Informal Insurance, Social Capital and Savings

Access

Evidence from a lab experiment in the field

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BREAD

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Introduction

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- How do these factors interact?
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Risk-sharing and savings

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  1. Ability to smooth uninsured risk can increase welfare.
  2. Savings in autarky ⇒ temptation to renege increases ⇒ insurance may be crowded out.
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  - effects by social distance...
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• Understanding *why* social networks matter is confounded by endogeneity of risk-sharing partners:
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Understanding why social networks matter is confounded by endogeneity of risk-sharing partners:

- share risk best with those I’m connected to, or form connections with those I share risk with?
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Understanding *why* social networks matter is confounded by endogeneity of risk-sharing partners:

- share risk best with those I’m connected to, or form connections with those I share risk with?
- do social ties mitigate certain market failures?
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Interpreting evidence

- Predictions of LC fit consumption and income data for some villages: Ligon et al. 2002, Dubois et al. 2008, Munshi and Rosenzweig 2009
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  2. or, LC may be important, but individuals don’t react to it as the model predicts
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  • 1⇒write/test other models (perhaps non-neoclassical)
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- 1 and 2 have different implications for theory, policy:
  - 1⇒write/test other models (perhaps non-neoclassical)
  - 2⇒modify/enrich the current model
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- Difficult to assess internal and external validity of model tests without ruling out these concerns

- Difficult to rule out without an experiment
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Our experiment

- Participants played variants of a consumption-smoothing game
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- Contracting environments, income process, dyad formation process are known
- Players were paid for only one round ⇒ incentives to smooth consumption across rounds
- ⇒ players cannot use side transfers to guarantee a certain outcome
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Why an experiment?

- Test whether players’ behavior matches the model
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  - estimate magnitude of LC’s impact, social capital’s role
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  - in a known LC environment, do individuals act as the model predicts?
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  - estimate magnitude of LC’s impact, social capital’s role
- Framed field experiment can act as “pilot” to identify important interactions to test in real-life settings (Leider et al. 2009)
Overview of results

- Smoothing mechanisms are used: people transfer and save
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  - crowdout effect may be greatest where insurance initially works best
Overview of results, cont.

- Savings increases welfare
Overview of results, cont.

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  - allows individuals to smooth risk that cannot be shared interpersonally
Overview of results, cont.

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Overview of results, cont.

- Savings increases welfare
  - allows individuals to smooth risk that cannot be shared interpersonally
  - even those with bad luck see welfare gains from savings access in a LC setting
  - less socially connected households use and benefit from savings most
Overview of results, cont.

Transfers and social distance, by game

Distance is the geodesic distance between partners.
Framework
Limited commitment

- Individuals cannot commit to participate in the insurance agreement
• **Individuals cannot commit to participate in the insurance agreement**

• **Individuals with high income realizations may prefer to renege on agreement**
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- When individual is tempted to renege, current consumption and promised future surplus $\uparrow$ to make her indifferent between leaving and staying
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When individual is tempted to renege, current consumption and promised future surplus to make her indifferent between leaving and staying

\[ \Rightarrow \text{cov}(\text{consumption}, \text{income}) > 0 \]
Framework

Introducing social capital

- Individuals are more likely to share risk with friends and family (FF) than with strangers.
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- All $\Rightarrow$ more risk-sharing with socially closer individuals when formal commitment is absent
Introduction to social capital

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- All ⇒ more risk-sharing with socially closer individuals when formal commitment is absent

- Reduced-form capturing all of these possibilities: reneging ⇒ cost, depending on social distance to partner, \( \gamma_{ij} \):

\[
\begin{align*}
  f &= f(\gamma_{ij}) \\
  f'(\gamma) &< 0
\end{align*}
\]
• The more often $i$ or $j$ have binding participation constraints, the more players’ consumption varies.
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- less interpersonal insurance is possible
Framework

Effect of social capital

- The more often $i$ or $j$ have binding participation constraints, the more players’ consumption varies
  - less interpersonal insurance is possible
- Participation constraints are less likely to bind when partners are socially close, *ceteris paribus*
• The more often $i$ or $j$ have binding participation constraints, the more players’ consumption varies
  • less interpersonal insurance is possible

• Participation constraints are less likely to bind when partners are socially close, *ceteris paribus*

• $\Rightarrow$ socially close pairs should achieve better consumption smoothing, when commitment is absent
Access to savings has 2 effects:

- Within insurance network, can smooth aggregate/uninsured idiosyncratic risk over time (+)
- Outside of insurance network, can smooth income risk (-)

Temptation to renege may be reduced by social capital. Costs of reneging on a socially close partner may be greater. Networks may facilitate punishments that don’t rely on exclusion from insurance.

Programming problems
Informal Insurance and Savings

Chandrasekhar et al.

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Introducing savings

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Goals of experiment

Replicate incentives to smooth risk and to think carefully about choices.

- Expected-utility preferences $\Rightarrow$ risk aversion $=$ intertemporal elasticity of substitution
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  - if $u(c) = \frac{u^{1-\rho}}{1-\rho}$, $RA = IES = \rho$
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  - if $u(c) = \frac{u^{1-\rho}}{1-\rho}$, RA = IES = $\rho$
  - measure incentives to smooth over time with smoothing variability of a one-shot lottery
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- High stakes: expected earnings $\sim 1.5 \times$ local NREGA (National Rural Employment Guarantee Act) daily wage.
Play 3 games (in random order):

- full commitment with no savings (FCNS)
- limited commitment with no savings (LCNS)
- limited commitment with savings (LCWS)
Experimental setup

- Before 1st round, \( i \) receives endowment \( w_i \in \{Rs. 30, Rs. 60\} \) with \( \rho_{y_i,y_{-i}} = -1 \).
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- Each round $i$ receives $y_{it} \in \{\text{Rs. 0, Rs. 250}\}$. 

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- **If savings:** after transfers are settled, individuals make consumption and savings decisions; else, “consume” income less net transfer.

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- Savings lost if game ends

**Timeline**
Experimental setup

- Each game played with a different partner
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- Randomization $\Rightarrow$ test model fit by comparison of outcomes across treatments
  - Outcomes: level of transfers, savings; consumption variability; defection
  - Mean consumption (almost) constant across treatments $\Rightarrow$ consumption variability is a sufficient statistic for welfare
- If models fit, use results to sign ambiguous effects
• Social network data from Banerjee et al. (2012).
Setting
Network data

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  - average 164 households in village; 50% completed network survey
  - can observe “friend of a friend of a friend,” etc.
• Construct social distance between partners (social distance, reachability)

• Geodesic distance from $i$ to $j$:

$$\gamma_{ij} = \min_{k \in \mathbb{N}} \left[ A^k \right]_{ij} > 0$$

• household $i$ is reachable by household $j$ ($\rho_{ij} = 1$) if $\exists$ any path from $i$ to $j$:

$$\rho_{ij} = 1 \{ \gamma_{ij} < \infty \}$$
- 20 participants per village
Setting
Participants

- 20 participants per village
- Locate in census and assign pairs for each of the 3 games
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  • Networks exhibit small world phenomenon: distance distribution is skewed left.
Setting

Participants

- 20 participants per village
- Locate in census and assign pairs for each of the 3 games
- Pair assignment by stratifying against the social network
  - Networks exhibit small world phenomenon: distance distribution is skewed left.
  - Random assignment $\Rightarrow$ often paired with near neighbors $\Rightarrow$ low power to study distant pairs
Setting
Participants

- 20 participants per village
- Locate in census and assign pairs for each of the 3 games
- Pair assignment by stratifying against the social network
  - Networks exhibit small world phenomenon: distance distribution is skewed left.
  - Random assignment ⇒ often paired with near neighbors ⇒ low power to study distant pairs
  - ⇒ oversample the right tail.
Average age is 30
56% of players are female
Average education level is 7th standard
97% of pairs are reachable through the network ($\gamma_{ij} < \infty$)
Among reachable pairs, average social distance is 3.5, median 4
  “friend of a friend of a friend of a friend”
Game Play
Estimation

Average effects

- Outcomes at individual-game-round level:

\[ \omega_{igr} = \alpha + D_g + X'_g \eta + \phi_i + Z'_{ig} \zeta + \epsilon_{igr} \]

- Outcomes: consumption abs. deviations \(|c_{igr} - \bar{c}_{ivg}|\), savings \(s_{igr}\).

- \(D_g\) is game, \(Z_{ig}\) - network distance, \(X_{gr}\) - experimental controls (game order, etc.)

- For transfers \(\tau_{igr}\), defection \(d_{igr}\), restrict sample to individual-game-round obs of “lucky” players.

- Cluster at village \(\times\) game level, include individual-fixed effects \(\phi_i\).
Estimation

Effects by social distance

- Allow effects of limited commitment, savings to vary by social distance:

\[
\omega_{igr} = \alpha + \beta_1 D_g + \eta_1 \rho \rho_{ij} + \eta_2 \gamma_{ij} \\
+ \delta_1 D_g \ast \rho_{ij} + \delta_2 D_g \ast \gamma_{ij} \\
+ \phi_i + Z'_{ig} \zeta + \epsilon_{igr}
\]
Do individuals smooth?

Proposition

*Risk-averse individuals prefer less to more consumption variation.*

- Smoothing mechanisms (transfers and savings) should be used
Binding constraints→less insurance

FCNS vs. LCNS

Proposition

*When comparing full commitment no savings (FCNS) vs. limited commitment no savings (LCNS), if participation constraints bind, transfers will be lower under LCNS vs. FCNS.*

- binding participation constraints reduce transfers and cause consumption variability
Savings access and insurance

Proposition

*If participations constraints bind under LCNS, they will be tightened by the introduction of savings (LCWS), crowding out interpersonal insurance.*

- $\Rightarrow$ transfers under LCWS will be lower than under LCNS
- Savings access $\uparrow$ value of reneging
Results

Transfers

- Transfers fall by 10% when commitment is removed (LCNS)
  - partially via reduction of promised transfers, partially via players reneging
- Overall fall in transfers due to savings is insignificant

<table>
<thead>
<tr>
<th></th>
<th>All rounds</th>
<th>Conditional on no defection</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCNS</td>
<td>-8.99***</td>
<td>-5.612***</td>
</tr>
<tr>
<td></td>
<td>[1.56]</td>
<td>[2.05]</td>
</tr>
<tr>
<td>LCWS</td>
<td>-11.26***</td>
<td>-6.207***</td>
</tr>
<tr>
<td></td>
<td>[1.71]</td>
<td>[1.90]</td>
</tr>
<tr>
<td>FC Mean</td>
<td>92.35</td>
<td>92.35</td>
</tr>
<tr>
<td>St. Dev.</td>
<td>36.3</td>
<td>36.3</td>
</tr>
<tr>
<td>N</td>
<td>6369</td>
<td>3845</td>
</tr>
<tr>
<td>Adj. R²</td>
<td>.312</td>
<td>.335</td>
</tr>
</tbody>
</table>
Empirical question

*Is average consumption smoothing better under LCNS or under LCWS?*

- Which dominates on average?
  - savings’ “pro-insurance” effect, allowing intertemporal smoothing
  - savings’ “anti-insurance” effect, tightening participation constraints
Results

Consumption smoothing

- Outcome: consumption absolute deviations $|c_{igr} - \bar{c}_{ig}|$
- LC binds: consumption smoothing falls when reneging is possible
- Savings access increases welfare (LCWS vs. LCNS)

<table>
<thead>
<tr>
<th></th>
<th>LCNS</th>
<th>LCWS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8.87***</td>
<td>4.90***</td>
</tr>
<tr>
<td></td>
<td>[1.35]</td>
<td>[1.37]</td>
</tr>
</tbody>
</table>

LCNS = LCWS

<table>
<thead>
<tr>
<th>F-stat (p-value)</th>
<th>10.17 (0.0019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC Mean / Std dev</td>
<td>40.9 / 32.1</td>
</tr>
<tr>
<td>N</td>
<td>12752</td>
</tr>
</tbody>
</table>
Distributional impact of savings

Empirical question

*Do transfers fall differentially across the income distribution due to savings?*

- Does savings’ pro-insurance or anti-insurance effect dominate for those with “bad luck”?

Empirical question

*Is consumption smoothing for those with low income realizations better or worse with access to savings?*

- Does savings’ pro-insurance or anti-insurance effect dominate for those with “bad luck”?
Transfers
By income level

- Split by terciles of in-game income
- Outcome: transfers received, regardless of income realization
- In middle tercile, LC does not reduce transfers; savings does crowd transfers out

<table>
<thead>
<tr>
<th>Income percentile</th>
<th>0-33rd</th>
<th>33rd-66th</th>
<th>66th-100th</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCNS</td>
<td>-8.222*</td>
<td>-0.6178</td>
<td>-5.065***</td>
</tr>
<tr>
<td></td>
<td>[4.644]</td>
<td>[1.079]</td>
<td>[1.256]</td>
</tr>
<tr>
<td>LCWS</td>
<td>-13.09***</td>
<td>-3.307***</td>
<td>-4.67***</td>
</tr>
<tr>
<td></td>
<td>[3.879]</td>
<td>[1.224]</td>
<td>[1.453]</td>
</tr>
<tr>
<td>LCNS=LCWS F-stat</td>
<td>1.7563</td>
<td>7.146</td>
<td>0.1062</td>
</tr>
<tr>
<td>p-value</td>
<td>0.1882</td>
<td>0.0088</td>
<td>0.7451</td>
</tr>
</tbody>
</table>

FCNS Mean/Std dev
63.5/52.9  47.1/52.3  33.7/50.2
Consumption smoothing
By income level

- Split by terciles of in-game income
- Even those with “bad luck” gain from savings access in a LC setting

<table>
<thead>
<tr>
<th>Income percentile</th>
<th>0-33rd</th>
<th>33rd-66th</th>
<th>66th-100th</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCNS</td>
<td>15.53***</td>
<td>4.004**</td>
<td>14.5***</td>
</tr>
<tr>
<td></td>
<td>[3.163]</td>
<td>[1.907]</td>
<td>[2.439]</td>
</tr>
<tr>
<td>LCWS</td>
<td>9.968***</td>
<td>4.129**</td>
<td>5.564**</td>
</tr>
<tr>
<td></td>
<td>[3.744]</td>
<td>[1.77]</td>
<td>[2.522]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>3.255</th>
<th>0.0052</th>
<th>14.300</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-stat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p-value</td>
<td>0.0743</td>
<td>0.9428</td>
<td>0.00026</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>39.7506</th>
<th>40.8573</th>
<th>40.7789</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCNS Mean</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>31.2281</td>
<td>31.8222</td>
<td>31.7478</td>
</tr>
</tbody>
</table>

Defection
Social capital, limited commitment, savings

Proposition

*Under LCNS, average transfers are lower and consumption smoothing is worse, the more socially distant the pair.*

- Participation constraints are more likely to bind.
Effects of social distance
Consumption smoothing

Consumption variation and social distance, by game

Distance is the geodesic distance between partners.
## LC impact by social distance

### Consumption smoothing and transfers

<table>
<thead>
<tr>
<th></th>
<th>Transfers</th>
<th>Cons. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lim. comm. $(\beta)$</td>
<td>-31.77**</td>
<td>33.00***</td>
</tr>
<tr>
<td></td>
<td>[13.94]</td>
<td>[12.34]</td>
</tr>
<tr>
<td>Reachable</td>
<td>-25.02***</td>
<td>17.05*</td>
</tr>
<tr>
<td></td>
<td>[7.705]</td>
<td>[5.99]</td>
</tr>
<tr>
<td>Distance</td>
<td>-0.3402</td>
<td>-0.2454</td>
</tr>
<tr>
<td></td>
<td>[1.115]</td>
<td>[.8771]</td>
</tr>
<tr>
<td>Lim. comm X Reachable $(\delta_1)$</td>
<td>34.46**</td>
<td>-34.51***</td>
</tr>
<tr>
<td></td>
<td>[15.04]</td>
<td>[12.38]</td>
</tr>
<tr>
<td>Lim. comm X Distance $(\delta_2)$</td>
<td>-2.996*</td>
<td>2.744***</td>
</tr>
<tr>
<td></td>
<td>[1.618]</td>
<td>[1.024]</td>
</tr>
</tbody>
</table>

- For non-connected pairs, LC ↓ transfers by Rs. 32 $(\beta)$; ↑ cons dev by Rs. 30
- For closest pairs, LC does not change transfers or cons dev: $\beta + \delta_1 + \delta_2 \approx 0$
Use of savings and social distance

Proposition

Socially distant pairs use savings more than socially close pairs.

• Use of savings $\Rightarrow$ participation constraints bind.
Use of savings and social distance

- Omit individual FEs

<table>
<thead>
<tr>
<th>Savings</th>
<th>Distance</th>
<th>0.8311***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>[.3224]</td>
</tr>
</tbody>
</table>

Distance = 1 mean 23.57
Std. dev 24.76
N 4211

- Socially farther pairs use savings more: 1 unit of distance ⇒ Rs. 0.83 more savings
Empirical question

*How does the degree to which interpersonal transfers are crowded out by savings access vary with social distance?*

- Opposite effects:
  - Crowdout mitigated by social capital (via sanctions other than insurance exclusion)
  - More social capital $\Rightarrow$ more insurance to crowd out

Financial network only
## Savings impact by social distance

### Consumption smoothing

<table>
<thead>
<tr>
<th></th>
<th>Cons. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC w/ savings</td>
<td>-.3133</td>
</tr>
<tr>
<td>[14.41]</td>
<td></td>
</tr>
<tr>
<td>Reachable</td>
<td>-14.20</td>
</tr>
<tr>
<td>[13.29]</td>
<td></td>
</tr>
<tr>
<td>Distance</td>
<td>1.339</td>
</tr>
<tr>
<td>[.8598]</td>
<td></td>
</tr>
<tr>
<td>LC w/ savingsXReachable</td>
<td>-4.631</td>
</tr>
<tr>
<td>(\delta_1)</td>
<td>[15.55]</td>
</tr>
<tr>
<td>LC w/ savingsXDistance</td>
<td>-.0823</td>
</tr>
<tr>
<td>(\delta_2)</td>
<td>[.9407]</td>
</tr>
</tbody>
</table>

- On net, savings access does not reduce cons. smoothing more for distant pairs, reflecting offsetting use of savings
Do other network moments matter?

Network centrality

- Other aspects of individuals’ network position may affect their ability to sustain cooperative behavior.
Do other network moments matter?

Network centrality

- Other aspects of individuals’ network position may affect their ability to sustain cooperative behavior
- Centrality:

Network centrality:

Centrality: centrality of a node reflects its importance in information transmission (Elliott and Golub 2012, Jackson 2008). Nodes with higher centrality tend to both acquire more and propagate more information when paired with peripheral individuals. Central individuals may fear reputational punishment less, may expect to interact less frequently with the peripheral partner outside the game. Focus on eigenvector centrality: best captures importance when information percolates through a network along the edges.
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Proposition

*Limited commitment will bind more, lowering transfers, the greater the relative eigenvector centrality of the high- vs. the low-income realization player.*

Proposition

*Access to savings will crowd out transfers to a larger extent the greater the relative eigenvector centrality difference of the two players.*

- More central individuals fear reputational punishment less
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Access to savings will crowd out transfers to a larger extent the greater the relative eigenvector centrality difference of the two players.

- More central individuals fear reputational punishment less
  ⇒ more tempted to default when income is high, ceteris paribus
Do other network moments matter?

Network centrality and LC

<table>
<thead>
<tr>
<th></th>
<th>Transfers</th>
<th>Cons. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCNS</td>
<td>-31.07**</td>
<td>33.28***</td>
</tr>
<tr>
<td></td>
<td>[13.3]</td>
<td>[12.25]</td>
</tr>
<tr>
<td>LCNSxE. Vector</td>
<td>-1.67*</td>
<td>.804*</td>
</tr>
<tr>
<td>centr. diff.</td>
<td>[.9425]</td>
<td>[.4696]</td>
</tr>
<tr>
<td>LCNSxReachable</td>
<td>34.57**</td>
<td>-35.01***</td>
</tr>
<tr>
<td></td>
<td>[14.47]</td>
<td>[12.29]</td>
</tr>
<tr>
<td>LCNSxDistance</td>
<td>-3.243**</td>
<td>2.813***</td>
</tr>
<tr>
<td></td>
<td>[1.613]</td>
<td>[1.022]</td>
</tr>
</tbody>
</table>

Control for main effects (evec, reach, dist)? Y Y
### Do other network moments matter?

#### Network centrality and savings

<table>
<thead>
<tr>
<th></th>
<th>Transfers</th>
<th>Cons. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCWS</td>
<td>-4.981</td>
<td>0.3465</td>
</tr>
<tr>
<td></td>
<td>[16.83]</td>
<td>[14.39]</td>
</tr>
<tr>
<td>LCWSxE. Vector</td>
<td>-1.562**</td>
<td>0.4189</td>
</tr>
<tr>
<td>centr. diff.</td>
<td>[.7697]</td>
<td>[.5257]</td>
</tr>
<tr>
<td>LCWSxReachable</td>
<td>1.033</td>
<td>-4.062</td>
</tr>
<tr>
<td></td>
<td>[16.81]</td>
<td>[15.13]</td>
</tr>
<tr>
<td>LCWSxDistance</td>
<td>0.5912</td>
<td>-0.0542</td>
</tr>
<tr>
<td></td>
<td>[1.262]</td>
<td>[.9024]</td>
</tr>
</tbody>
</table>

Control for main effects (evec, reach, dist)? Y Y
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- LC ⇒ additional INR 1.67 fall in transfers when partners have 1 standard deviation greater relative eigenvector centrality
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  - for the pair w/ largest difference in eigenvector centrality (6.33 SDs), savings access crowds out transfers by 14.60 rupees
  - use of savings⇒consumption does not become more variable on net
Conclusions

• Limited commitment model with social sanctions fits data well
Conclusions

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- Findings:
Conclusions

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- Findings:
  - Limited commitment binds for socially distant pairs; not for the closest
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- Findings:
  - Limited commitment binds for socially distant pairs; not for the closest
  - Savings crowds out transfers when luck is evenly distributed
    - Crowdout effect may be greatest where insurance works best
  - On net, welfare increases with savings (for distant and close pairs, lucky and unlucky players)
  - Distant pairs use, and benefit from, savings more
• LC matters more, and savings’ crowdout is greater, when partners differ in relative centrality (i.e., importance).
Conclusions

- LC matters more, and savings’ crowdout is greater, when partners differ in relative centrality (i.e., importance).
- If more central individuals are more likely to learn about and adopt technologies which raise incomes (cf Banerjee et al. 2012), growth may have negative spillovers to the less-central via reduced insurance.
Conclusions

• Social ties matter: heterogeneity by social distance suggests anonymous experiments would have...
Conclusions

- Social ties matter: heterogeneity by social distance suggests anonymous experiments would have...
  - mis-stated the role of LC (overstated if anonymous pairs act similar to distant pairs)

Results for distant pairs may be particularly relevant if development weakens social ties, transactionalizes risk sharing. Dynamic incentives matter, experiments that shut down these incentives may mis-measure levels of risk sharing and effects of frictions.
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Extensions

- Endogenous risk-sharing network formation experiment
Extensions

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  - players choose to pair with socially closer partners to mitigate incomplete contracts
Extensions

• Endogenous risk-sharing network formation experiment
  ⇒ players choose to pair with socially closer partners to mitigate incomplete contracts

• Hidden income and hidden savings experiment
Extensions

- Endogenous risk-sharing network formation experiment
  - players choose to pair with socially closer partners to mitigate incomplete contracts
- Hidden income and hidden savings experiment
  - hidden income crowds out insurance
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- Why is response to defection so mild?
Extensions

- Endogenous risk-sharing network formation experiment
  - ⇒ players choose to pair with socially closer partners to mitigate incomplete contracts

- Hidden income and hidden savings experiment
  - ⇒ hidden income crowds out insurance

- Why is response to defection so mild?
  - renegotiation-proofness (Ligon et al. 2002, Jackson et al. 2010)
Extensions

- Endogenous risk-sharing network formation experiment
  - players choose to pair with socially closer partners to mitigate incomplete contracts

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  - hidden income crowds out insurance

- Why is response to defection so mild?
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Extensions

- **Endogenous risk-sharing network formation experiment**
  - $\Rightarrow$ players choose to pair with socially closer partners to mitigate incomplete contracts

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- **Why is response to defection so mild?**
  - renegotiation-proofness (Ligon et al., 2002, Jackson et al., 2010)
  - fragility to errors (Selten 1975)
  - imperfect information (Green and Porter 1984)
  - social norms
Programming problem, no savings

\[ V^1 (V^2 (s_t)) = \max_{\tau^1(s_t), \{V^2(s_{t+1})\}_{s_t} \in S} \left\{ \begin{array}{c} u (y^1 (s_t) - \tau^1 (s_t)) \\ + \beta \mathbb{E}_{s_{t+1}} V^1 (V^2 (s_{t+1})) \end{array} \right\} \]

s.t.

\[ \lambda : u (y^2 (s_t) + \tau^1 (s_t)) + \beta \mathbb{E}_{s_{t+1}} V^2 (s_t) \geq V^2 (s_t), \forall s_t \in S \]

\[ \phi_{2t} : V^2 (s_t) \geq V^2_{A,NS} (s_t), \forall s_t \in S \quad (3) \]

\[ \phi_{1t} : V^1 (V^2 (s_t)) \geq V^2_{A,NS} (s_t), \forall s_t \in S \quad (4) \]
Autarky without savings

\[ V^i_{A,NS}(h_t) = u(y^i(s_t)) - f(\gamma_{ij}) + \beta E_{h_{t+1}} V^i_{A,NS}(h_{t+1}) \]  

(5)

where

\[ f = f(\gamma) \]  

(6)

\[ f(\gamma) \geq 0, \forall \gamma \]

\[ f'(\gamma) < 0 \]

Therefore,

\[ \frac{\partial V^i_{A,NS}(h_t)}{\partial f(\gamma_{ij})} < 0 \]
**Effect of social ties**

$\phi_{it} \equiv$ Lagrange multiplier on $i$’s time $t$ participation constraint. Taking expectations over the possible states of nature at $t$:

$$\frac{\partial \mathbb{E}_{t-1} \phi_{it}}{\partial f(\gamma_{ij})} < 0.$$  \hspace{1cm} (7)

FOCs (2), (4) and (3) yield the relationship between $i$ and $j$’s marginal utilities, as a function of $i$’s relative bargaining power $\lambda_{it}$:

$$\lambda_{it} = \frac{u'(y_{jt} + \tau_j^t)}{u'(y_{it} + \tau_i^t)}$$ \hspace{1cm} (8)

and updating rule for the multiplier on $i$’s time $t$ promise-keeping constraint:

$$\lambda_{i,t+1} = \lambda_{it} \left[ \frac{1 + \phi_{i,t+1}}{1 + \phi_{j,t+1}} \right]$$ \hspace{1cm} (9)
Effect of social ties

Ratio of $i$ and $j$’s time $t + 1$ marginal utility:

\[
\frac{u'(y_{jt+1} - \tau_{t+1}^i)}{u'(y_{it+1} + \tau_{t+1}^i)} = \frac{u'(y_{jt} + \tau_t^j)}{u'(y_{it} + \tau_t^i)} \left[ \frac{1 + \phi_{i,t+1}}{1 + \phi_{j,t+1}} \right]
\]  

(10)

- The more often $i$ or $j$ have binding participation constraints, the more each player’s consumption $c_{it} = y_{it} + \tau_t^i$ is expected to vary.
Effect of social ties

Ratio of $i$ and $j$’s time $t + 1$ marginal utility:

$$\frac{u'(y_{j,t+1} - \tau_{t+1}^i)}{u'(y_{i,t+1} + \tau_{t+1}^i)} = \frac{u'(y_{jt} + \tau_t^i)}{u'(y_{it} + \tau_t^i)} \left[ \frac{1 + \phi_{i,t+1}}{1 + \phi_{j,t+1}} \right]$$  \hspace{1cm} (10)

- The more often $i$ or $j$ have binding participation constraints, the more each player’s consumption $c_{it} = y_{it} + \tau_t^i$ is expected to vary.
- When participation constraints are more binding, less interpersonal insurance is possible.
Effect of social ties

Ratio of $i$ and $j$’s time $t + 1$ marginal utility:

$$
\frac{u'(y_{jt,t+1} - \tau^i_{t+1})}{u'(y_{it,t+1} + \tau^i_{t+1})} = \frac{u'(y_{jt} + \tau^i_t)}{u'(y_{it} + \tau^i_t)} \left[ \frac{1 + \phi_{i,t+1}}{1 + \phi_{j,t+1}} \right]
$$

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- Players will on average transfer less to each other under limited commitment when they are more socially distant.
Effect of social ties

Ratio of $i$ and $j$’s time $t + 1$ marginal utility:

$$\frac{u'(y_{jt, t+1} - \tau_{t+1}^i)}{u'(y_{it, t+1} + \tau_{t+1}^i)} = \frac{u'(y_{jt} + \tau_t^j)}{u'(y_{it} + \tau_t^i)} \left[ \frac{1 + \phi_{i,t+1}}{1 + \phi_{j,t+1}} \right] \tag{10}$$

- The more often $i$ or $j$ have binding participation constraints, the more each player’s consumption $c_{it} = y_{it} + \tau_t^i$ is expected to vary.
- When participation constraints are more binding, less interpersonal insurance is possible.
- Players will on average transfer less to each other under limited commitment when they are more socially distant.
- Consumption is more variable under limited commitment when partners are more socially distant.
Programming problem, with savings

\[ V^1 (V^2_t (s_t)) = \max_{\tau^1(s_t), \{V^2_{t+1}(s_{t+1})\}_{s \in S}} \left\{ \begin{array}{c} u (y^1(s_t) - \tau^1(s_t)) \\ + \beta \mathbb{E}_{s_{t+1}} V^1 (V^2_{t+1}(s_{t+1})) \end{array} \right\} \]

\( s.t. \)

\[ \lambda : \quad u (y^2(s_t) + \tau^1_t(s_t)) + \beta \mathbb{E}_{s_{t+1}} V^2_t (s_t) \geq V^2_t (s_t), \forall s_t \quad (12) \]

\[ \beta \phi_t : \quad V^2_t (s_t) \geq V^2_{A,S} (s_t), \forall s_t \in S \quad (13) \]

\[ \beta \mu_t : \quad V^1 (V^2_t (s_t)) \geq V^2_{A,S} (s_t), \forall s_t \in S \quad (14) \]

\[ \psi_1 : \quad y^1(s_t) - \tau^1_t(s_t) \geq 0, \forall s_t \in S \quad (15) \]

\[ \psi_2 : \quad y^2(s_t) + \tau^1_t(s_t) \geq 0, \forall s_t \in S \quad (16) \]
Autarky with savings

\[ V^i_{A,S} (h_t, z^1_{t-1}) = \max_{z^i(h_t)} \left\{ u \left( z^i_{t-1} + y^i \left( s_t \right) - z^i_t \left( h_t \right) \right) - f \left( \gamma (i, j) \right) + \beta \mathbb{E}_{h_{t+1}} V^i_{A,S} (h_{t+1}, z^1_t) \right\} \]

Therefore,

\[ \frac{\partial V^i_{A,S} (h_t, z^1_{t-1})}{\partial f \left( \gamma (i, j) \right)} < 0. \]
Experimental timeline

- **Game 1 begins**: players paired.
- **Random income draw reveals who is lucky.**
- **If Limited Commitment**: Lucky player decides whether to abide by transfer plan or transfer new amount (defection).
- **Game 2 begins**: players re-paired.
- **Transfers made**: planned if full commitment or no defection; new amount otherwise.
- **If Savings**: Players decide how much to save.
- **Game 3 ends**.
- **One consumption value is drawn, player is paid.**
- **Players consume income + transfers - savings (if any).**
- **Ball is drawn**: Does the game continue?
- **Players make sharing plan**: “i transfers Rs. X to j if i is lucky.”
- **Extra slides**
## LC impact by social distance

<table>
<thead>
<tr>
<th></th>
<th>Transfers</th>
<th>Cons. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lim. comm. ($\beta$)</td>
<td>-18.12***</td>
<td>19.98***</td>
</tr>
<tr>
<td></td>
<td>[6.45]</td>
<td>[5.93]</td>
</tr>
<tr>
<td>Reachable</td>
<td>6.306</td>
<td>4.091</td>
</tr>
<tr>
<td></td>
<td>[7.172]</td>
<td>[4.675]</td>
</tr>
<tr>
<td>Distance</td>
<td>-0.5509</td>
<td>-0.4076</td>
</tr>
<tr>
<td></td>
<td>[.6684]</td>
<td>[.5209]</td>
</tr>
<tr>
<td>Lim. commXReachable</td>
<td>17.72**</td>
<td>-20.38***</td>
</tr>
<tr>
<td>($\delta_1$)</td>
<td>[8.786]</td>
<td>[6.414]</td>
</tr>
<tr>
<td>Lim. commXDistance</td>
<td>-1.721</td>
<td>1.924**</td>
</tr>
<tr>
<td>($\delta_2$)</td>
<td>[1.165]</td>
<td>[.8086]</td>
</tr>
</tbody>
</table>

- For non-financially connected pairs, LC ↓ transfers by Rs. 18 ($\beta$); ↑ cons dev by Rs. 20
- For financially-closest pairs, LC does not change transfers or cons dev: $\beta + \delta_1 + \delta_2 \approx 0$
Savings impact by social distance
Financial network only

Cons.  Dev.

LC w/ savings        -4.11
                   [4.552]
Reachable           -17.02***
                   [5.641]
Distance            1.358*
                   [.7345]
LC w/ savingsXReachable  3.08
                   [6.299]
LC w/ savingsXDistance -0.6699
                   [.8096]

• On net, savings access does not reduce cons. smoothing more for financially distant pairs
Proposition

*If players share risk due to insurance motives, realizations of the initial endowment should not be insured.*

- information revealed before the insurance contract is “signed” cannot be insured
- the high endowment individual should consume Rs. 30 more than the low endowment individual
- sharing of endowments gives a bound on non-insurance motives
Is the endowment insured?

- Players receiving high endowment (Rs. 60 vs. Rs. 30) consume Rs. 29.24 more

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Effect (Mean)</th>
<th>Std. dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>High endowment</td>
<td>29.24**</td>
<td>[13.93]</td>
</tr>
<tr>
<td>No comm.</td>
<td>-3.235</td>
<td>[15.91]</td>
</tr>
<tr>
<td>No commXHigh end.</td>
<td>-6.334</td>
<td>[18.5]</td>
</tr>
<tr>
<td>Reachable</td>
<td>4.929</td>
<td>[61.04]</td>
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<tr>
<td>Distance</td>
<td>15.84</td>
<td>[17.91]</td>
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<tr>
<td>LC mean</td>
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<tr>
<td>Std. dev</td>
<td>150.03</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>1222</td>
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</tbody>
</table>
Eigenvector centrality

- The eigenvector centrality of a household in a village corresponds to the $i$th entry of the eigenvector which corresponds to the maximal eigenvalue of the adjacency matrix representing the network.
- It is the solution to

$$A(G)\xi = \lambda \xi$$

where $\lambda(G)$ is the maximal (magnitude) eigenvalue.
- $\xi$ delivers the centrality value.
Empirical question

Does defection occur when individuals make informal agreements to share risk?

Empirical question

If defection is observed, what type of punishment do individuals use?
Response to defection

- Punishment occurs but is mild relative to GT; similar for close and distant pairs

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Defection</td>
<td>-10.73**</td>
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<tr>
<td>1 Period Ago</td>
<td></td>
<td>[5.075]</td>
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<tr>
<td></td>
<td>Defection</td>
<td>-8.315**</td>
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<tr>
<td>2 Periods Ago</td>
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<tr>
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<td>Defection</td>
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<td>3 Periods Ago</td>
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<td>Defection</td>
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<td>4 Periods Ago</td>
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<tr>
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<td>Defection rate</td>
<td>23%</td>
</tr>
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<td>N</td>
<td>884</td>
</tr>
<tr>
<td></td>
<td>Adjusted $R^2$</td>
<td>0.4638</td>
</tr>
</tbody>
</table>
Response to defection

![Graph showing response to defection over periods after defection. The graph has two lines, one solid and one dashed, representing the change in transfers with 90% confidence intervals. The x-axis is labeled "Periods after defection," and the y-axis is labeled "Change in transfers." The graph indicates a trend that the response to defection stabilizes over time.]