"Social Network Structures and the Politics of Public Goods Provision: Evidence from the Philippines"

Online Appendix

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A Variables Definition

A.1 Network Measures

Edge Betweenness Centrality

Edge betweenness centrality is the extent to which an edge (marriage between 2 families) serves as a link between different groups of families. It assesses centrality by looking at whether the edge is an important hub in the paths traversing the network and is calculated using the number of shortest paths in the network that necessarily pass through the edge. This measure is analogous to betweenness centrality, which considers the relative importance of a node in the paths traversing the network (Freeman, 1977).

In the family network f, let $P_e(kj)$ indicate the number of shortest paths between family k and family j that necessarily pass through edge e, while $P(kj)$ is the total number of shortest paths between k and j.

The ratio $P_e(kj)/P(kj)$ approximates the importance of edge e in connecting k and j. If $P_e(kj) = P(kj)$, yielding a ratio of 1, then edge e lies on all of the shortest paths connecting families k and j. Conversely, if $P_e(kj) = 0$, then the intermarriage represented by edge e is not important for connecting families k and j.

Edge betweenness centrality is calculated by averaging this ratio for the entire network.

$$Betweenness_e(f) = \sum \frac{P_e(kj)}{P(kj)} \tag{A1}$$

A.2 Effective Number of Candidates Indices

The Laakso and Taagepera (1979) index is given by $N = 1/\sum_{i=1}^{n} s_i^2$, where n is the number of candidates and s_i is the share of votes of candidate i.

The index by Golosov (2010) is defined as $N = \sum_{i=1}^{n} s_i/(s_i + s_1^2 - s_i^2)$, where s_1 is the vote share of the candidate with the largest number of votes.

A.3 Computing Indices, following Anderson (2008)

Here we explain how we compute our public goods and political competition indices. The public goods index aggregates dummies for whether the barangay has an elementary school, a high school, a public market, a health center or a community water system. The political competition index aggregates the win margin (vote share of the candidate that received the most votes in that precinct minus vote share of the runner-up in that precinct) and the number of candidates running in the race. We also use the indices of effective number of candidates, proposed by Laakso and Taagepera (1979) and Golosov (2010).

As carefully explained by Anderson (2008), we compute the public goods index and the electoral competition indices as follows:

1. For all outcomes (y_{ik}) in each of the two categories, switch signs where necessary so that the positive direction always indicates a *better* outcome.

2. Compute $z_{ik} = \frac{y_{ik} - \bar{y_k}}{\sigma_k^y}$, where $\bar{y_k}$ is the sample average and σ_k^y the standard deviation of y_{ik}.

3. Compute $s_i = (\mathbf{1'\hat{\Sigma}^{-1}1})^{-1}(\mathbf{1'\hat{\Sigma}^{-1}z_i})$, where $\mathbf{1}$ is a column vector of 1's. $\mathbf{\hat{\Sigma}^{-1}}$ is the inverted covariance matrix, and $\mathbf{z_i}$ is vector of all outcomes for individual i.

B Descriptive Statistics

Table A1: Describing our Sample

	(1) Sample	(2) National Average
Population	1,412.28	2,196.38
	(1535.37)	(4629.95)
Urban	0.11	0.24
	(0.31)	(0.43)
Religious diversity	0.20	0.21
	(0.22)	(0.20)
Ethnic diversity	0.18	0.21
	(0.23)	(0.24)
Elementary school	0.81	0.77
	(0.40)	(0.42)
High school	0.21	0.23
	(0.41)	(0.42)
Market	0.19	0.18
	(0.39)	(0.38)
Health centre	0.64	0.68
	(0.48)	(0.47)
Waterworks	0.60	0.62
	(0.49)	(0.49)

Source: 2010 Census. Column 1 reports the mean and standard deviation (in parenthesis) of the relevant variables for villages in our sample. Column 2 reports the mean and standard deviation (in parenthesis) of the relevant variables for villages in the country.

Table A2: Descriptive Statistics

	Mean	Std. Dev.	Median	Min	Max
Number of communities	45.89	(41.04)	34.00	1.00	614.00
Share largest community	0.13	(0.06)	0.12	0.02	1.00
Share 2nd largest community	0.10	(0.04)	0.10	0.02	0.50
Fractionalization (edge)	0.00	(1.00)	0.20	-21.98	1.46
Fractionalization (walktrap)	0.00	(1.00)	0.23	-14.69	1.30
Fractionalization (edge) 1st population tercile	-0.61	(1.25)	-0.35	-21.98	1.30
Fractionalization (edge) 2nd population tercile	0.09	(0.62)	0.19	-6.54	1.34
Fractionalization (edge) 3rd population tercile	0.51	(0.66)	0.60	-21.98	1.46
Elementary School	0.81	(0.40)	1.00	0.00	1.00
High School	0.21	(0.41)	0.00	0.00	1.00
Market	0.19	(0.39)	0.00	0.00	1.00
Health centre	0.64	(0.48)	1.00	0.00	1.00
Waterworks	0.60	(0.49)	1.00	0.00	1.00
Number of candidates barangay captain	2.17	(0.99)	2.00	1.00	21.00
Effective no. of candidates barangay captain (Laakso)	1.87	(0.69)	1.95	1.00	8.17
Effective no. of candidates barangay captain (Golosov)	1.67	(0.62)	1.70	0.00	7.36
Win margin (barangay captain elections)	36.92	(36.88)	19.89	0.07	100.00
Number of candidates barangay council	16.83	(7.03)	15.00	0.00	96.00

C Additional Results

Table A3: Fractionalization and Public Goods: Robustness to Excluding Outliers

	(1)	(2)	(3)	(4)
	Fractionalization:		Population:	
	1%	5%	1%	5%
Fractionalization	0.07**	0.06**	0.03**	0.02**
	(0.01)	(0.01)	(0.01)	(0.01)
Observations	15,147	13,908	15,133	13,888
R-squared	0.182	0.175	0.191	0.171

Notes: Results from village-level regressions with municipal fixed-effects. The dependent variable is an index capturing the availability of key public goods at the village-level (elementary schools, high schools, markets, health center and water systems). In Column 1, we remove all villages in the top and bottom 1% of the distribution of fractionalization. In Column 2, we remove all villages in the top and bottom 5% of the distribution of fractionalization. In Column 3, we remove all villages in the top and bottom 1% of the distribution of population. In Column 4, we remove all villages in the top and bottom 5% of the distribution of population. Regressions control for village-level average age, average length of stay in the village, gender ratio, village population, the number of distinct families in the village, whether the village is classified as rural, as well as education levels in the village, occupation in the village and average per capita income and poverty incidence. Standard errors (in parentheses) are clustered by municipality. * $p < 0.05$, ** $p < .01$.

Table A4: Fractionalization and Public Goods: Robustness to Alternative Samples and Controls

	(1)	(2)	(3)	(4)	(5)	(6)
	Exclude:			Control for:		
	Urban	"Hometown"	ARMM	Incumbent Family	Incu. & Chall. Family	Ethnic & Relig. Fractionalization
Fractionalization	0.05**	0.05**	0.07**	0.06**	0.05**	0.05**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	13,740	10,921	13,147	9,704	8,746	15,445
R-squared	0.141	0.157	0.174	0.186	0.193	0.173

Notes: Results from village-level regressions with municipal fixed-effects. The dependent variable is an index capturing the availability of key public goods at the village-level (elementary schools, high schools, markets, health center and water systems). In Column 1, we drop all villages classified as urban. In Column 2, we drop villages where the incumbent has the most number of relatives. In Column 3, we drop all villages in ARMM from our sample. In Column 4, we further control for characteristics of the incumbent's family. In Column 5, we further control for characteristics of both the challenger and the incumbent's family. In Column 6, we further control for ethnic and religious fractionalization. Regressions control for village-level average age, average length of stay in the village, gender ratio, village population, the number of distinct families in the village, whether the village is classified as rural, as well as education levels in the village, occupation in the village and average per capita income and poverty incidence. Standard errors (in parentheses) are clustered by municipality. * $p < 0.05$, ** $p < .01$

Table A5: Ethnic and Religious Fragmentation, Public Goods and Elections

	(1)	(2)	(3)	(4)	(5)	(6)
	Public Goods			Electoral Competition		
Fractionalization*Below	0.05**	0.04**		0.06**	0.06**	
	(0.01)	(0.01)		(0.01)	(0.01)	
Fractionalization*Above	0.05**	0.07**		0.04**	0.05**	
	(0.02)	(0.01)		(0.01)	(0.01)	
Fractionalization			0.05**			0.01
			(0.01)			(0.02)
Sample	Full	Full	ARMM	Full	Full	ARMM
Interaction with:	Ethnic	Religious		Ethnic	Religious	
Observations	15,445	15,445	2,298	31,306	31,306	4,039
R-squared	0.170	0.170	0.217	0.016	0.016	0.013

Notes: Results from village-level regressions with municipal*election fixed-effects. In Columns 1 and 4 we interact the fractionalization variable with dummies capturing whether a village is below or above the median in the distribution of ethnic fractionalization. In Columns 2 and 5 we interact the fractionalization variable with dummies capturing whether a village is below or above the median in the distribution of religious fractionalization. In Columns 1-3, the dependent variable is an index capturing the availability of key public goods at the village-level (elementary schools, high schools, markets, health center and water systems). In Columns 4-6, the dependent variable is an index capturing the competitiveness of barangay elections (number of candidates for barangay captains, win margin and number of candidates for barangay councilors). Regressions control for village-level average age, average length of stay in the village, gender ratio, village population, the number of distinct families in the village, whether the village is classified as rural, as well as education levels in the village, occupation in the village and average per capita income and poverty incidence. Standard errors (in parentheses) are clustered by municipality. * $p < 0.05$, ** $p < .01$.

Table A6: Fractionalization and Political Competition: Robustness to Alternative Fractionalization Measures

	(1)	(2)	(3)	(4)	(5)
	Over 45		Communities Weighted by:		Walktrap
	OLS	IV	Family Size	# Voters	Algorithm
Fractionalization	0.06**	0.11**	0.05**	0.05**	0.04**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Observations	31,298	31,298	31,306	31,306	31,306
R-squared	0.016	0.014	0.015	0.015	0.015

Notes: Results from village*election-level regressions with municipal*election fixed-effects (OLS in Columns 1, 3-5 and 2SLS in Column 2). The dependent variable is an index capturing the competitiveness of barangay elections (number of candidates for barangay captains, win margin and number of candidates for barangay councilors). In Column 1 the fractionalization measure is computed using communities obtained on the network restricted to individuals over the age of 45. In Column 3, the fractionalization measure weights each community by total population in the family. In Column 4, the fractionalization measure weights each community by the number of members above the age of 18 in the family. In Column 5, the fractionalization measure is computed using communities obtained with the walktrap algorithm. Regressions control for village-level average age, average length of stay in the village, gender ratio, village population, the number of distinct families in the village, whether the village is classified as rural, as well as education levels in the village, occupation in the village and average per capita income and poverty incidence. Standard errors (in parentheses) are clustered by municipality. * $p < 0.05$, ** $p < .01$.

Table A7: Fractionalization and Political Competition: Robustness to Excluding Outliers

	(1)	(2)	(3)	(4)
	Fractionalization:		Population:	
	1%	5%	1%	5%
Fractionalization	0.07**	0.08**	0.05**	0.03**
	(0.01)	(0.01)	(0.01)	(0.01)
Observations	30,690	28,191	30,676	28,170
R-squared	0.016	0.019	0.016	0.016

Notes: Results from village*election-level regressions with municipal*election fixed-effects. The dependent variable is an index capturing the competitiveness of barangay elections (number of candidates for barangay captains, win margin and number of candidates for barangay councilors). In Column 1, we remove all villages in the top and bottom 1% of the distribution of fractionalization. In Column 2, we remove all villages in the top and bottom 5% of the distribution of fractionalization. In Column 3, we remove all villages in the top and bottom 1% of the distribution of population. In Column 4, we remove all villages in the top and bottom 5% of the distribution of population. Regressions control for village-level average age, average length of stay in the village, gender ratio, village population, the number of distinct families in the village, whether the village is classified as rural, as well as education levels in the village, occupation in the village and average per capita income and poverty incidence. Standard errors (in parentheses) are clustered by municipality. * $p < 0.05$, ** $p < .01$.

Table A8: Fractionalization and Political Competition: Robustness to Alternative Samples and Controls

	(1)	(2)	(3)	(4)	(5)	(6)
		Exclude:			Control for:	
	Urban	"Hometown"	ARMM	Incumbent Family	Incu. & Chall. Family	Ethnic & Relig. Fractionalization
Fractionalization	0.05**	0.05**	0.07**	0.05**	0.05**	0.05**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	27,249	21,704	27,267	19,703	17,777	31,306
R-squared	0.019	0.017	0.021	0.021	0.027	0.016

Notes: Results from village-level regressions with municipal fixed-effects. The dependent variable is an index capturing the competitiveness of barangay elections (number of candidates for barangay captains, win margin and number of candidates for barangay councilors). In Column 1, we drop all villages classified as urban. In Column 2, we drop villages where the incumbent has the most number of relatives. In Column 3, we drop all villages in ARMM from our sample. In Column 4, we further control for characteristics of the incumbent's family. In Column 5, we further control for characteristics of both the challenger and the incumbent's family. In Column 6, we further control for ethnic and religious fractionalization. Regressions control for village-level average age, average length of stay in the village, gender ratio, village population, the number of distinct families in the village, whether the village is classified as rural, as well as education levels in the village, occupation in the village and average per capita income and poverty incidence. Standard errors (in parentheses) are clustered by municipality. * $p < 0.05$, ** $p < .01$

Table A9: Electoral Competition and Public Goods Provision

	(1)	(2)	(3)	(4)	(5)
Electoral Competition	0.03**	0.01*	0.01*	0.01*	0.01*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	31,345	31,306	31,306	31,306	31,306
R-squared	0.002	0.152	0.166	0.170	0.172

Notes: Results from village*election-level regressions with municipal*election fixed-effects. The dependent variable is an index capturing the availability of key public goods at the village-level (elementary schools, high schools, markets, health center and water systems). The main independent variable is an index capturing the competitiveness of barangay elections (number of candidates for barangay captains, win margin and number of candidates for barangay councilors). In Columns 2-5, we control for village-level average age, average length of stay in the village, gender ratio, village population, the number of distinct families in the village , whether the village is classified as rural. In Columns 3-5, regressions also control for education levels in the village. In Column 4-5, regressions also control for occupation in the village. In Column 5, regressions also control for average per capita income and poverty incidence. Standard errors (in parentheses) are clustered by municipality. * $p < 0.05$, ** $p < .01$.

References

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