Income interdependence and informal risk sharing under the shadow of the future

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Informal Risk Sharing

- Individuals may face income fluctuations.
- They may smooth consumption and protect themselves from bad times using insurance.
- In a society where market insurance is not available, an informal risk-sharing arrangement is crucial.
- Individuals facing adverse shocks may receive financial help in cash, in-kind transfers, or loans from those in better circumstances.

Literature

Development Economics

- Theory
  - Coate and Ravallion (1993)
  - Townsend (1994)
  - Kocherlakota (1996)
- Evidence
  - India: Townsend (1994), Ligon et al (2002)
  - Nigeria: Udry (1994)
  - The Philippines: Fafchamps and Lund (2003)
  - Kenya: Jack and Suri (2014)
  - China: Wu and Zhao (2020)

Literature

Experimental Economics

- In the field: Barr and Genicot (2008)
  - One-shot game
  - Social ties: Barr et al (2012), Attanasio et al (2012), Chandrasekhar et al (2018), Islam et al (2020)
- In the lab: Charness and Genicot (2009)
  - Infinitely repeated game

Charness and Genicot (2009)

Infinitely-repeated risk-sharing game

- Subjects are randomly assigned to a group of two (fixed partners) for an uncertain number of periods in each segment.
- After a segment has ended, each subject will be randomly assigned a new partner for the next segment.
- The number of segments is also uncertain.

Charness and Genicot (2009)

Two stages in each period:

- **Stage 1:** Each player receives an endowment and a 50% chance to receive additional income. Only one of the players receives the extra income.
- **Stage 2:** Each player privately and simultaneously chooses the transfer amount to the paired subject.

Charness and Genicot (2009)

Observe more transfer:

- with higher match continuation probability
- in treatments with equal endowment
- from more risk-averse subjects
- from men

Motivation

- Charness and Genicot (2009) assume that there is always one (random) player that receives extra income.
  - Favorable for risk sharing since one player can always help the other.
- In many situations, individuals face similar shocks to their income, especially when they are neighbors or have similar characteristics.
  - The income correlation will not be -1, as assumed in Charness and Genicot (2009).
- This paper considers risk-sharing agreements under different income correlations.

The Model

- Infinitely repeated game with two risk-averse players
- In each period, each player is given an initial income of L and a random extra income $Y_{i,t}$.
- Suppose that the support of $Y_{i,t}$ is $\{0, y\}$, with $y > 0$ and the joint PDF of $Y_{1,t}$ and $Y_{2,t}$ is given by

$$f(y_{1,t}, y_{2,t}) = \begin{cases} \frac{m-1}{2m} & \text{if } y_{1,t} = y_{2,t} \\ \frac{1}{2m} & \text{if } y_{1,t} \neq y_{2,t} \end{cases}$$

where $m \geq 1$.

The Model

Two implications:

- $Prob(Y_{i,t} = y) = Prob(Y_{i,t} = 0) = \frac{1}{2}$ for $i = 1, 2$.
- $Corr(Y_{1,t}, Y_{2,t}) = \frac{m-2}{m}$ where $m \geq 1$.

m	Corr	$y_{1,t} = y$, $y_{2,t} = y$	$y_{1,t} = y$, $y_{2,t} = 0$	$y_{1,t} = 0$, $y_{2,t} = y$	$y_{1,t} = 0$, $y_{2,t} = 0$
1	-1	0	1/2	1/2	0
2	0	1/4	1/4	1/4	1/4
3	1/3	1/3	1/6	1/6	1/3
⋮	⋮	⋮	⋮	⋮	⋮
∞	1	1/2	0	0	1/2

The Model

Define

- $H = L + y$
- δ = discount factor
- V_{t+1}= sum of all discounted utilities beginning in period $t + 1$
- rsa = risk sharing agreement: the player with income H to transfer x to the player with income L
- aut = autarky: no transfer between players

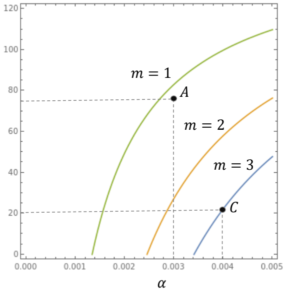
Implementability (or sustainability) constraint:

$$u(H - x) + V_{t+1}^{rsa} \geq u(H) + V_{t+1}^{aut}$$

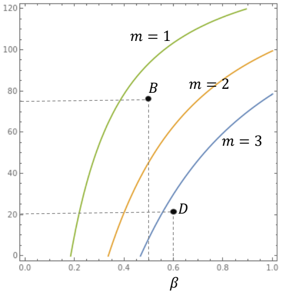
The Model

Numerical examples:

- CARA: $u(w) = -e^{-\alpha w}$ where $\alpha > 0$
- CRRA: $u(w) = w^{1-\beta}$ where $\beta \in (0, 1)$
- $L = 75$ and $H = 225$
- $H - L = 150 \rightarrow$ first-best transfer $= 75$.
- $\delta = 0.9$
- $m = 1, 2, 3$



(a) CARA



(b) CRRA

Figure: Maximum sustainable transfer in equilibrium

Note: $m = 1 \rightarrow Corr = -1,\ m = 2 \rightarrow Corr = 0,\ m = 3 \rightarrow Corr = \frac{1}{3}$.

Experimental Design

- Subjects are randomly assigned to a group of two (with the same counterpart) for an uncertain number of periods in each segment.
- The probability that a period is the last period of the segment is 10%.
- After a segment has ended, each subject will be randomly assigned a new counterpart for the next segment.

Experimental Design

Two stages in each period.

- **Stage 1:** Each player receives 75 units and a 50% chance to receive additional 150 units.
  - with negative/zero/positive correlation coefficients
- **Stage 2:** Notify about the outcomes and privately and simultaneously chooses the transfer amount to the counterpart.

Treatments

Treatment		Probability of extra income given to			
m	Corr	Both players	Self	The other	Neither
1	-1	0	1/2	1/2	0
2	0	1/4	1/4	1/4	1/4
3	1/3	1/3	1/6	1/6	1/3

Experimental Procedures

- The University of Alabama's TIDE Lab
- 3 treatments $\times$ 10 cohorts $\times$ 6 subjects $=$ 180 subjects.
- Number of segments, number of periods in each segment, and matching in each segment were randomly determined once and applied across all cohorts.

Experimental Procedures

Before the main experiment, we collect information about risk preference (Gneezy and Potters, 1997).

- Subject earns 50 points and chooses how much to invest in a risky option.
- Risky option: Either lose or receive 2.5 times the amount invested with the same probability.

Experimental Procedures

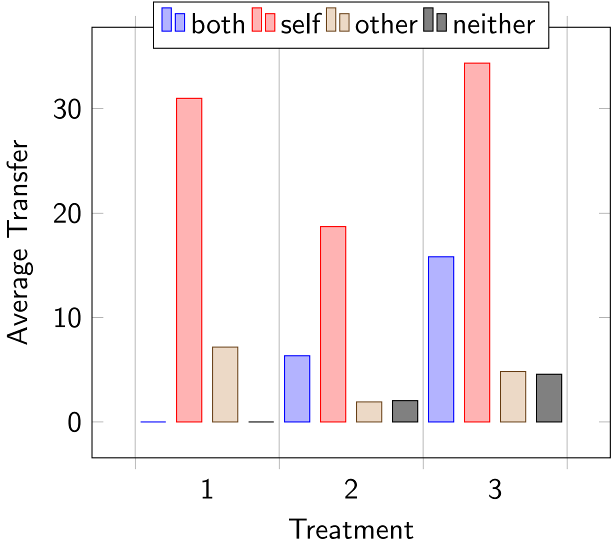
- Each session lasted approximately 70 minutes.
- Earning = risk preference experiment + one random period from risk sharing experiment.
    - A conversion rate = 15 units for one dollar from both experiments.
    - Average earning = $22 ($7.50 show-up fee included).
- Subjects are the University of Alabama undergraduate students. (Approx 40% are men)
- Survey includes questions about the game, descriptive characteristics, and CRT (average 2.2 out of 5).

Average Transfer

Treatment		Average transfer when extra income given to				
m	Corr	Both players	Self	The other	Neither	All cases
1	-1	N/A	31.00 (37.50) [3,210]	7.17 (13.20) [3,210]	N/A	19.09 (30.53) [6,420]
2	0	6.34 (19.51) [1,642]	18.71 (27.51) [1,566]	1.92 (5.69) [1,566]	2.04 (5.48) [1,646]	7.18 (18.53) [6,420]
3	$^1/_3$	15.82 (32.17) [2,176]	34.37 (33.68) [1,042]	4.83 (10.94) [1,042]	4.57 (11.33) [2,160]	13.26 (26.62) [6,420]

Notes: 1. Standard deviations are shown in parentheses.
2. Numbers of observations are shown in brackets.

Average Transfer by Treatment

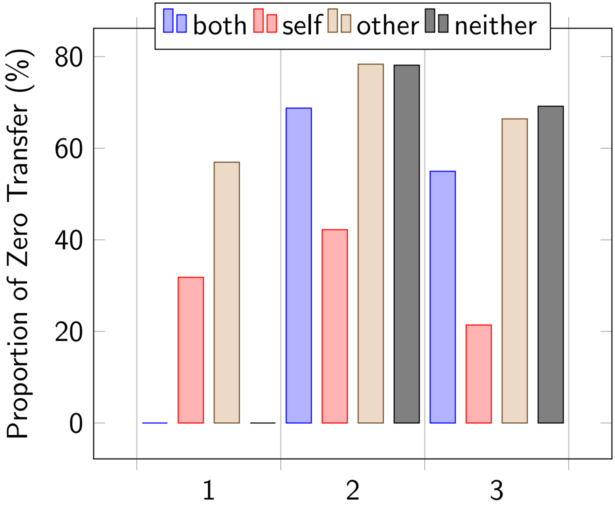


Zero Transfer

Treatment		Proportion of zero transfers when extra income given to				
m	Corr	Both players	Self	The other	Neither	All cases
1	-1	N/A	31.81% [3,210]	56.95% [3,210]	N/A	44.38% [6,420]
2	0	68.76% [1,642]	42.21% [1,566]	78.35% [1,566]	78.13% [1,646]	67.02% [6,420]
3	$^1/_3$	54.96% [2,176]	21.40% [1,042]	66.41% [1,042]	69.17% [2,160]	56.15% [6,420]

Note: Numbers of observations are shown in brackets.

Proportion of Zero Transfer by Treatment



Distribution of Transfers

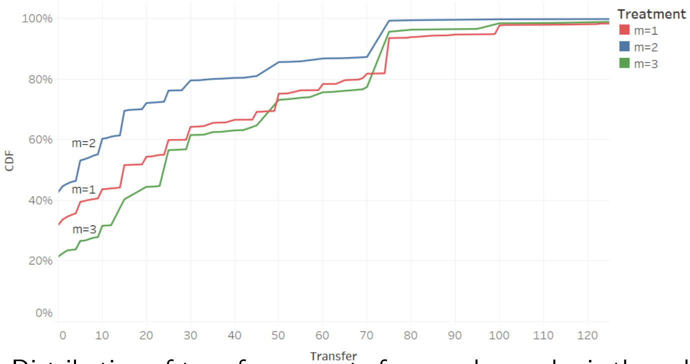


Figure: Distribution of transfer amounts from a player who is the only one receiving extra income

Average Transfer by Period

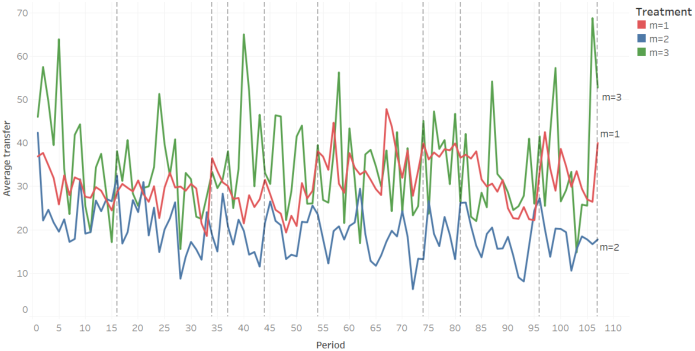


Figure: Average transfer by period from a player who is the only one receiving extra income

Regression Analysis (Tobit Models)

I. Determinants of transfers in all cases

	(1) Standard		(2) Clustered		(3) RE	
	Coef	S.E.	Coef	S.E.	Coef	S.E.
$m = 1$	20.12***	0.892	20.12***	0.940	21.03***	4.485
$m = 3$	8.581***	0.896	8.581***	0.913	12.61***	4.490
Invest	−0.173***	0.031	−0.173***	0.033	−0.254	0.157
Men	0.062	0.763	0.062	0.770	−0.567	3.995
CorrectCRT	−2.774***	0.251	−2.774***	0.256	−2.979**	1.292
Others1stTrans	1.665***	0.063	1.665***	0.085	0.943***	0.062
Others1stTrans × *H*	−1.167***	0.061	−1.167***	0.082	−0.615***	0.061
SegmentPeriod	−0.669***	0.071	−0.669***	0.072	−0.668***	0.067
Constant	−19.79***	1.182	−19.79***	1.229	−15.00***	5.245

Notes: 1. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.
2. $m = 2$ is the base category.
3. $N = 19,260$.

Regression Analysis (Tobit Models)

II. Determinants of transfers from a player who is the only one receiving extra income

	(1) Standard		(2) Clustered		(3) RE	
	Coef	S.E.	Coef	S.E.	Coef	S.E.
$m = 1$	7.610***	1.347	7.610***	1.491	10.68*	5.485
$m = 3$	17.98***	1.670	17.98***	1.678	22.60***	5.548
Invest	−0.262***	0.047	−0.262***	0.051	−0.163	0.193
Men	4.436***	1.205	4.436***	1.222	3.154	4.915
CorrectCRT	0.716*	0.391	0.716*	0.397	0.993	1.588
Others1stTrans	1.833***	0.148	1.833***	0.197	1.053***	0.124
Others1stTrans × *H*	−1.150***	0.147	−1.150***	0.194	−0.640***	0.122
SegmentPeriod	−0.662***	0.111	−0.662***	0.113	−0.665***	0.090
Constant	−2.011	1.863	−2.011	1.841	0.447	6.447

Notes: 1. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.
2. $m = 2$ is the base category.
3. $N = 5,818$.

Regression Analysis (Tobit Models)

III. Determinants of first-time transfer from a player who is the only one receiving extra income

	(1) Standard		(2) Clustered		(3) RE	
	Coef	S.E.	Coef	S.E.	Coef	S.E.
$m = 1$	19.77***	2.769	19.77***	2.885	18.93***	6.118
$m = 3$	25.50***	2.915	25.50***	2.775	26.40***	6.160
Invest	0.011	0.099	0.011	0.107	0.020	0.215
Men	3.608	2.514	3.608	2.555	3.277	5.470
CorrectCRT	1.212	0.815	1.212	0.820	0.973	1.769
Constant	5.365	3.304	5.365*	3.128	5.331	7.139

Notes: 1. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.
2. $m = 2$ is the base category.
3. $N = 1,526$.

Altruistic players

- $v(w_{i,t}, w_{-i,t}) = u(w_{i,t}) + \gamma u(w_{-i,t})$ where $\gamma \in [0, 1)$.
- V_{t+1}= sum of all discounted utilities $v(w_{i,t}, w_{-i,t})$ beginning in period $t + 1$

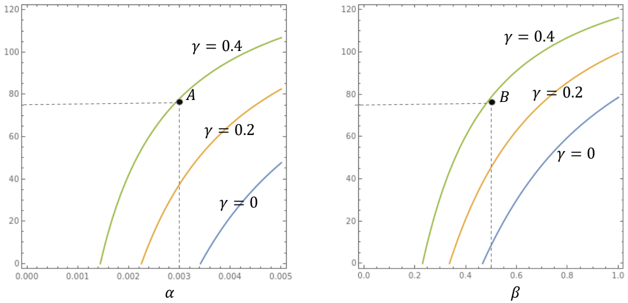
Implementability (or sustainability) constraint:

$$v(H - x, L + x) + V^{rsa}_{t+1} \geq v(H, L) + V^{aut}_{t+1}$$

The Model

Numerical examples:

- Same parameters with $m = 3$ only
- $\gamma = 0, 0.2, 0.4$



(a) CARA (b) CRRA

Figure: Maximum transfer in equilibrium given $m = 3$

Summary

- Experimental results support the model of risk sharing without commitment.
  - Transfer more often & with a higher amount when they receive extra income and their counterparts do not.
  - Men, risk-averse subjects, and those with more correct CRT questions engage more in risk sharing.

Summary

- Theory predicts a negative relationship between the correlation of receiving the extra income and engagement in risk sharing.
- In contrast, we observe that subjects in the treatment with a positive correlation transfer the most often and with the highest amount.
- To explain this result, we include directed altruism in the theoretical model.

Areas for future research

- Framing as a loss instead of gain
- Insurance vs. Risk sharing

Thank you!