14.75: Collective Action Lecture 1

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Collective Action

- Each of you has \$5
- You can choose how much to keep and how much to put into the pot. You put c into the pot and keep $\$5 - c$.
- I will triple whatever is in the pot, and then divide it back among all of you.
- I will randomly select one of you to be the winner. If you are the winner, you will get paid

$$5 - c_i + 3 \times \frac{1}{N} \sum_j c_j$$

  Clear?
- We will do this 5 times, and then I'll randomly select one of the 5 rounds, and 1 person, and pay them.
- For each round, please write your name, round number, and contribution on it. The class will only know the distribution of contributions but they will be anonymous. (We need your name to pay you).

Discussion

- What did you observe?

Overview

- Collective action failures stem from misalignment of private and collective incentives
- In the developing world, this manifests itself in many ways. Thoughts?
  - Insufficient provision of local public goods
    - Roads, schools, health clinics, security, forest protection, etc
  - Insufficient monitoring of local officials
    - Teachers and health workers not coming to work
    - Local officials stealing funds from central government projects
- How does this relate to the experiment we just did?

Public goods

- What was the game we just solved?
- Each individual maximizes

$$5 - c_i + 3 \times \frac{1}{N} \sum_j c_j$$

- How do we solve this?
- Individual i solves

$$\max_{c_i} 5 - c_i + 3 \times \frac{1}{N} \sum_j c_j$$

- So individual i's payoff is

$$5 + \frac{3}{N} \sum_{j \neq i} c_j + \frac{3}{N} c_i - c_i$$

- This is increasing in c_i if $N < 3$ and decreasing in c_i if $N > 3$.

Public goods

- So if $N < 3$ the equilibrium is? If $N > 3$ the equilibrium is? What about if $N = 3$?
- Why do contributions depend on N?
- What about total contributions?
- Total contributions are Nc_i.
  - If $N < 3$, total contributions are increasing in N.
  - If $N > 3$, total contributions are 0.

Interior solutions

- Note that in the previous model the first order condition was always positive or negative – so you always contributed either everything or nothing (or were indifferent)
- We can easily make the model smooth by changing the objective function a bit
- Now suppose that I will rebate to everyone

$$\frac{3}{N}\sum_j \sqrt{c_j}$$

so each individuals payoff is

$$5 - c_i + \frac{3}{N}\sum_j \sqrt{c_j}$$

- How is this different?

Interior solutions

$$5 - c_i + \frac{3}{N}\sum_j \sqrt{c_j}$$

- The marginal return for individual i is

$$\frac{3}{2N}\frac{1}{\sqrt{c_i}} - 1$$

- So as $c_i \longrightarrow 0$ the marginal return goes to ∞. So, you'll always contribute something.

Interior solutions

- Solving this model, we have that the FOC is

$$\begin{aligned}
\frac{3}{2N}\frac{1}{\sqrt{c_i}} - 1 &= 0 \\
\frac{3}{2N}\frac{1}{\sqrt{c_i}} &= 1 \\
\sqrt{c_i} &= \frac{3}{2N} \\
c_i &= \left(\frac{3}{2N}\right)^2
\end{aligned}$$

Interior solutions

$$c_i = \left(\frac{3}{2N}\right)^2$$

- Total contributions are

$$\begin{aligned} Nc_i &= N\left(\frac{3}{2N}\right)^2 \\ Nc_i &= \left(\frac{3}{2}\right)^2 \frac{1}{N} \end{aligned}$$

- So in this model, total contributions decrease with N.

Interior solutions

- Are you sensing any patterns about contributions?
- The idea that contributions per individual fall as N increases is a very general feature of these types of models. The reason is that a given individuals' marginal return from contributing is decreasing in N.
- However, what happens to total contributions – Nc_j – is in general ambiguous and depends on the model. Just depends on whether individual contributions fall with N faster than $\frac{1}{N}$ or slower than $\frac{1}{N}$.

Variants

- Two more tweaks:
- What if everyone needs to contribute fully for their to be a refund?
  - I.e. suppose that if $c_j = 5$ for all j, then payoff is $5 + 15 - c_i$; otherwise payoff is $5 - c_i$
  - What is the equilibrium?
  - There are two equilibria
  - $c_j = 0$. Why is this an equilibrium?
  - $c_j = 5$. Why is this an equilibrium?

Variants

- What if we need at least k people to contribute fully for their to be a refund?
  - I.e. suppose that if $c_j = 5$ for at least k individuals, then payoff is $5 + 15 - c_i$; otherwise payoff is $5 - c_i$
  - What is the equilibrium?
  - There are two pure strategy equilibria
  - $c_j = 0$ for everyone. Why is this an equilibrium?
  - $c_j = 5$ for k people and $c_j = 0$ for everyone else. Why is this an equilibrium?
- In reality, which do you think is easier to harder to organize?

A slightly more general model

Banerjee, Iyer, and Somanathan (2007)

- Olson (1965): "the larger the group, the less it will be able to favor its common interests."
- Let

$$f(\sum^{n} a_i) = [\sum^{n} a_i]^{\alpha}, 0 < \alpha < 1$$

be the probability that a particular collective effort succeeds. a_i is the effort of group member i, and assume that there are n group members.

- Let everyone benefit an amount b from the success of the effort.
- Let the cost of the effort be $v(a) = a^{\beta}, \beta > 1$.
- Then a group member will maximize

$$b[\sum^{n} a_i]^{\alpha} - a_i^{\beta}$$

- Then a_i will satisfy

$$\alpha b[\sum^{n} a_i]^{\alpha-1} = \beta a_i^{\beta-1}$$

Collective action and group size

- So in equilibrium

$$\begin{aligned} \alpha b[na]^{\alpha-1} &= \beta a^{\beta-1} \\ \alpha b &= \beta n^{1-\alpha} a^{\beta-\alpha} \end{aligned}$$

- Denote $A^e = na$, the total equilibrium collective effort. Then

$$\begin{aligned} \alpha b &= \beta n^{1-\alpha} a^{\beta-\alpha} \\ \alpha n^{\beta-1} b &= \beta (A^e)^{\beta-\alpha} \\ \frac{\alpha n^{\beta-1} b}{\beta} &= (A^e)^{\beta-\alpha} \\ A^e &= \left(\frac{\alpha n^{\beta-1} b}{\beta} \right)^{\frac{1}{\beta-\alpha}} \\ A^e &= k n^{\frac{\beta-1}{\beta-\alpha}} \end{aligned}$$

- So A^e – total group effort – is increasing in n since $\beta > 1$ and $0 < \alpha < 1$.

Optimal effort

- Recall that an individual group member maximizes

$$b[\sum^{n} a_i]^{\alpha} - a_i^{\beta}$$

- By contrast, the socially optimal choice of effort maximizes

$$nb[\sum^{n} a_i]^{\alpha} - \sum^{n} a_i^{\beta}$$

- How is this different?
- This tells us that

$$n\alpha b[na]^{\alpha-1} = \beta a^{\beta-1}$$

Hence the optimal social effort A^o satisfies

$$\alpha n^{\beta} b = \beta (A^o)^{\beta-\alpha}$$

Optimal vs. actual effort

- Recall
$$\alpha n^{\beta-1} b = \beta (A^e)^{\beta-\alpha}$$
- and
$$\alpha n^{\beta} b = \beta (A^o)^{\beta-\alpha}$$
- Which implies
$$\frac{1}{n} = \left(\frac{A^e}{A^o}\right)^{\beta-\alpha}$$
- Hence A^e / A^o goes to zero as n goes to infinity.

Implications

- As before, collective action is harder per capita in larger groups because the misalignment of private and social incentives is larger.
- In this model however A^e is always increasing in n.
- To get at the possibility that A^e is actually declining in n, one option is to bring in the idea that smaller groups have higher stakes per capita.
- In other words we now introduce the idea that there is some private component in the returns from collective action.

Adding crowd-out

- A group member will now maximize

$$(b + \frac{w}{n})[\sum^{n} a_i]^{\alpha} - a_i^{\beta}$$

- So in equilibrium

$$\alpha(b + \frac{w}{n})[na]^{\alpha-1} = \beta a^{\beta-1}$$

and

$$\alpha(b + \frac{w}{n})[n]^{\beta-1} = \beta(A^e)^{\beta-\alpha}$$

- Clearly increasing n has two effects and the result can go either way
  - (e.g., $b = 0$ and $\beta < 2$ reverses the previous result)
- Intuitively there is more of a free rider problem in big groups but the bigger group has to put in less effort per capita to get to the same total effort.

Collective action and heterogeneity

- There is a few that it is harder to have collective action in heterogenous groups.
- Why might this be?
- We will explore several models of heterogeneity
- Suppose there are m groups each of size n_j. $mn_j = n$
- Assume that once again the public good has a public component and a private component, where private means that some group captures it. What might this be? E.g. location of a public good

Collective action and heterogeneity

- The probability of it being captured by group J conditional on the public good being built is

$$\frac{\sum_{i \in J} a_i}{\sum a_i}$$

- The payoff function is then

$$\begin{aligned} & (b + w \frac{\sum_{i \in J} a_i}{\sum a_i}) [\sum a_i]^{\alpha} - a_i^{\beta} \\ = \quad & b \left[\sum a_i\right]^{\alpha} + w \left[\sum_{i \in J} a_i\right] \left[\sum a_i\right]^{\alpha - 1} - a_i^{\beta} \end{aligned}$$

Collective action and heterogeneity

- At the optimum we will have

$$\begin{aligned} & \alpha b[\sum a_i]^{\alpha-1} + [\sum a_i]^{\alpha-1} w \\ & -(1-\alpha)\left[\sum_{i\in J} a_i\right][\sum a_i]^{\alpha-2} w \\ = \quad & \beta a_i^{\beta-1} \end{aligned}$$

or

$$\begin{aligned} & \alpha b A^{\alpha-1} + A^{\alpha-1} w - (1-\alpha)\frac{A}{m}[A]^{\alpha-2} w \\ = \quad & \beta a_i^{\beta-1} \end{aligned}$$

or

$$\begin{aligned} & \alpha b A^{\alpha-1} + A^{\alpha-1} w - (1-\alpha)\frac{1}{m}[A]^{\alpha-1} w \\ = \quad & \beta (A/n)^{\beta-1} \end{aligned}$$

Collective action and heterogeneity

- Recall that keeping n fixed, increasing m increases heterogeneity.
- We just showed that

$$\begin{aligned} \alpha b A^{\alpha-1} + A^{\alpha-1} w - (1-\alpha)\frac{1}{m}[A]^{\alpha-1} w &= \beta(A/n) \\ \alpha b + w - (1-\alpha)\frac{1}{m} w &= \beta(A/n)^{\beta-1} A^{1-\alpha} \end{aligned}$$

- So increasing m increases the left hand side of the equation. To balance, A must also increase.
- This shows that increasing m (i.e., increasing heterogeneity) increases A. Heterogeneity helps!Intuition?
- The intuition in this model is that the groups are competing with one another to capture the good, and the smaller each group is, the more you have an incentive to work.

Collective action and heterogeneity

- Intuition:
  - Group size in this framework matters only because your incentive to put in effort depends in part on what is happening in your group and bigger groups discourage effort.
  - So having smaller groups increases effort.
- In order to capture the intuition that heterogeneity hurts, we need to look for a context where the free-rider problem is not the big problem.
- Instead, we'll look at a context where the problem is heterogeneity in tastes

Collective action and heterogeneity

Alesina, Baqir, and Easterly (1999): "Public Goods and Ethnic Divisions"

- Key distinction between this model and the previous model: now there is a *type* of public good, not just an amount of public good
- Individual i utility function given by

$$u_i = g^{\alpha}(1 - l_i) + y - t$$

where g is amount of public good, and l_i is distance between individual's most preferred type of public good and the actual type of public good, y is income, and t is lump-sum taxes used to finance the public good. Assume $0 < \alpha < 1$.

- Normalize population size to one, so $g =$ t Rewrite utility as

$$u_i = g^{\alpha}(1 - l_i) + y - g$$

- Assume voters vote first on size of public good, and then vote on the type of the public good. In the second stage, type of good is the one preferred by the median voter.

Collective action and heterogeneity

- How does this affect amount of public good?
- Individual i solves

$$\max g^{\alpha}\left(1-\hat{l}_i\right)+y-g$$

where $\hat{l}_i$ is the distance of individual i from the ideal type of the median voter. Solution is

$$g_i^*=\left[\alpha\left(1-\hat{l}_i\right)\right]^{\frac{1}{1-\alpha}}$$

- Define $\hat{l}_i^m$ as the median distance from the type most preferred by median voter. ("median distance from the median").
- Then amount of public good is given by

$$g_i^*=\left[\alpha\left(1-\hat{l}_i^m\right)\right]^{\frac{1}{1-\alpha}}$$

- This implies that equilibrium amount of public good is decreasing in $\hat{l}_i^m$.
- Polarization increases this distance.

Illustration

Low heterogeneity

Image removed due to copyright restrictions. See: Alesina, Alberto, Reza Baqir, et al. "Public Goods and Ethnic Divisions." *Quarterly Journal of Economics* 114, no. 4 (1999): 1243-84.
Figure I Examples of Different "Median Distances from the Median."

Evidence

Alesina, Baqir, and Hoxby 2004: "Political Jurisdictions in Heterogeneous Communities"

- Setting: US school districts
- Idea: political jurisdictions are formed from a trade-off of economies of scale and homogeneity.
- So number of school districts in a county is:
  - Increasing in county size
  - Increasing in fixed costs measures
  - Decreasing in heterogeneity

OLS results with state fixed effects and panel data.

Images from Alesina, Alberto, Reza Baqir, et al . "Political Jurisdictions in Heterogeneous Communities." *Journal of Political Economy* 112, no. 2 (2004): 348-96. Removed:
Table 2 "Effect of Population Heterogeneity on the Number of School Districts in a County Dependent Variable: ln (Number of School Districts in a County)" from
Fig 2. Does racial heterogeneity prevent districts from consolidating?
Table 5 Effect of Changes in Population Heterogeneity on Changes in the Number of School Districts in a County between 1990 and 1960 Dependent Variable: Change in ln(Number of School Districts in a County), 1990 - 1960

Evidence from Kenya

Miguel and Gugerty (2005): "Ethnic diversity, social sanctions, and public goods in Kenya"

- Setting: school funding and facilities in rural Kenya
- Slightly different theoretical motivation:
  - They posit no preference heterogeneity over these types of goods
  - Instead, they think about voluntary contributions (not compulsory taxes), with social sanctions for non-payment
  - Assume no ability to impose social sanctions across ethnic groups
- Empirical approach:
  - Low residential mobility implies that ethnic heterogeneity is exogenously determined with respect to public goods provision (e.g., no sorting)
  - Compare contributions cross-sectionally

How to measure heterogeneity

- How do they measure heterogeneity?
- A common metric is the probability that two randomly drawn individuals will be from two different ethnic groups, denoted ethnolinguistic fractionalization.
- Define the proportion of individuals in ethnic group e as p_e
- Then heterogeneity is denoted by

$$ELF = 1 - \sum_{e} (p_e)^2$$

Results

Table 5
Ethnic diversity and local primary school funding

Explanatory variable	Dependent variable								
	School ELF across tribes	Total local primary school funds collected per pupil in 1995 (Kenyan Shillings)							
	(1) OLS 1st stage	(2) OLS	(3) OLS	(4) IV-2sls	(5) OLS	(6) OLS	(7) OLS	(8) Spatial OLS	(9) Spatial OLS
Ethnic diversity measures									
Zonal ELF across tribes	0.86*** (0.07)		−185.7** (77.9)		−145.2*** (49.6)	−143.6* (82.1)			
School ELF across tribes		−32.9 (64.0)		−216.4** (88.4)					
1-(Proportion largest ethnic group in zone)							−162.9** (66.6)		
ELF across tribes for all schools within 5 km								−174.0** (76.3)	−174.0** (80.8)
Zonal controls									
Proportion fathers with formal employment					189.5 (165.1)	−220.6* (120.5)	184.6 (170.9)		142.8 (167.3)
Proportion of pupils with a latrine at home					−431.6*** (139.9)	−286.3 (228.0)	−429.8*** (150.3)		−466.9 (250.2)
Proportion livestock ownership					120.1 (136.9)	186.2 (130.4)	110.6 (148.3)		116.9 (117.7)
Proportion cultivates cash crop					35.7 (61.4)	22.2 (106.9)	27.8 (62.4)		85.2 (78.4)
Proportion Teso pupils						67.9 (181.4)			
Geographic division indicators	No	No	No	No	No	Yes	No	No	No
Root MSE	0.14	99.8	96.7	105.5	95.0	93.0	95.4	97.1	95.0
R^2	0.40	0.00	0.06	–	0.14	0.25	0.12	0.06	0.09
Number of schools	84	84	84	84	84	84	84	84	84
Mean dependent variable	0.20	152.6	152.6	152.6	152.6	152.6	152.6	152.6	152.6

Informal taxation

Olken and Singhal (2011): "Informal Taxation"

- How prevalent are these types of collective action problems in developing countries?
- Olken and Singhal (forthcoming) study phenomenon of 'voluntary' contributions to local public goods
  - *Harambee* in Kenya
  - *Gotong Royong* in Indonesia
  - and see Ostrom (1991) for more
- Use micro data from 10 countries to establish some stylized facts

Stylized facts

Magnitude

- Participation rates are 20% or higher in all surveyed countries (except Albania) and exceed 50% in Ethiopia, Indonesia, and Vietnam
- Participation rates are always higher in rural areas
  - Between 27% and 183% higher, depending on country
- A substantial share of households (10-76%) make in-kind payments in labor
  - Average labor payments range from 0.2 days per year (Albania) to 14.1 days per year (Ethiopia)

Comparison to Local Budgets

Olken and Singhal (forthcoming): Table 5

Table 5: Comparison to other local budgets in Indonesia

Per household value of:	Mean	Informal taxes as percent of….
From Indonesia household survey:		
Informal taxes	49.86	.
Direct formal taxes	29.16	171%
Indirect formal taxes	158.88	31%
From village budget data:		
Total annual village budget:	117.64	42.4%
Village revenue from inter-governmental transfers:	86.20	57.8%
Village revenue from local taxes/fees (including informal tax):	31.44	158.6%
From district budget data:		
Total annual district budget	1138.45	4.4%
Expenditures on salaries:	474.89	10.5%
Expenditures on goods & services	224.70	22.2%
Capital expenditures:	396.90	12.6%
District revenue from central government transfers:	933.07	5.3%
District revenue from local formal taxes/fees:	43.41	114.9%
District revenue from other sources:	31.77	156.9%

Is it voluntary?

- In Indonesia survey, asked questions about:
  - Who decides whether a household should pay
  - Who decides amount each household should pay
  - Formal sanctions (if any) for failure to pay specified amount
- Results:
  - Only 8% of households report that they decide whether to pay; 84% say village/neighborhood head decides
  - Only 20% of households report that they decide how much to pay; 69% say village/neighborhood head decides
  - 38% report an official sanction for failing to pay – typically replace with someone else, give materials instead, or pay a fine.
    - Higher income people have higher probability of reporting sanctions for failure to pay
- Suggests these types of semi-formal contributions are an important part of the story for local public goods – and that social sanctions are used to overcome the free rider problem

Does "social capital" matter?

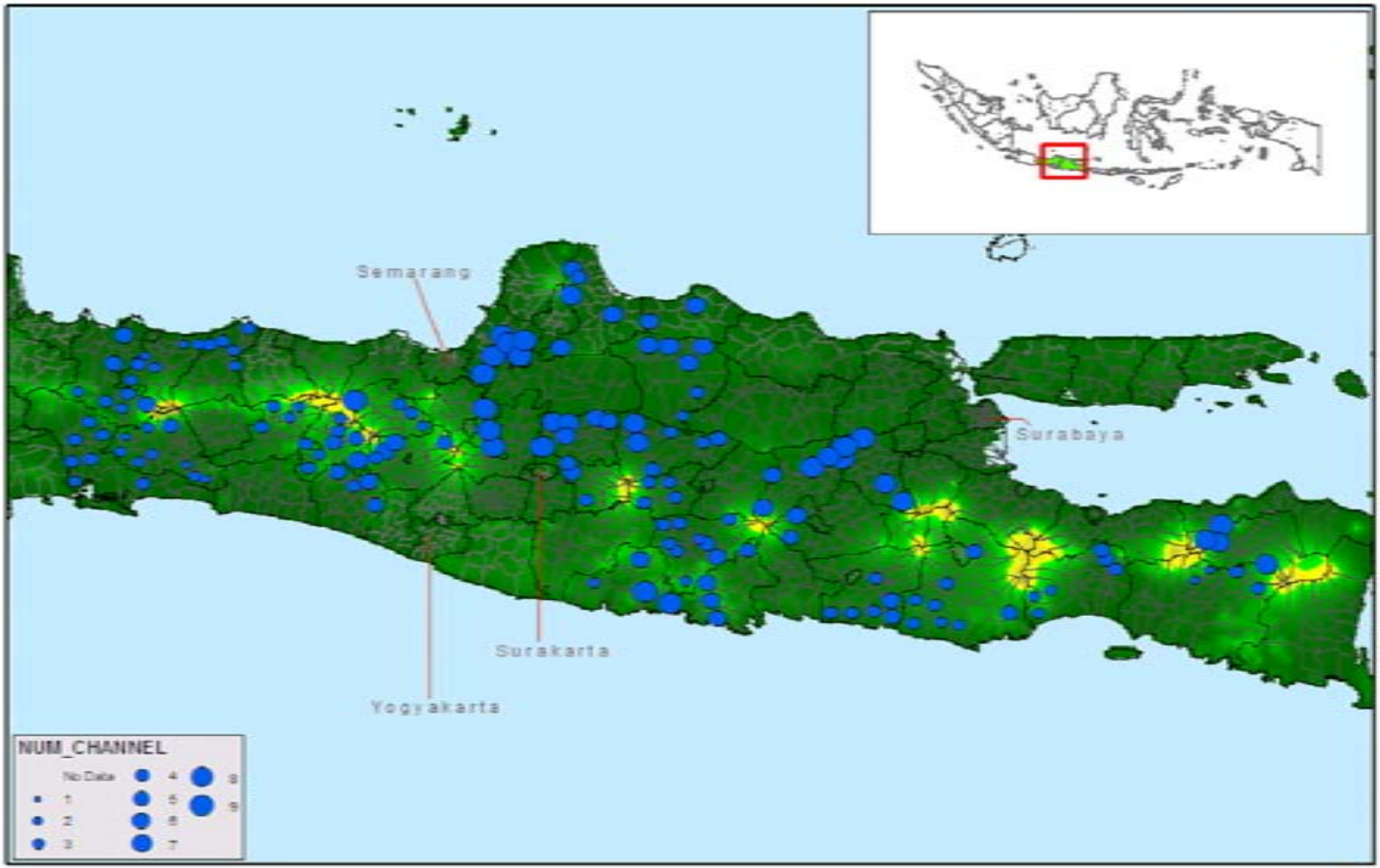
- Miguel and Gugerty and Olken and Singhal papers suggest that these contributions are enforced through "social sanctions"
- This is connected to a broader idea, that "social capital" is an important supporter of collective action
  - E.g., Putnam – "Making Democracy Work" and "Bowling Alone"
  - Could be because people trust each other (with trust enforced through links on social network)
  - Could be because social links are a way to exclude people who fail to participate

Testing social capital's impact using TV

Olken (2009): "Does TV and Radio Destroy Social Capital?"

- Setting: Examines the impact of television (and radio) on social capital in over 600 Indonesian villages
- Main source of identification: plausibly exogenous variation in signal strength associated with the mountainous terrain of East / Central Java
- Additional sources of identification:
  - Compare social capital in subdistricts before and after introduction of private television in 1993
  - Use model of electromagnetic signal propagation to explicitly isolate impact of topography
- Then: examine the impact of television reception on corruption in road projects

Map: Variation in television reception



Setting

- Indonesian villages have extremely dense social networks
  - Typical Javanese village of 2,600 adults has 179 groups of various types
  - Types of groups: Neighborhood associations, religious study groups, ROSCAs, health and women's groups, volunteer work
- Television and radio
  - 80 percent of rural households watch TV per week in 2003
  - 11 national TV stations, showing mix of news, soap operas, movies, etc
  - Broadcasting centered around major cities
  - But prior to 1991, only 1 TV channel (gov't channel)
  - Will not separately identify TV and radio as I don't have independent data on radio, and they are likely co-linear in any case

Does better reception translate into increased use?

- Show that in Central / East Java sample, television reception is orthogonal to a large number of village characteristics
- Estimate impact of channels on use at individual level with data from East / Central Java survey:

$$\begin{aligned} MINUTES_{hvsd} &= \alpha_d + NUMCHAN_{sd} \\ &\quad + Y_{hvsd}\gamma + X_{vsd}\delta_1 + \delta_2 ELEVATION_{sd} + \varepsilon_{hvsd} \end{aligned}$$

where:

- $MINUTES_{hvsd}$ is number of minutes respondent spends watching TV or listening to radio
- Y_{hvsd} are respondent covariates (gender, predicted per-cap expenditure, has electricity)
- all specifications include district FE α_d
- standard errors clustered by subdistrict

Does better reception translate into increased use?

TABLE 4—MEDIA USAGE AND OWNERSHIP

	Individual-level data (Java survey)			
	Total minutes per day (1)	TV minutes per day (2)	Radio minutes per day (3)	Own TV (4)
Number of TV channels	14.243***	6.948***	6.997***	−0.007
	(2.956)	(1.827)	(1.881)	(0.008)
Observations	4,213	4,250	4,222	4,266
R^2	0.18	0.16	0.10	0.17
Mean dep. var.	180.15	124.54	55.82	0.70

Participation in social groups

TABLE 5—PARTICIPATION IN SOCIAL GROUPS
(*Cross sectional data*)

	Village-level data (Java survey)		Individual-level data (Java survey)	
	Log number of groups in village (1)	Log attendance per adult at group meetings in past three months (2)	Number types of groups participated in during last three months (3)	Number times participated in last three months (4)
Number of TV channels	−0.068** (0.026)	−0.111** (0.045)	−0.186* (0.096)	−0.970 (0.756)
Observations	584	556	4,268	4,268
R^2	0.64	0.49	0.40	0.29
Mean dep. var.	4.94	1.97	4.27	22.77

- Qualitatively similar results using introduction of private TV (panel) and using electromagnetic model of signals to instrument for who receives channels

Affects number of people showing up at meetings

	Log attendance at meeting (1)	Log attendance of "insiders" at meeting (2)	Log attendance of "outsiders" at meeting (3)
Number of TV channels	−0.030**	−0.047**	−0.009
	(0.015)	(0.020)	(0.032)
Observations	2,273	2,266	2,124
Mean dep. var.	0.26	0.19	0.26
	3.75	2.77	2.71

Significant at the 1 percent level.

But no impact on actual monitoring...

Log number of people who talk at meeting (4)	Number of problems discussed (5)	Any corruption-related problem (6)	Any serious action taken (7)
0.002	0.019	−0.009	0.000
(0.020)	(0.059)	(0.008)	(0.003)
2,200	1,702	1,702	1,702
0.22	0.37	0.15	0.15
2.07	1.18	0.06	0.02

Or on corruption

TABLE 9—IMPACT ON "MISSING EXPENDITURES"

	Missing expenditures in road project (1)	Missing expenditures in road and ancillary projects (2)	Discrepancy in prices in road project (3)	Discrepancy in quantities in road project (4)
Number of TV channels	−0.033*	−0.042**	−0.030***	0.003
	(0.019)	(0.019)	(0.010)	(0.021)
Observations	460	517	476	460
R^2	0.35	0.29	0.30	0.32
Mean dep. var.	0.24	0.25	−0.01	0.24

Note: See notes to Table 8.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Summing up...

- In many cases in developing countries, there are many public goods that aren't provided by the government
- The free-rider problem suggests that as group size increases, per-capita contributions decrease, and can be far below the social optimum
  - Though the impact on total provision with respect to N is theoretically ambiguous
- This can lead to
  - Not enough public goods being provided
  - Or using social sanctions to encourage people to contribute anyway
- But this may work less well in heterogeneous societies
  - Depends on whether groups are competing for a limited resource (grabbing game) or have to agree on a common resource (type of public good)
- Is this one reason why ethnic heterogeneity may be correlated with lower GDP?

14.75 Political Economy and Economic Development

Fall 2012