is some loss of degrees of freedom as the trade data only covers the period up to 2009. Further, we included dummies for defense alliances (Gibler, 2009) and this does not affect the other coefficients.

Policy Position We have explored whether policy positions rather than complementarities matter. Figure A.2 gives the distribution of ideal point; we observe a bimodal distribution with both modes close to zero. In calculating policy centrality score, we note that a dyad has a score of 0 if estimated positions are maximally dissimilar. We added .000000001 to all scores, as the Stata centrality algorithm cannot deal with zero values.



Figure A.2. Distribution of policy ideal points, 1990-2011.

Table A.V Proportionate contribution of troops to UN peacekeeping operations 1990 – 2011, GLS with AR(1) disturbances - additional models policy position

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | prop\_troop | prop\_troop | prop\_troop | prop\_troop |
| abs\_idealpointB | 3.05e-04 |  |  |  |
|  | (0.44) |  |  |  |
| idealpointB |  | -7.89e-04 |  |  |
|  |  | (1.58) |  |  |
| idealpointB\_sq |  | -8.19e-05 |  |  |
|  |  | (0.21) |  |  |
| similarityAB |  |  | -4.60e-04 | -7.85e-05 |
|  |  |  | (1.08) | (0.17) |
| rgdppcB | -7.23e-08 | -5.23e-08 | -5.75e-08 | -4.71e-08 |
|  | (2.30)\* | (1.59) | (1.91)+ | (1.49) |
| Distw | -2.27e-07 | -2.51e-07 | -1.93e-07 | -2.01e-07 |
|  | (2.29)\* | (2.54)\* | (2.02)\* | (2.09)\* |
| US | 1.08e-02 | 1.36e-02 | 1.22e-02 | 2.73e-02 |
|  | (2.14)\* | (2.41)\* | (2.50)\* | (4.15)\*\* |
| polity2B | 1.27e-04 | 1.58e-04 | 1.06e-04 | 1.08e-04 |
|  | (2.67)\*\* | (3.04)\*\* | (2.25)\* | (2.28)\* |
| comcol | 4.27e-03 | 4.02e-03 | 2.93e-03 | 2.98e-03 |
|  | (2.77)\*\* | (2.60)\*\* | (1.88)+ | (1.91)+ |
| col45 | 3.48e-02 | 3.58e-02 | 4.14e-02 | 4.27e-02 |
|  | (5.77)\*\* | (5.90)\*\* | (6.76)\*\* | (6.96)\*\* |
| ratio\_pop | 1.74e-05 | 1.71e-05 | 1.70e-05 | 1.68e-05 |
|  | (2.07)\* | (2.03)\* | (2.08)\* | (2.06)\* |
| num\_missions | 4.04e-03 | 4.04e-03 | 3.98e-03 | 3.95e-03 |
|  | (20.61)\*\* | (20.61)\*\* | (20.48)\*\* | (20.24)\*\* |
| eigen |  |  |  | 1.42e+00 |
|  |  |  |  | (3.32)\*\* |
| eigen\_sq |  |  |  | -9.56e+00 |
|  |  |  |  | (3.20)\*\* |
| \_cons | 3.00e-03 | 3.05e-03 | 3.31e-03 | -4.92e-02 |
|  | (2.96)\*\* | (3.33)\*\* | (3.65)\*\* | (3.18)\*\* |
| *N* | 45,678 | 45,678 | 42,143 | 42,143 |

We find no empirical support for the idea that countries in the center of the global ideological spectrum contribute more peacekeepers. Countries with moderate spatial ideal points do not contribute a higher proportion of troops. Neither the linear functional form of absolute ideal point nor the nonlinear functional form—by controlling for the quadratic of absolute ideal points—is significant. Secondly, we explore whether countries countribute more if their spatial position is more similar to that of the country where the mission takes places, but the similarity of policy positions between the sender and receiver countries is not significant.

**Spatial Lags**

Arguably, some spatial lag could be called for, because our theoretical intuition suggests for an interdependent decision-making process --- a country i is more likely to contribute when a like-minded country has done so. We have created the following spatial lags. Take two countries that were involved in sending troops at some point in the data set, B1 and B2. For B1 in a particular mission year SL\_prop\_troop is the sum across other countries in the data set, B2 of their proportion of contributions to that mission in the previous year weighted by the similarity between their spatial ideal point and that of B1. To be able to estimate these models, we use spatial OLS: it is impossible to generate a weighting matrix big enough to use the spatial ML code we’ve got. Using spatial OLS, you have to lag the values of the dependent variable by one year (Gleditsch and Ward) to prevent endogeneity. Table A.VI gives the models with the spatial lag. We find that there is a marginally significant positive effect: when other countries with similar preferences contribute more, so do you. Controlling for eigen and eigen-sq, the spatial lag is still positive but only marginally significant. Eigen and eigen\_sq remain significant at 95% with similar coefficient vales to the baseline model (allowing for loss of degrees of freedom). We can reasonably conclude that the equilibrium prediction relating to eigen isn’t improved by including an additional spatial lag. Note the loss of degrees of freedom. This is due to temporal lagging when generating the spatial lag.

Table A.V Proportionate contribution of troops to UN peacekeeping operations 1990 – 2011, GLS with AR(1) disturbances - spatial lags

|  |  |  |
| --- | --- | --- |
|  | prop\_troop | prop\_troop |
| SL\_prop\_troop | 4.14e-04 | 3.86e-04 |
|  | (0.85) | (0.75) |
| eigen |  | 1.22e+00 |
|  |  | (2.48)\* |
| eigen\_sq |  | -8.12e+00 |
|  |  | (2.31)\* |
| rgdppcB | -8.50e-08 | -6.70e-08 |
|  | (2.67)\*\* | (1.95)+ |
| distw | -2.67e-07 | -2.81e-07 |
|  | (2.58)\*\* | (2.65)\*\* |
| US | 1.20e-02 | 2.59e-02 |
|  | (2.29)\* | (3.56)\*\* |
| polity2B | 1.23e-04 | 1.31e-04 |
|  | (2.46)\* | (2.54)\* |
| comcol | 3.70e-03 | 3.70e-03 |
|  | (2.28)\* | (2.25)\* |
| col45 | 2.78e-02 | 2.93e-02 |
|  | (4.37)\*\* | (4.55)\*\* |
| ratio\_pop | 1.50e-05 | 1.50e-05 |
|  | (1.69)+ | (1.68)+ |
| num\_missions | 3.62e-03 | 3.62e-03 |
|  | (18.19)\*\* | (17.94)\*\* |
| eigen |  | 1.22e+00 |
|  |  | (2.48)\* |
| eigen\_sq |  | -8.12e+00 |
|  |  | (2.31)\* |
| \_cons | 3.87e-03 | -4.20e-02 |
|  | (4.17)\*\* | (2.41)\* |
| *N* | 42,376 | 41,153 |

**Additional References**

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