# Gift Exchange versus Monetary Exchange: Theory and Evidence

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# MOTIVATION

- Social norms: rules of behavior used to coordinate our interactions
- Social norms of exchange: money and gift-exchange
- Which social norm emerges? Which one performs better?

# ENVIRONMENT WITH MONEY

- Environment with money: modified Lagos-Wright (LW)

- Why Lagos-Wright? It provides a good theoretical framework

- it exhibits autarky, first best and monetary equilibria

- no upper bound on money holdings, divisible money, endogenous prices

- it facilitates our comparison with environments with no money but centralized meetings (in addition to decentralized ones)

# ENVIRONMENT WITH NO MONEY

- Environment with no money: modified Aliprantis, Camera and Puzzello (ACP)

- No money $\Rightarrow$ exchange can only take place via gift-giving

- Does the presence of centralized meetings help support exchange in decentralized meetings via gift-giving?

# WHAT DO WE DO?

- Develop modified versions of LW (Money, M) and ACP (No Money, NM) with finite populations
- Show money is not theoretically essential in these environments
- Implement modified LW and ACP models in the laboratory
- Which equilibrium is selected? Is behavior consistent with theoretical predictions?
- Does the population size matter for the essentiality and value of money?

# MAIN FINDINGS

- In the environment with money, choices are consistent with monetary equilibrium predictions
- In the environment without money, outcomes are closer to autarky than to the first-best
- Money is empirically, if not theoretically, essential: Welfare is higher in economies with money than in economies without money
- Money works better in smaller economies

# RELATED LITERATURE

- Experimental literature on money

Camera, Noussair and Tucker (2003), Deck, McCabe and Porter (2006), Lian and Plott (1998), McCabe (1989), Brown (1996), Duffy and Ochs (1999, 2002)

Camera and Casari (2010): different environment and findings

prices are exogenous, money and goods indivisible, upper bound on money holdings, only decentralized interactions, groups of 4 subjects

money does not improve average overall cooperation rates

# DESIGN

Two treatment variables

Environment: Money (M)/No money (NM) (M $\approx$ LW, NM $\approx$ ACP)

Population size: $2N = 6$ or $2N = 14$

$2 \times 2$ design

| | $M$ | $NM$ |
|---|---|---|
| $2N = 6$ | 4 Sessions | 4 Sessions |
| $2N = 14$ | 4 Sessions | 4 Sessions |

# GENERAL SETUP

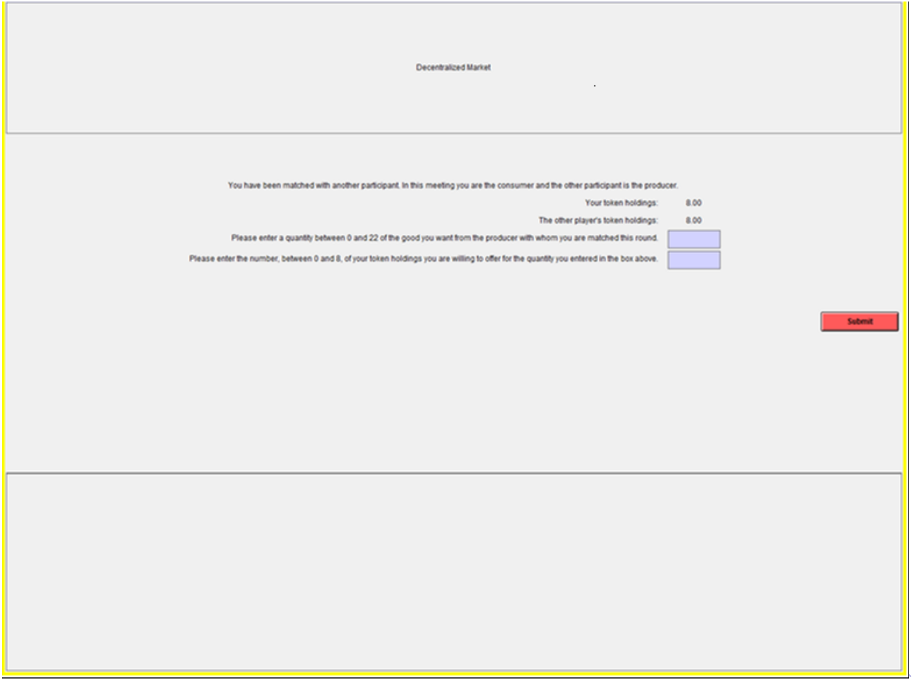
- Each session consisted of several sequences (supergames)
- Each sequence consisted of an indefinite number of repetitions (periods) of a stage game
- Each stage game involved 2 rounds, a decentralized meeting round and a centralized meeting round
- Every sequence began with the play of at least one, two-round stage game
- At the end of each stage game, the sequence continued with another repetition (period) of the stage game with probability $\beta = 5/6$ and ended with probability $1 - \beta = 1/6$
- Sessions averaged 31.1 total periods; on average 5.7 sequences were played in each session with each sequence having an average length of 5.5 rounds

# GENERAL SETUP, Cont'd

- Subjects were initially endowed with 20 points
- In the M treatment, at the start of each new indefinite length sequence, each subject was endowed with 8 tokens (fixed $M$)
- Subjects earned points from consumption and lost points from production. In the money treatment they are instructed that "tokens" have NO point (redemption) value
- Subjects in every period participate to decentralized meetings and centralized meetings
- Utility from decentralized market consumption, $u(q)$ is concave. All other utility and cost functions were linear. These functions were presented to subjects as tables mapping quantities into points
- Subjects's point totals from all sequences played were converted into money at the known rate of 1 point = \$0.20 cent. Average total earnings were \$23.54 per subject for a 2.25 hour experiment

# DECENTRALIZED MEETING

- $2N$ Subjects randomly formed into $N$ pairs. One member randomly selected to be the consumer, the other the producer
- Consumers make a proposal: $q \in [0, \overline{q}]$. In the M treatment, they can also offer $d \in [0, m_t]$ of their current money holdings, $m_t$
- Producers accept or reject the proposal. In the money treatment, the decision can be conditioned on their own current money balance, $m_{p,t}$, and that of the consumer with whom they were paired, $m_{c,t}$
- If accepted:
    - The producer gives up $q$ points. In the M treatment s/he receives $d$ additional tokens
    - The consumer gains $u(q)$ points. In the M treatment s/he gives up the $d$ tokens offered in the proposal
- If rejected: No exchange; point totals and token balances are unchanged
- Following outcome of the Decentralized meeting –> Centralized Meeting



Decentralized Market

You have been matched with another participant. In this meeting you are the consumer and the other participant is the producer.

Your token holdings: 8.00

The other player's token holdings: 8.00

Please enter a quantity between 0 and 22 of the good you want from the producer with whom you are matched this round.

Please enter the number, between 0 and 8, of your token holdings you are willing to offer for the quantity you entered in the box above.

Submit

# CENTRALIZED MEETING

- M treatment: subjects decide whether to be a buyer, seller or non-participant in the market for the homogeneous good X. Consumption (production) of 1 unit of good X is worth (costs) 1 point
  - Buyers submit a quantity and per unit bid price in tokens for good X, subject to budget constraints
  - Sellers submit a quantity and per unit ask price in tokens for good X
  - A centralized market clearing mechanism sorted bids from highest to lowest and asks from lowest to highest. The intersection determines the market price, $P$. All transactions involving the exchange of tokens for goods take place at price $P$
- NM treatment: subjects indicate how many units $x \in \{0, 1\}$ they wished to produce of good X. Consumption (production) of 1 unit of good X is worth (costs) 1 point
  - The average number of units of good X produced, $\overline{x}$, is calculated
  - Subjects' net payoff (consumption-production) in points from the centralized meeting was $\overline{x} - x$

# CONTINUATION OF A SEQUENCE

- Following completion of the Centralized Meeting, a die roll determined whether or not the sequence continued with a new 2-round period (stage game)
- If a 1,2,3,4,or 5 was rolled, the sequence continued with another 2-round period
    - In the M treatment, if a sequence continued, each subjects' token balances as of the end of the centralized meeting were carried over to the decentralized round of the new period
- If a 6 was rolled, the sequence was declared over
    - In the M treatment, if a sequence ended, then all subjects' token balances were set to zero
    - Depending on the time available a new sequence might then begin

# MONETARY STEADY STATE EQUILIBRIUM

Characterized by the solution to a dynamic programming problem, *ignoring* repeated game dynamics (i.e., the possibility that agents coordinate on a cooperative "social norm")

SS Quantity in the DM $\widetilde{q}: \frac{u'(\widetilde{q})}{c'(\widetilde{q})} = 1 + \frac{1-\beta}{\beta/2}$. Notice that $\widetilde{q} \to q^*$ as $\beta \to 1$. So for $\beta < 1$, $\tilde{q} < q^*$, where $u'(q^*) = c'(q^*)$

Price of good in DM $p: p = \frac{M/2N}{\widetilde{q}}$

Price of money in CM $\phi : \phi = \frac{c(\widetilde{q})}{M/2N}$

Money distribution in DM is degenerate at $M/2N$

# OTHER EQUILIBRIA: DECENTRALIZED SOCIAL NORMS

There exists a *decentralized social norm* supporting the first-best outcome in the money environment.

*"Do not participate in the CM. Participate only in the DM. Propose* $(q^*, 0)$ *every time you are a consumer and accept* $(q^*, 0)$ *whenever you are a producer, so long as everyone has produced* $q^*$ *for you in your past meetings. If you have observed a deviation then, whenever a producer, reject the terms of trade forever after"*

Under some conditions, we show this strategy supports the first best equilibrium. Intuition: since the population is finite contagion can be a threat severe enough. However, the larger the population the longer it takes for info about a deviation to spread

# NM EQUILIBRIA: CENTRALIZED SOCIAL NORMS

There exists a *centralized social norm* that supports the first-best as sequential equilibrium

*"In the decentralized meeting, propose* $q^*$ *whenever you are a consumer and accept to produce* $q^*$ *whenever you are a producer.*
*Produce* 1 *unit in the centralized meeting. Continue to do so if you have observed cooperation (i.e., you received or produced* $q^*$ *and* 1 *was the average production in the CM). If you have observed a deviation, then choose reject whenever a producer in the decentralized meeting and produce* 0 *forever after in the centralized meeting"*

Intuition: since finite population agents can use CM to spread information about a deviation, the presence of the CM may strengthen attractiveness of cooperation as contagion is more immediate

# PARAMETERIZATION AND PREDICTIONS

- $M/2N = 8$. Known, constant money supply $M = 48$ if $N = 3$; 112 if $N = 7$
- First best eq. DM quantity: $u(q) = 7\log(1+q)$, $c(q) = q$, $q^* : u'(q^*) = c'(q^*) \Rightarrow q^* = 6$
- Monetary eq. decentralized market quantity of special good: $\tilde{q} : ((u'(\tilde{q}))/(c'(\tilde{q}))) = 1 + ((1-\beta)/(\beta/2)) \Rightarrow \tilde{q} = 4$
- Monetary eq. decentralized market price of special good: $((M/2N)/\tilde{q}) = (8/4) = 2$
- Monetary eq. centralized market price of general good: $(M/2N)/c(\tilde{q}) = 2$
- Monetary eq. centralized market trade volume: $4N$: 12 if $N = 3$; 28 if $N = 7$
- First best eq. payoff per pair per period: $v^* = 7 \cdot \log 7 - 6 = 7.62$ points
- Monetary eq. payoff per pair per period: $v = 7 \cdot \log 5 - 4 = 7.26$ points

# FINDING 1

There are no differences in offer acceptance rates across M and NM treatments. In the money treatment, more than 95% of proposals involve positive amounts of tokens.

# Support for Finding 1

| Session No., Treatment | Acceptance Rates % | | | % Monetary Offers | | |
|---|---|---|---|---|---|---|
| | $1^{st}$ half | $2^{nd}$ half | All | $1^{st}$ half | $2^{nd}$ half | All |
| 1, M6 | 53.3 | 35.6 | 44.4 | 93.3 | 86.7 | 90.0 |
| 2, M6 | 50.0 | 57.8 | 54.0 | 92.9 | 95.6 | 94.3 |
| 3, M6 | 42.2 | 48.9 | 45.6 | 97.8 | 100 | 98.9 |
| 4, M6 | 47.9 | 70.6 | 59.6 | 93.8 | 100 | 97.0 |
| Avg. 1-4 | 48.3 | 53.8 | 51.1 | 94.4 | 95.7 | 95.1 |
| 5, M14 | 32.5 | 42.9 | 37.9 | 100 | 94.0 | 96.9 |
| 6, M14 | 35.7 | 32.4 | 34.0 | 99.0 | 94.3 | 96.6 |
| 7, M14 | 46.2 | 46.2 | 46.2 | 98.3 | 93.3 | 95.8 |
| 8, M14 | 42.9 | 42.9 | 42.9 | 99.2 | 91.3 | 95.1 |
| Avg. 5-8 | 40.2 | 41.2 | 40.7 | 99.0 | 93.1 | 96.0 |
| 9, NM6 | 52.1 | 68.6 | 60.6 | n/a | n/a | n/a |
| 10, NM6 | 58.3 | 52.1 | 55.2 | n/a | n/a | n/a |
| 11, NM6 | 22.2 | 25.0 | 23.7 | n/a | n/a | n/a |
| 12, NM6 | 62.2 | 60.0 | 61.1 | n/a | n/a | n/a |
| Avg. 9-12 | 48.9 | 51.6 | 50.3 | n/a | n/a | n/a |
| 13, NM14 | 36.1 | 39.5 | 37.8 | n/a | n/a | n/a |
| 14, NM14 | 44.8 | 45.9 | 45.3 | n/a | n/a | n/a |
| 15, NM14 | 29.4 | 46.2 | 37.8 | n/a | n/a | n/a |
| 16, NM14 | 46.7 | 34.8 | 40.6 | n/a | n/a | n/a |
| Avg. 13-16 | 38.8 | 41.6 | 40.2 | n/a | n/a | n/a |

Table: Average Acceptance Rates and % Monetary Offers Each Session

# FINDING 2

Proposals are less likely to be accepted as the quantity requested increases. In the Money treatment, proposals are more likely to be accepted the higher the number of tokens offered.

# Support for Finding 2

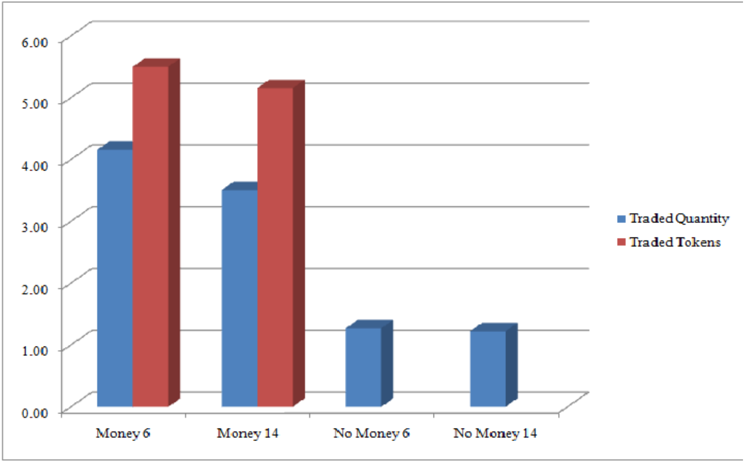
| | Dependent Variable, Accept=1, Reject=0 | | | |
|---|---|---|---|---|
| | All Sessions | NM Sessions | M Sessions (1) | M Sessions (2) |
| Constant | 0.358 | 2.708*** | 1.547*** | -0.318 |
| | (0.277) | (0.406) | (0.372) | (0.276) |
| NM14 | 0.082 | 0.132 | | |
| | (0.167) | (0.170) | | |
| M6 | 0.927*** | | | |
| | (0.306) | | | |
| M14 | 0.351 | | -0.544*** | -0.670*** |
| | (0.231) | | (0.134) | (0.153) |
| NewSeq | 0.342*** | 0.411*** | 0.422*** | 0.302*** |
| | (0.088) | (0.157) | (0.126) | (0.095) |
| Period | -0.012** | -0.049*** | -0.044*** | -0.064*** |
| | (0.006) | (0.006) | (0.009) | (0.017) |
| PriorCons | 0.202*** | 0.437*** | 0.105 | -0.017 |
| | (0.078) | (0.132) | (0.126) | (0.162) |
| HLscore | -0.038 | -0.194*** | -0.009 | -0.001 |
| | (0.039) | (0.058) | (0.027) | (0.027) |
| $q$ | -0.232*** | -1.410*** | -0.513*** | |
| | (0.088) | (0.167) | (0.058) | |
| $d$ | | | 0.292*** | |
| | | | (0.047) | |
| $d/q$ | | | | 1.584*** |
| | | | | (0.195) |
| $m_p$ | | | -0.024** | -0.029* |
| | | | (0.011) | (0.017) |
| $m_c$ | | | 0.009 | -0.037*** |
| | | | (0.011) | (0.014) |
| No. obs. | 2,487 | 1,274 | 1,213 | 1,184 |
| Log Likl. | -1517.5 | -587.2 | -730.3 | -681.7 |

*, **, ***, indicate significance at the: 10%, 5%, 1% significance levels.

# FINDING 3

Quantities exchanged in the decentralized meeting are significantly greater when there is money than when there is no money. However, quantities in both environments are well below the efficient equilibrium level.

# Support for Finding 3



# Support for Finding 3, cont'd

| Session No., Treatment | Average $q$ | | | Average $d$ | | | Avg. Price | | |
|---|---|---|---|---|---|---|---|---|---|
| | $1^{st}$ half | $2^{nd}$ half | All | $1^{st}$ half | $2^{nd}$ half | All | $1^{st}$ half | $2^{nd}$ half | All |
| 1, M6 | 5.05 | 4.19 | 4.68 | 5.59 | 5.63 | 5.61 | 1.18 | 1.31 | 1.23 |
| 2, M6 | 4.62 | 4.25 | 4.41 | 5.10 | 5.80 | 5.48 | 1.12 | 1.37 | 1.25 |
| 3, M6 | 5.05 | 4.09 | 4.54 | 4.54 | 6.90 | 5.81 | 0.92 | 1.73 | 1.35 |
| 4, M6 | 3.32 | 3.00 | 3.12 | 4.33 | 5.61 | 5.14 | 1.52 | 1.88 | 1.75 |
| Avg. 1-4 | 4.49 | 3.85 | 4.16 | 4.88 | 5.97 | 5.50 | 1.19 | 1.58 | 1.41 |
| 5, M14 | 3.64 | 3.81 | 3.74 | 4.27 | 6.03 | 5.29 | 1.15 | 1.61 | 1.42 |
| 6, M14 | 4.49 | 2.09 | 3.34 | 4.03 | 4.54 | 4.28 | 0.96 | 2.31 | 1.60 |
| 7, M14 | 4.00 | 2.46 | 3.24 | 5.28 | 5.46 | 5.36 | 1.40 | 2.37 | 1.87 |
| 8, M14 | 4.48 | 3.00 | 3.75 | 5.30 | 5.87 | 5.58 | 1.33 | 1.96 | 1.64 |
| Avg. 5-8 | 4.19 | 2.79 | 3.51 | 4.80 | 5.47 | 5.16 | 1.23 | 2.09 | 1.65 |
| 9, NM6 | 1.55 | 1.26 | 1.37 | n/a | n/a | n/a | n/a | n/a | n/a |
| 10, NM6 | 1.36 | 1.13 | 1.25 | n/a | n/a | n/a | n/a | n/a | n/a |
| 11, NM6 | 1.70 | 0.57 | 1.11 | n/a | n/a | n/a | n/a | n/a | n/a |
| 12, NM6 | 1.63 | 1.07 | 1.35 | n/a | n/a | n/a | n/a | n/a | n/a |
| Avg. 9-12 | 1.56 | 1.01 | 1.27 | n/a | n/a | n/a | n/a | n/a | n/a |
| 13, NM14 | 1.67 | 0.99 | 1.31 | n/a | n/a | n/a | n/a | n/a | n/a |
| 14, NM14 | 1.89 | 1.08 | 1.46 | n/a | n/a | n/a | n/a | n/a | n/a |
| 15, NM14 | 1.24 | 0.69 | 0.91 | n/a | n/a | n/a | n/a | n/a | n/a |
| 16, NM14 | 1.49 | 0.94 | 1.24 | n/a | n/a | n/a | n/a | n/a | n/a |
| Avg. 13-16 | 1.56 | 0.92 | 1.22 | n/a | n/a | n/a | n/a | n/a | n/a |

Table: Trade Average Offer Quantities and Prices, Each Session

# FINDING 4

Welfare is higher in economies with money than in economies without money.

# Support for Finding 4

| Session No., Treatment | Efficiency w.r.t First Best Eq. | | | Efficiency w.r.t. Monetary Eq. | | |
|---|---|---|---|---|---|---|
| | $1^{st}$ half | $2^{nd}$ half | All Periods | $1^{st}$ half | $2^{nd}$ half | All Periods |
| 1, M6 | 0.45 | 0.30 | 0.37 | 0.47 | 0.31 | 0.39 |
| 2, M6 | 0.46 | 0.53 | 0.49 | 0.48 | 0.55 | 0.52 |
| 3, M6 | 0.40 | 0.44 | 0.42 | 0.42 | 0.46 | 0.44 |
| 4, M6 | 0.36 | 0.60 | 0.43 | 0.38 | 0.63 | 0.45 |
| Avg. 1-4 | 0.42 | 0.47 | 0.43 | 0.44 | 0.49 | 0.45 |
| 4, M14 | 0.29 | 0.36 | 0.32 | 0.30 | 0.37 | 0.34 |
| 5, M14 | 0.30 | 0.21 | 0.25 | 0.31 | 0.22 | 0.26 |
| 6, M14 | 0.40 | 0.31 | 0.36 | 0.42 | 0.33 | 0.37 |
| 7, M14 | 0.35 | 0.27 | 0.30 | 0.36 | 0.29 | 0.32 |
| Avg. 5-8 | 0.34 | 0.28 | 0.31 | 0.36 | 0.30 | 0.39 |
| 7, NM6 | 0.28 | 0.36 | 0.33 | 0.30 | 0.38 | 0.35 |
| 8, NM6 | 0.34 | 0.26 | 0.30 | 0.36 | 0.27 | 0.31 |
| 9, NM6 | 0.14 | 0.07 | 0.10 | 0.15 | 0.08 | 0.11 |
| 10, NM6 | 0.39 | 0.31 | 0.35 | 0.41 | 0.33 | 0.37 |
| Avg. 9-12 | 0.29 | 0.25 | 0.27 | 0.30 | 0.26 | 0.29 |
| 11, NM14 | 0.22 | 0.20 | 0.21 | 0.23 | 0.21 | 0.22 |
| 12, NM14 | 0.28 | 0.24 | 0.26 | 0.29 | 0.25 | 0.27 |
| 13, NM14 | 0.16 | 0.17 | 0.17 | 0.17 | 0.18 | 0.17 |
| 14, NM14 | 0.28 | 0.17 | 0.23 | 0.29 | 0.18 | 0.24 |
| Avg. 13-16 | 0.23 | 0.19 | 0.21 | 0.24 | 0.20 | 0.22 |

Table: Efficiency Relative to First Best or Monetary Equilibrium, Each Session

# FINDING 5

Welfare is higher in treatment M6 as compared with treatment M14; there is no welfare difference between treatments NM6 and NM14.

Support for this finding is found in the same Table used in support of Finding 4.

# FINDING 6

In the M treatments, centralized market prices and trade volume are lower than predicted in the monetary equilibrium. The distribution of money holdings at the end of the centralized market is not degenerate. However, there is evidence that subjects are using the centralized meeting to re-balance their money holdings.

# Support for Finding 6

| Session No., Treatment | Particp. Rate | Avg. Centralized Mkt. Price | | | Avg. Centralized Mkt. Volume | | |
|---|---|---|---|---|---|---|---|
| | | $1^{st}$ half | $2^{nd}$ half | All Periods | $1^{st}$ half | $2^{nd}$ half | All Periods |
| 1, M6 | .81 | 1.16 | 1.30 | 1.23 | 8.08 | 5.46 | 6.77 |
| 2, M6 | .77 | 0.96 | 1.03 | 0.99 | 8.29 | 5.27 | 6.72 |
| 3, M6 | .87 | 1.26 | 1.55 | 1.41 | 4.29 | 3.80 | 4.03 |
| 4, M6 | .87 | 2.43 | 1.84 | 2.11 | 3.85 | 5.31 | 4.65 |
| Avg. 1-4 | .83 | 1.48 | 1.44 | 1.46 | 6.05 | 4.97 | 5.51 |
| 5, M14 | .79 | 1.30 | 1.58 | 1.45 | 9.82 | 6.67 | 8.17 |
| 6, M14 | .67 | 2.52 | 3.16 | 2.85 | 4.54 | 4.15 | 4.35 |
| 7, M14 | .80 | 1.67 | 2.31 | 1.99 | 12.18 | 9.00 | 10.59 |
| 8, M14 | .66 | 1.36 | 1.52 | 1.44 | 14.35 | 10.73 | 12.66 |
| Avg. 5-8 | .73 | 1.71 | 2.14 | 1.93 | 10.55 | 7.88 | 9.23 |

Table: Participation Rates, Market Prices and Volume in the Centralized Round of the Money Treatment Sessions

# Support for Finding 6, cont'd

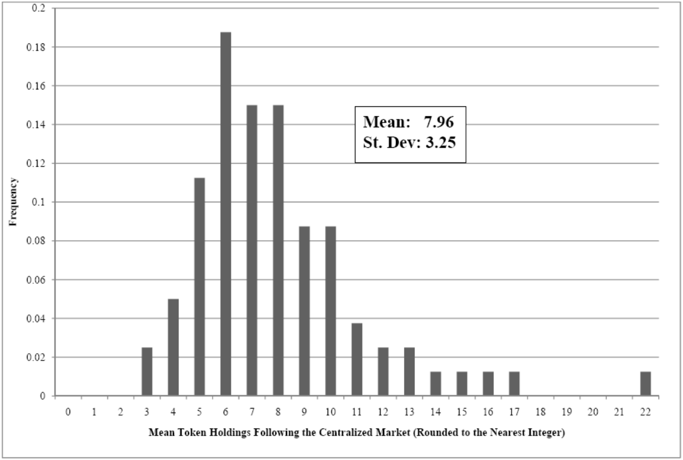
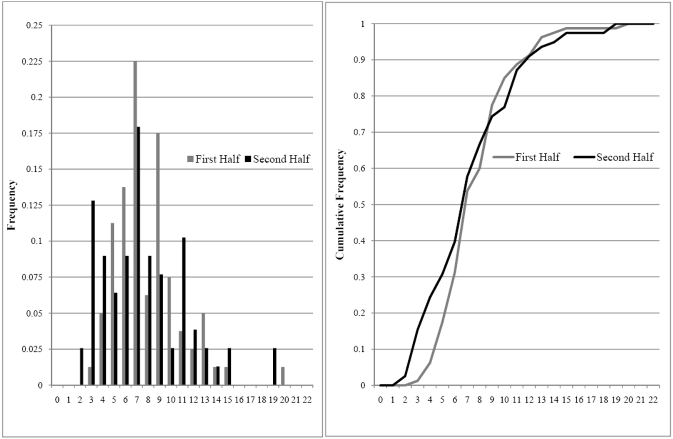
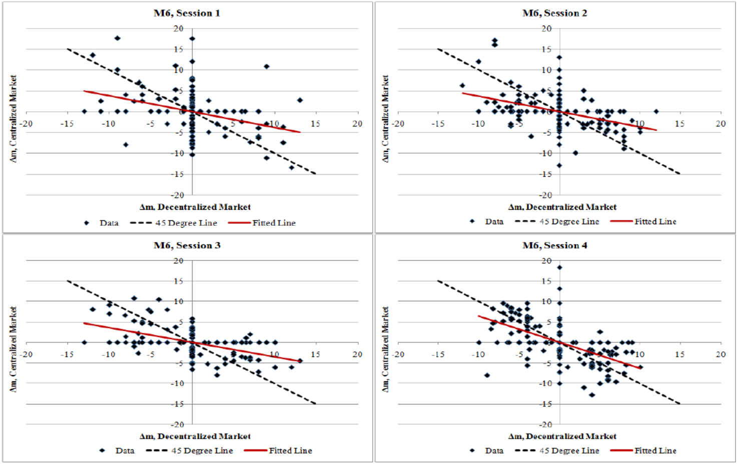



Figure: Frequency Distribution of Subjects' Mean Token Holdings Following All Centralized Meetings. Pooled Data From All 8 Money Sessions
Note: 80 individual observations. The smallest bar height = 1 subject and the tallest bar height (at 6 tokens) =15 subjects.

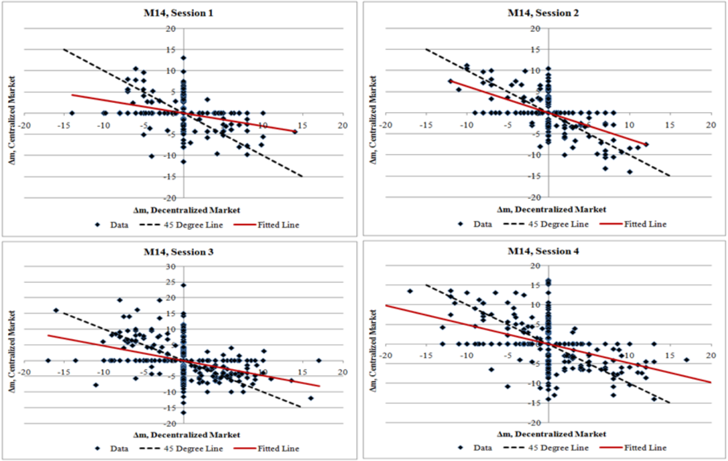
# Support for Finding 6, cont'd



# Support for Finding 6, cont'd



# Support for Finding 6, cont'd



# FINDING 7

In the NM treatments, contributions to the public good in the centralized meeting are close to zero irrespective of the population size.

# Support for Finding 7

| Session No., Treatment | Average Public Good Contribution | | |
|---|---|---|---|
| | $1^{st}$ half | $2^{nd}$ half | All Periods |
| 9, NM6 | 0.06 | 0.03 | 0.05 |
| 10, NM6 | 0.20 | 0.04 | 0.12 |
| 11, NM6 | 0.04 | 0.00 | 0.02 |
| 12, NM6 | 0.00 | 0.00 | 0.00 |
| Avg. 9-12 | 0.08 | 0.02 | 0.05 |
| 13, NM14 | 0.02 | 0.01 | 0.02 |
| 14, NM14, | 0.02 | 0.01 | 0.02 |
| 15, NM14, | 0.01 | 0.00 | 0.01 |
| 16, NM14, | 0.04 | 0.02 | 0.03 |
| Avg. 13-16 | 0.02 | 0.01 | 0.02 |

Table: Average Public Good Contributions in the Centralized Round of the No Money Treatment Sessions

# CONCLUSIONS AND FUTURE WORK

- Money is empirically essential and efficient social norms are difficult to emerge and sustain
- Robustness of money relative to other social norms
- What other institutional features facilitate the emergence and sustainability of cooperation? (CM is not enough)
- Will a Friedman rule be welfare improving?