Online Appendix to Accompany "Shifting Sands: How Change-Point and Community Detection Can Enrich our Understanding of International Politics"

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Robustness of Method to Changes in Network Size

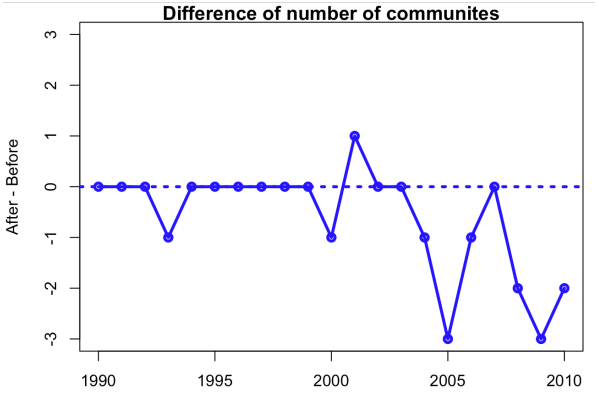
In order to investigate the potential impact of network size on our results, we conducted experiments by successively removing the top 5, 10 countries with the lowest degrees and comparing these outcomes with the original dataset. In this context, we identify the change points in the network series' structure and detect the community labels within each network. To assess the robustness of our method, we analyze the variations in three key metrics before and after the exclusion of certain countries: (1) change point locations, (2) the count of communities in each year, and (3) the assignment of community labels to each country for each year.

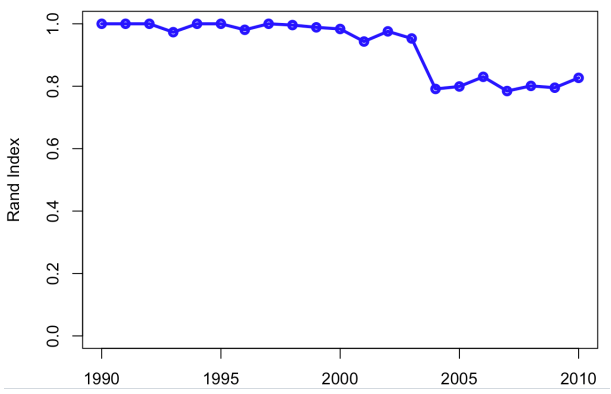
The 10 countries with the averaged lowest degrees across 20 years are listed by rank: Dominican Republic, Panama, Somalia, Comoros, Maldives, Guyana, Ireland, Malawi, Liberia, Sierra Leone.

As evident from the table below, when we exclude the top 5 countries with the fewest degrees, the change point remains consistent with the original dataset. When the top 10 countries are removed, the year of the second change point differs, while the four-stage structure remains unchanged.

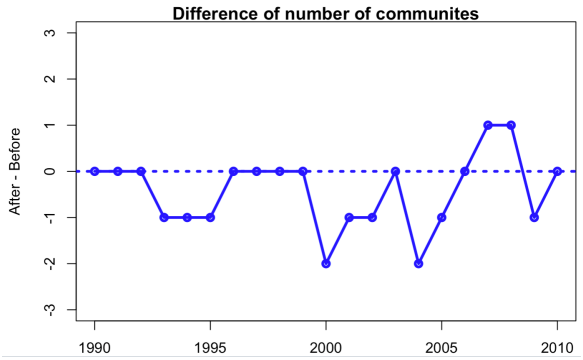
Countries	Change point year (starting year of each stage)
ALL (original)	1994, 1999, 2006
Top 5 removed	1994, 1999, 2006
Top 10 removed	1996, 2001, 2006

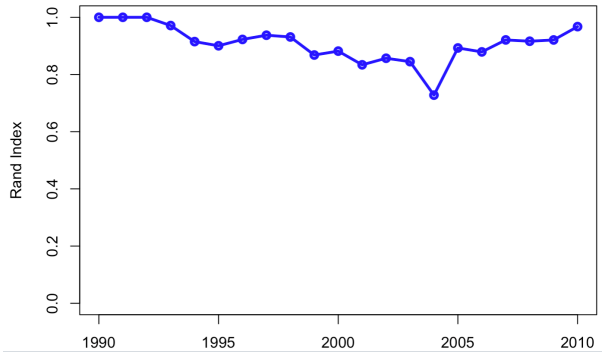
Top 5 countries removed:





Top 10 countries removed:


Difference of number of communites
After - Before
3
2
1
0
-1
-2
-3
1990
1995
2000
2005
2010


Rand Index
1.0
0.8
0.6
0.4
0.2
0.0
1990
1995
2000
2005
2010

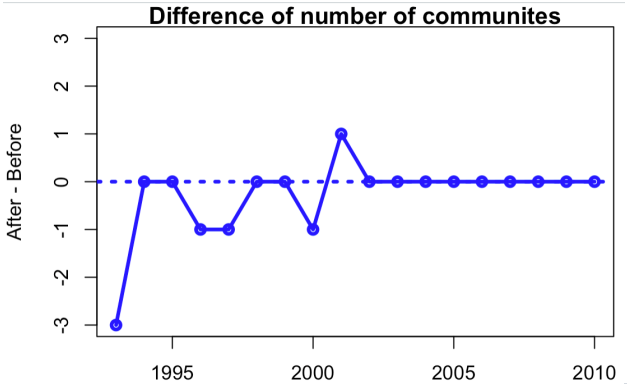
Robustness of Method to Changes in Temporal Period Covered

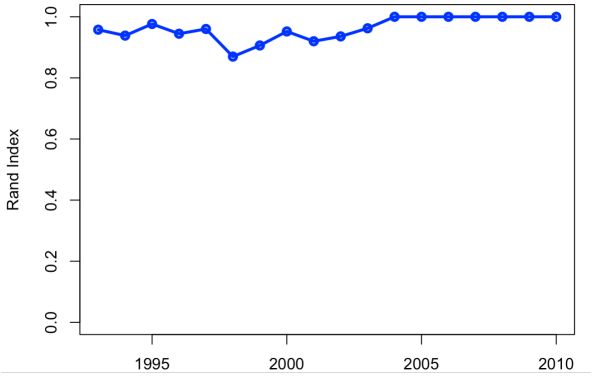
To conduct a robustness analysis involving variations in the time span, we apply our method to five different time spans by excluding the initial 3, 4, and 5 years, as well as the last 3 and 4 years, respectively. These time spans correspond to the following periods: Year 1993-2010, Year 1994-2010, Year 1995-2010, Year 1990-2007, and Year 1990-2006. In this context, we identify the change points in the network series' structure and detect the community labels within each network. To assess the robustness of our method, we examine the differences in three metrics before and after excluding certain years: (1) change point location, (2) the count of communities in each year, and (3) the assignment of community labels to each country in each year. The results are presented below:

Time period	Change point year (starting year of each stage)
1990-2010 (original)	1994, 1999, 2006
1993-2010	1994, 1999, 2006
1994-2010	1994, 1999, 2005
1995-2010	1994, 1999, 2005
1990-2007	1994, 1999, 2006
1990-2006	1994, 1999, 2006

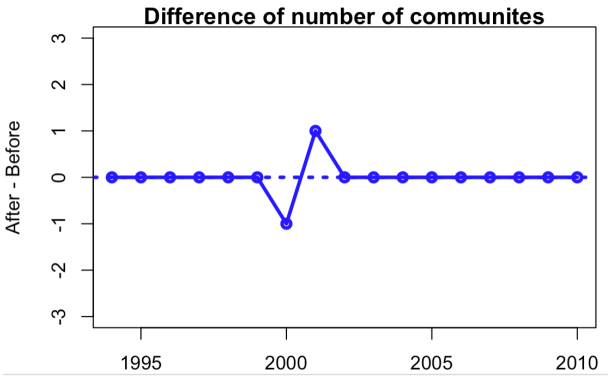
We then calculate the difference of the number of communities in each year, and the rand index of the country's community labels in each year before and after changing the time spans.

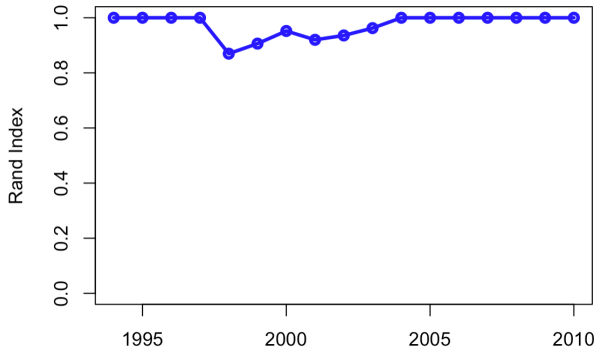
Time period 1993-2010:



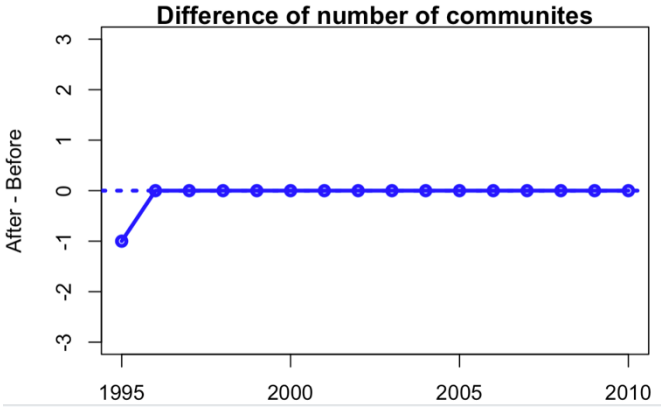


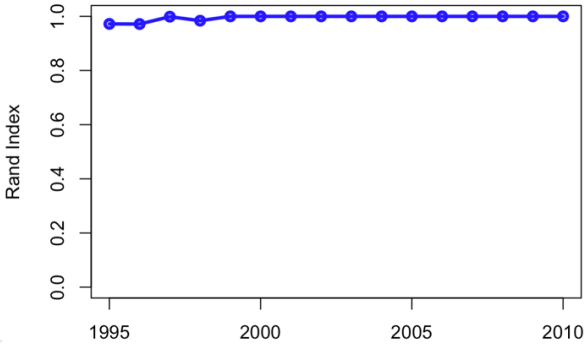
Time period 1994-2010:



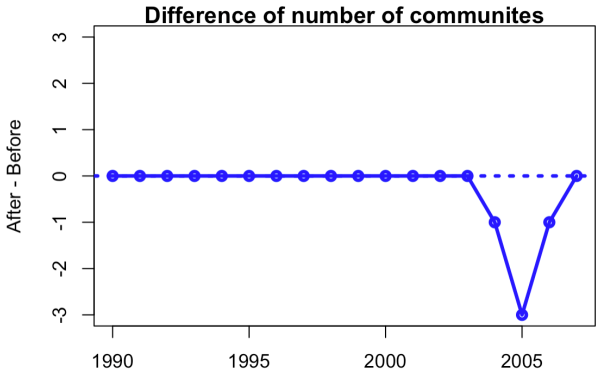


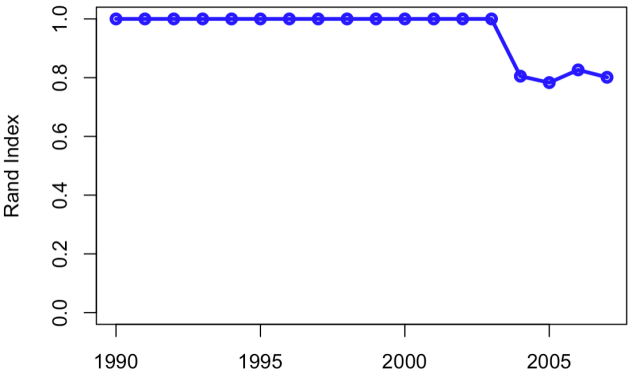
Time period 1995-2010:



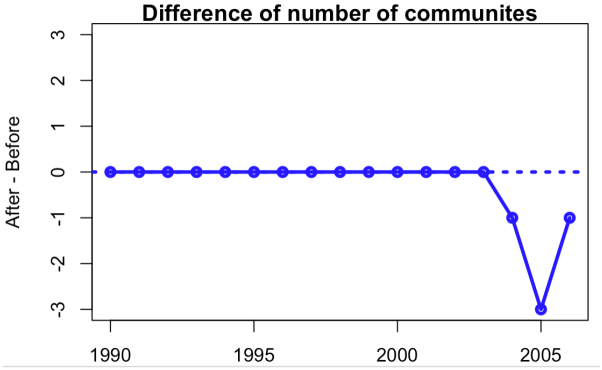


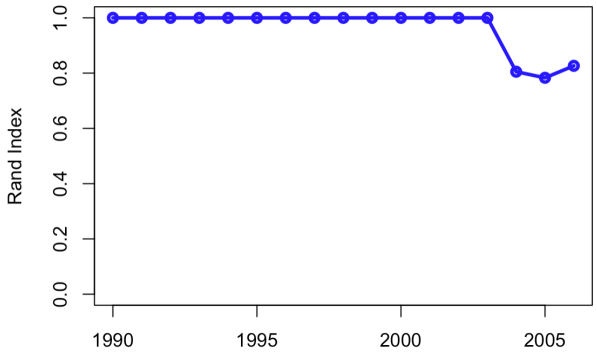
Time period 1990-2007:





Time period 1990-2006:

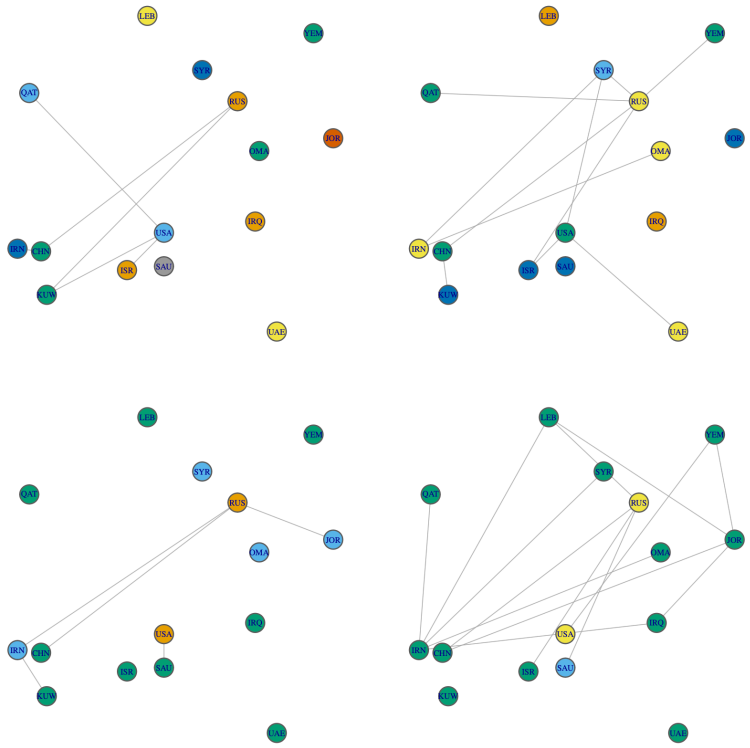




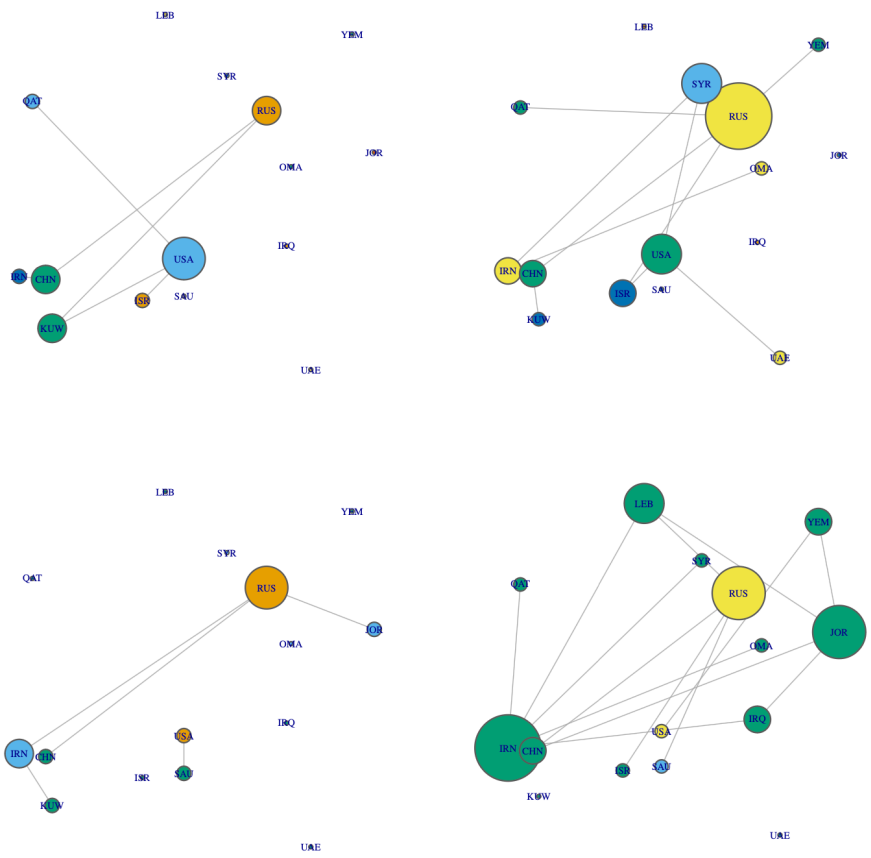
Middle East Example

we have looked at the Middle East as a region. We isolated the Middle Eastern countries from the original dataset, which includes Lebanon, Syria, Iraq, Iran, Israel, Jordan, Saudi Arabia, Kuwait, Qatar, United Arab Emirates, Oman, and Yemen. Alongside these Middle Eastern countries, we have also included the three major countries, namely the USA, China, and Russia. Below, you will find the community detection plot for these four stages:

Without node degree:



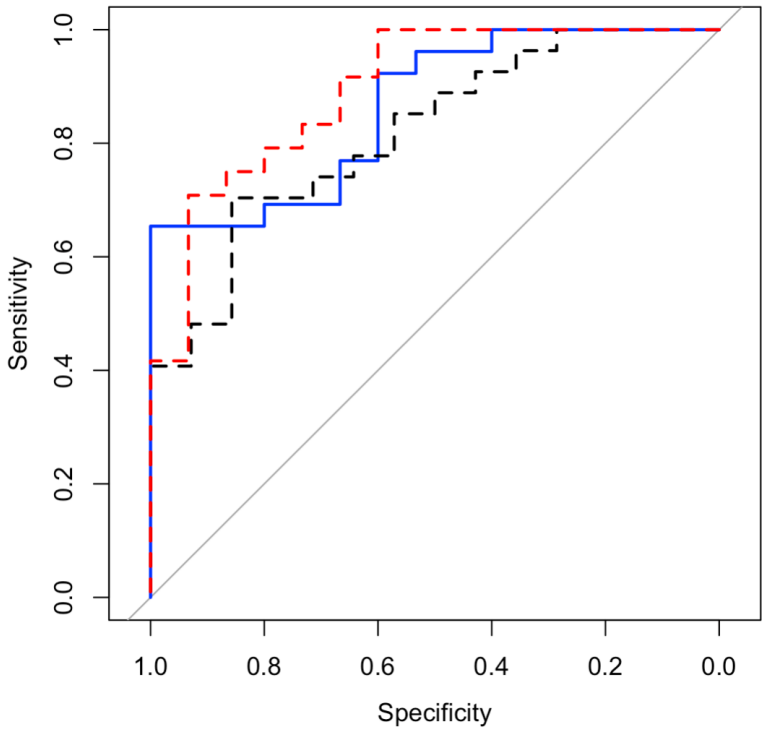
With node degree:



As shown, the Middle East example shows the growth of Russian and Chinese influence over time, as well as the strengthening of a community between Lebanon, Iran, and Jordan. We think this exercise helps show the potential of this new method.

AUC of Final Model

AUC-ROC Curve, Predicting Shifters Across Communities at Change-Points



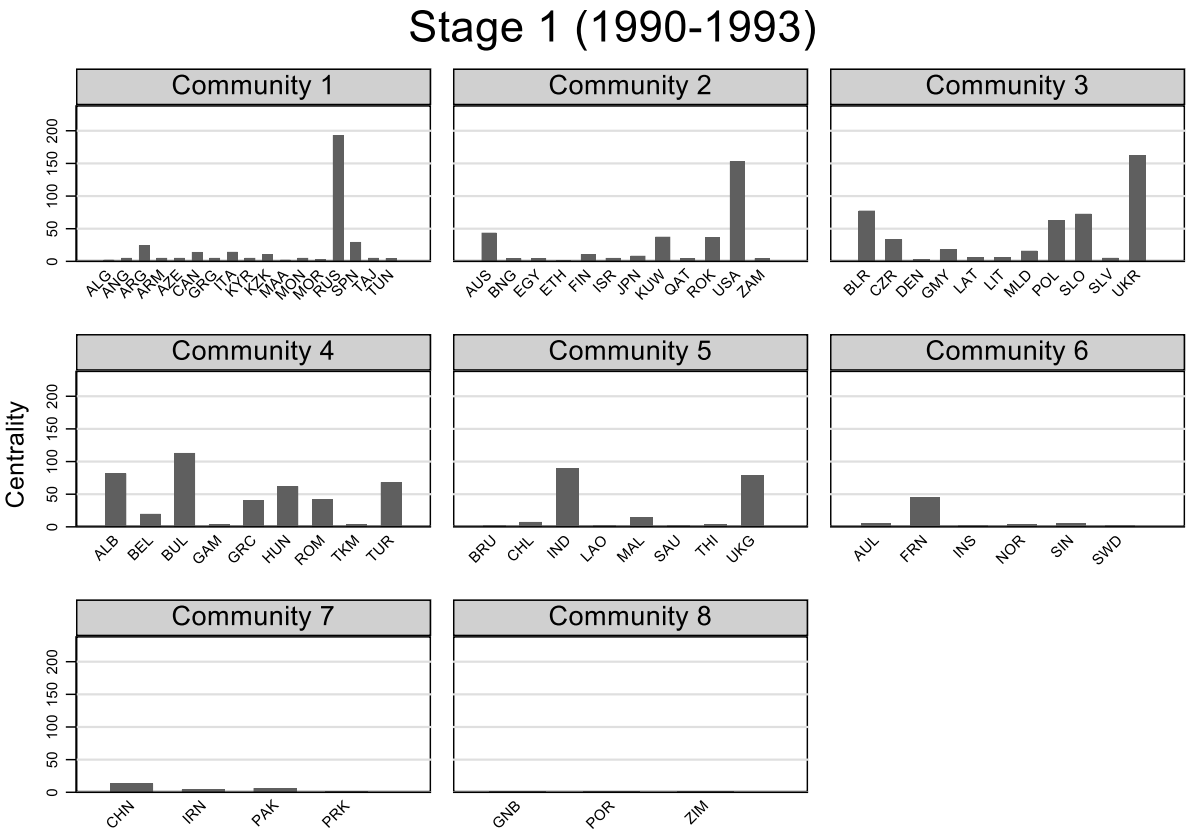
Logistic Regression Results

coefficients	
intercept	4.36399
fh_polity2	-0.55038
atop_number	-0.06679
bicc_milper	0.79085

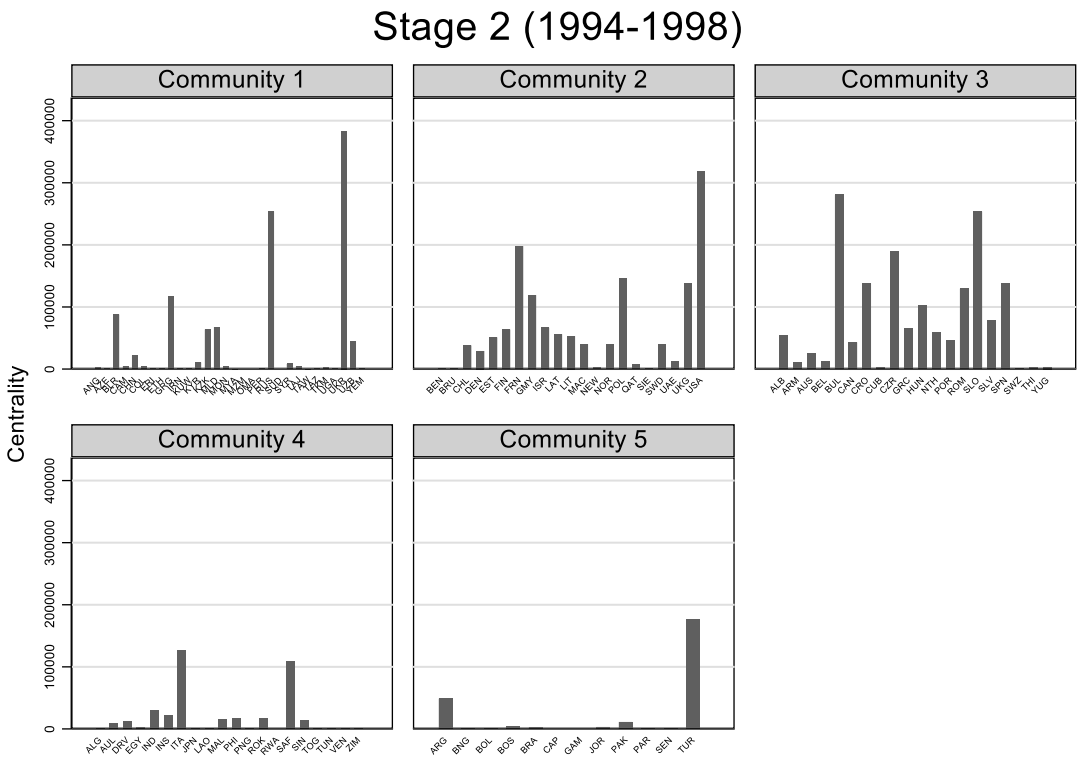
```
Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)  4.36399    1.00286   4.352 1.35e-05 ***
fh_polity2  -0.55038    0.10156  -5.419 5.99e-08 ***
atop_number -0.06679    0.02259  -2.957  0.00311 **
bicc_milper  0.79058    0.39467   2.003  0.04516 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Communities and Country-Level Subgroup Centrality

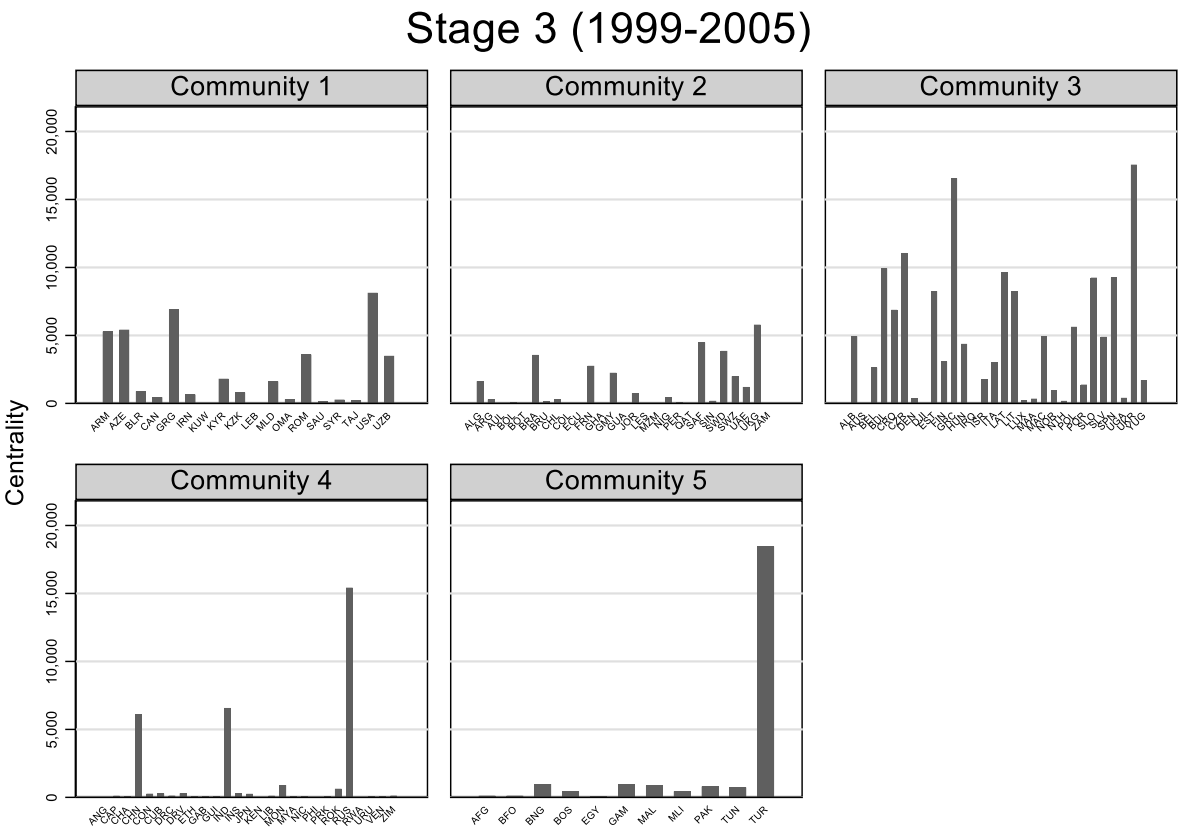
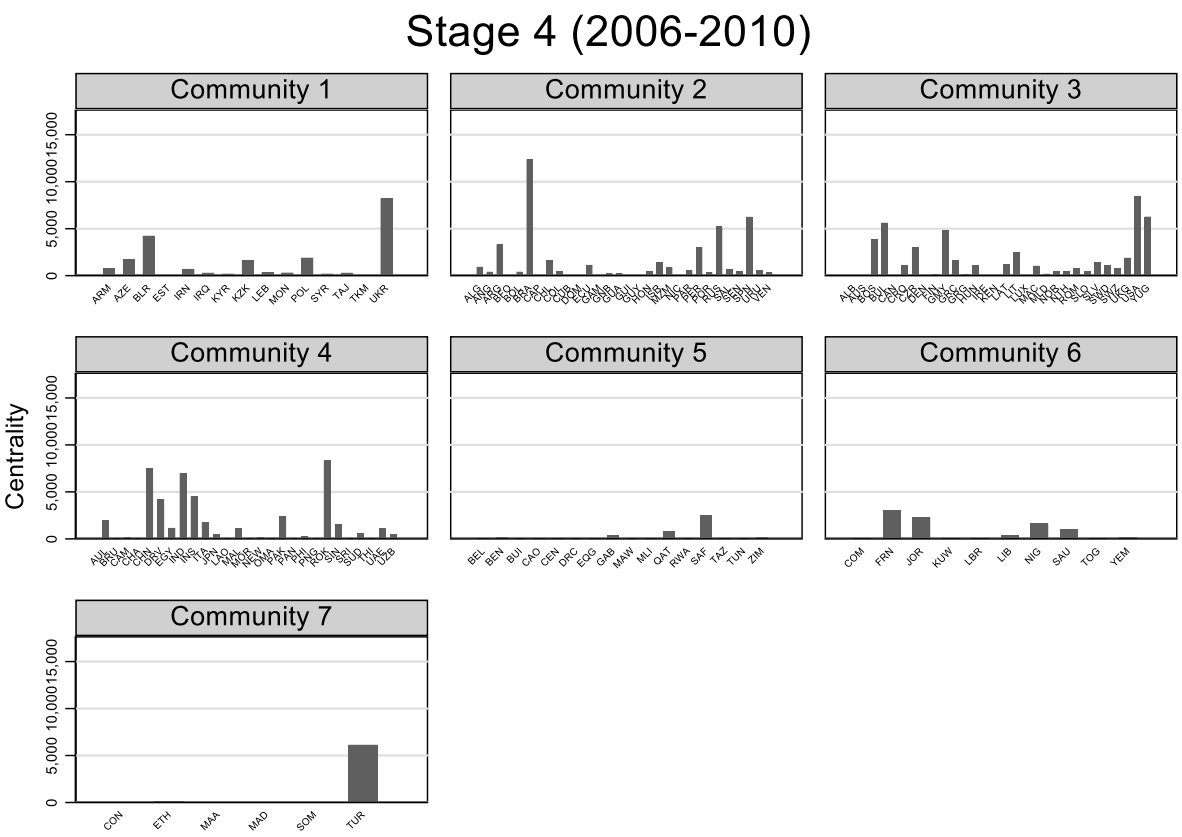
Communities and Country-Level Subgroup Centrality in Stage 1 (1990-1993)



Communities and Country-Level Subgroup Centrality in Stage 2 (1994-1998)



Communities and Country-Level Subgroup Centrality in Stage 3 (1999-2005)



Communities and Country-Level Subgroup Centrality in Stage 4 (2006-2010)