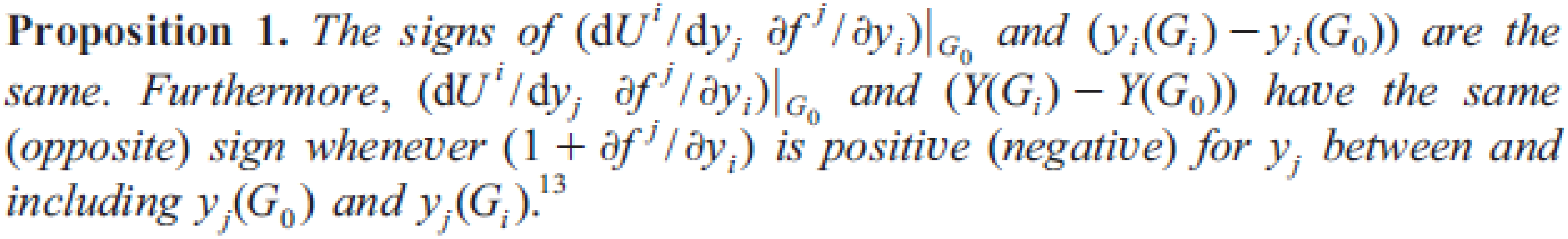
Econ 2230: Public Economics

Lecture 18: Announcement: changing the set of equilibria

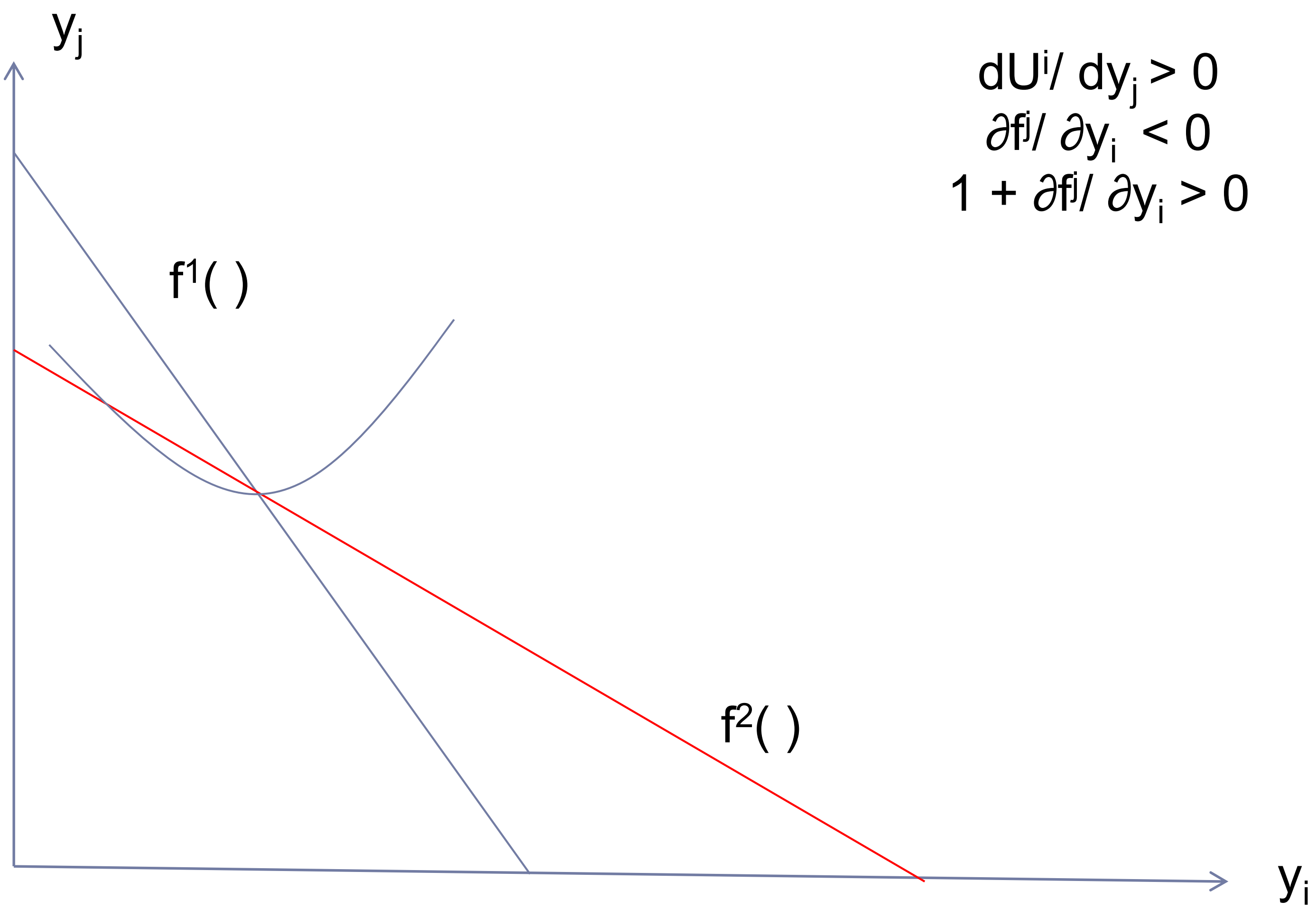
Review

- Romano and Yildirim



Proposition 1. *The signs of* $(\mathrm{d}U^i/\mathrm{d}y_j\ \ \partial f^j/\partial y_i)|_{G_0}$ *and* $(y_i(G_i)-y_i(G_0))$ *are the same. Furthermore,* $(\mathrm{d}U^i/\mathrm{d}y_j\ \ \partial f^j/\partial y_i)|_{G_0}$ *and* $(Y(G_i)-Y(G_0))$ *have the same (opposite) sign whenever* $(1+\partial f^j/\partial y_i)$ *is positive (negative) for* y_j *between and including* $y_j(G_0)$ *and* $y_j(G_i)$.[13]

When public good aspect dominates sequential giving decreases giving

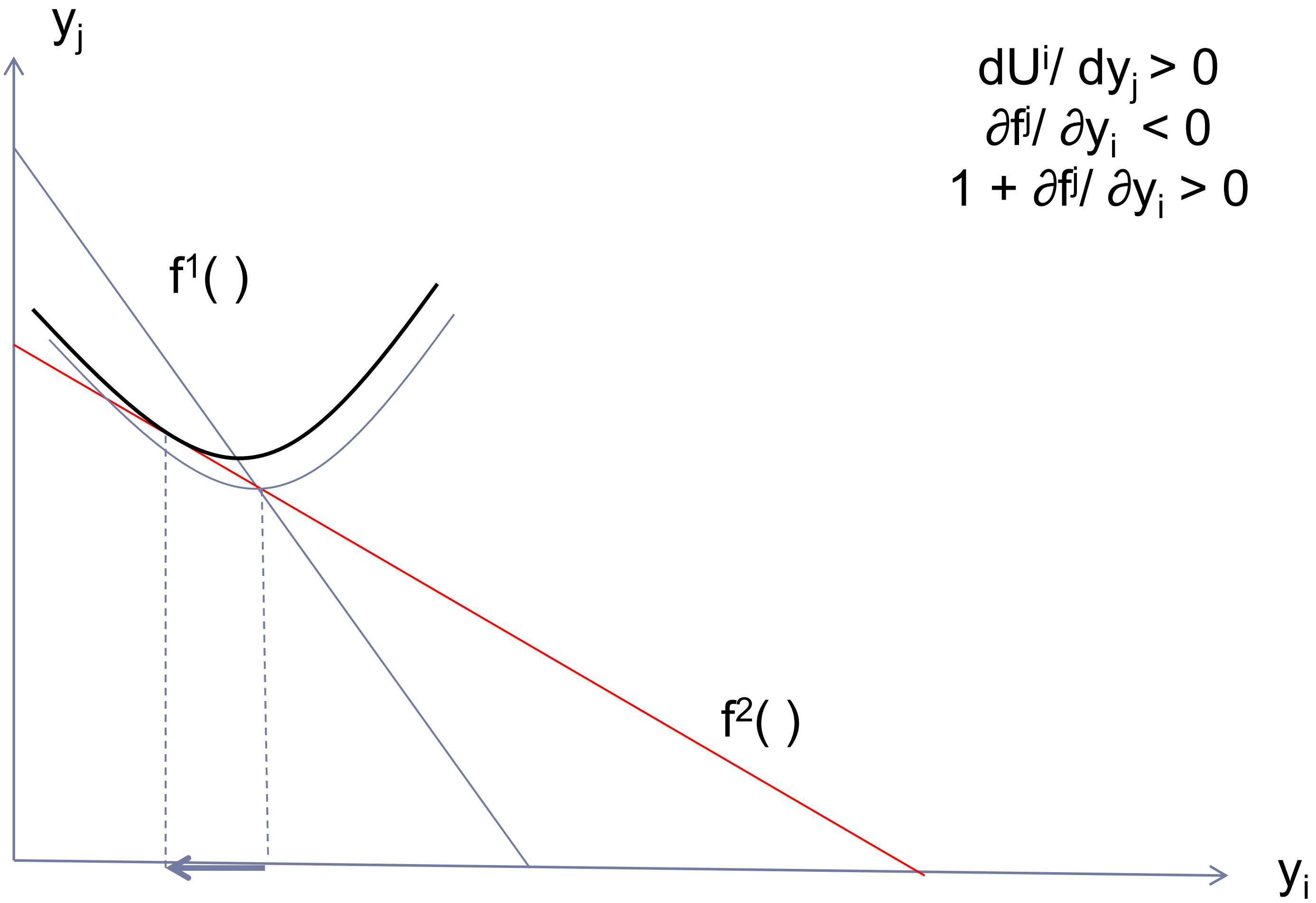


$dU^i / dy_j > 0$

$\partial f^j / \partial y_i < 0$

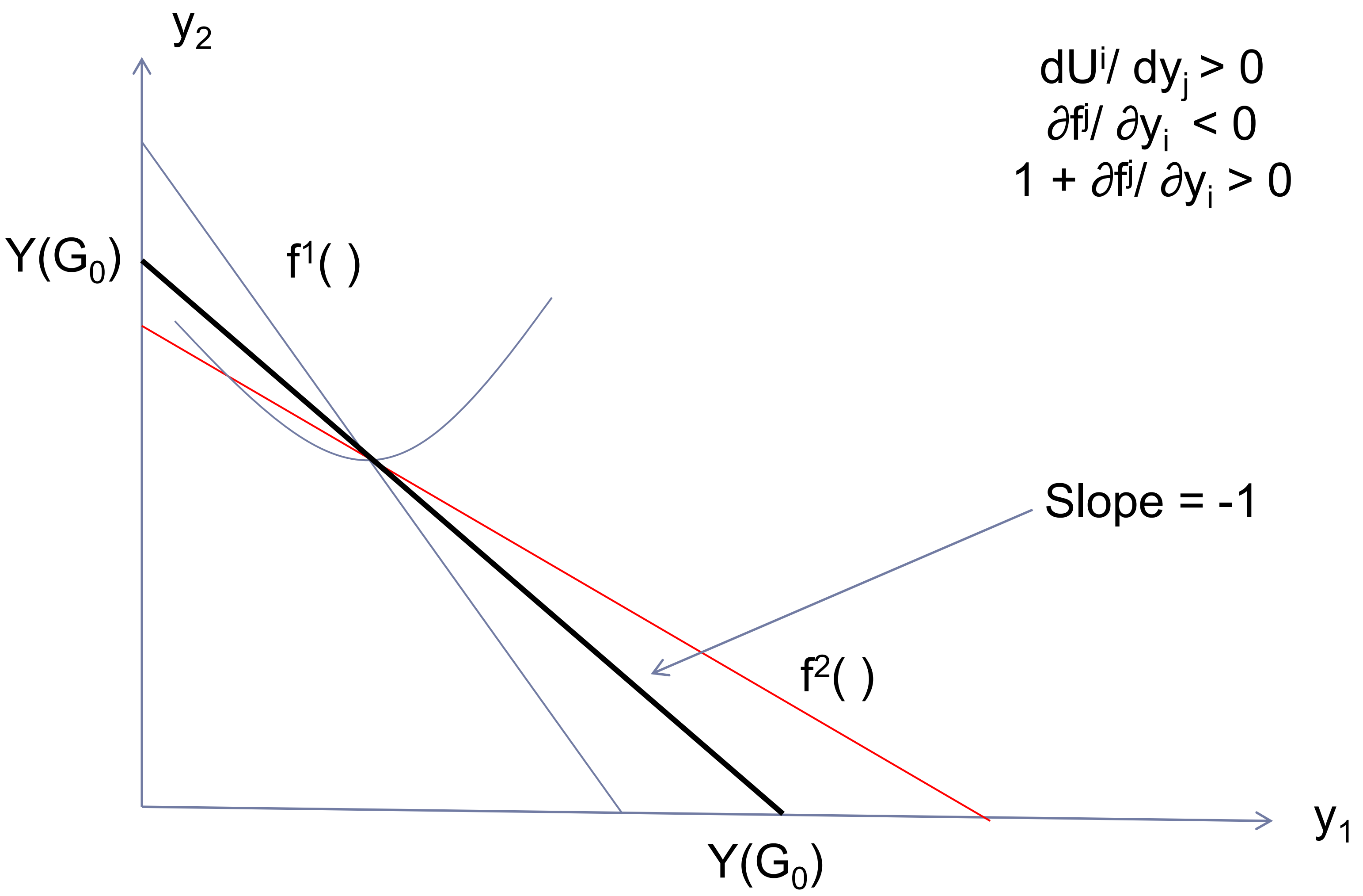
$1 + \partial f^j / \partial y_i > 0$

When public good aspect dominates sequential giving decreases giving



$$dU^i / dy_j > 0$$
$$\partial f^j / \partial y_i < 0$$
$$1 + \partial f^j / \partial y_i > 0$$

When public good aspect dominates sequential giving decreases giving



$dU^i/ dy_j > 0$

$\partial f^j/ \partial y_i < 0$

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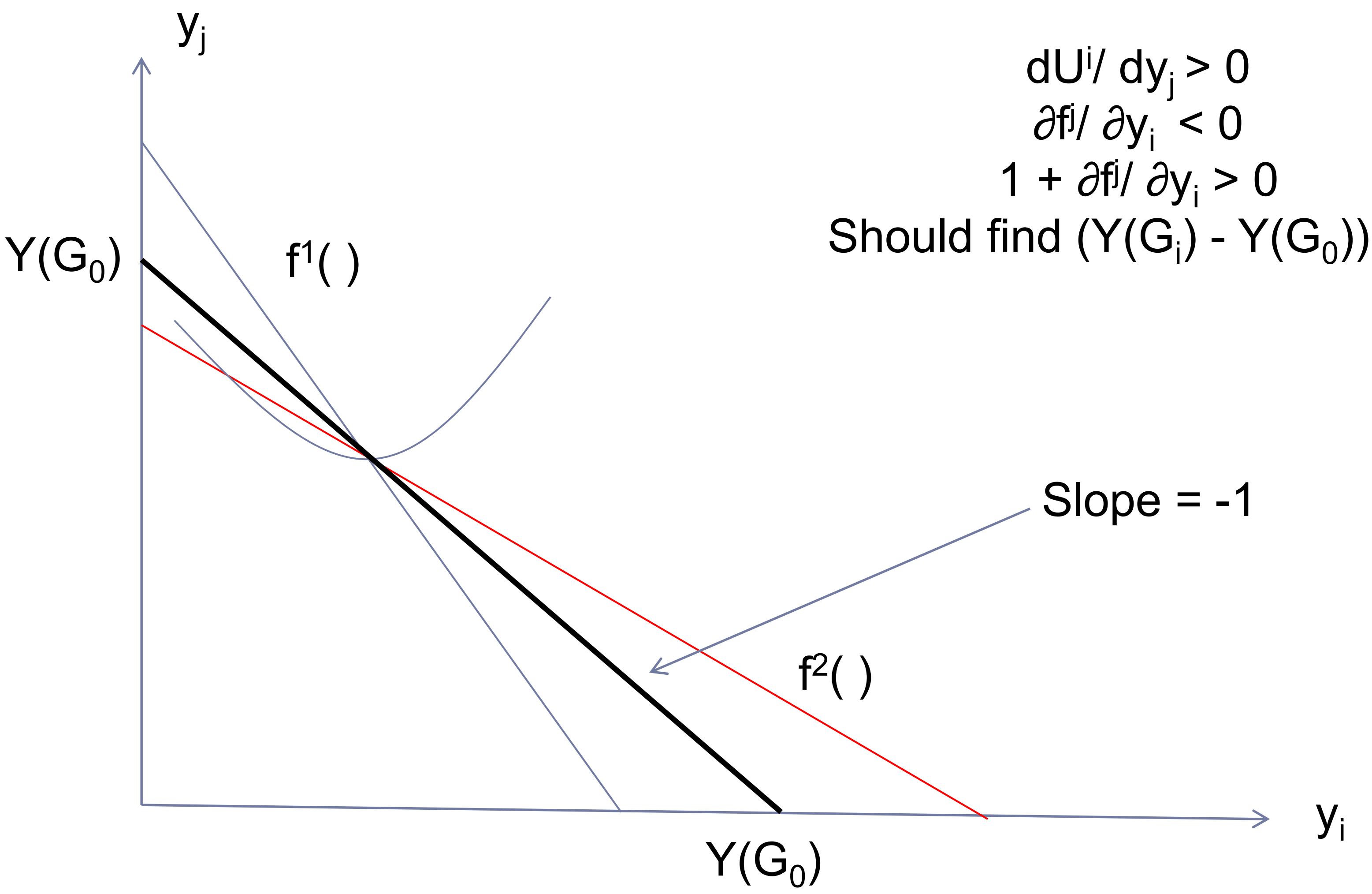
When public good aspect dominates sequential giving decreases giving



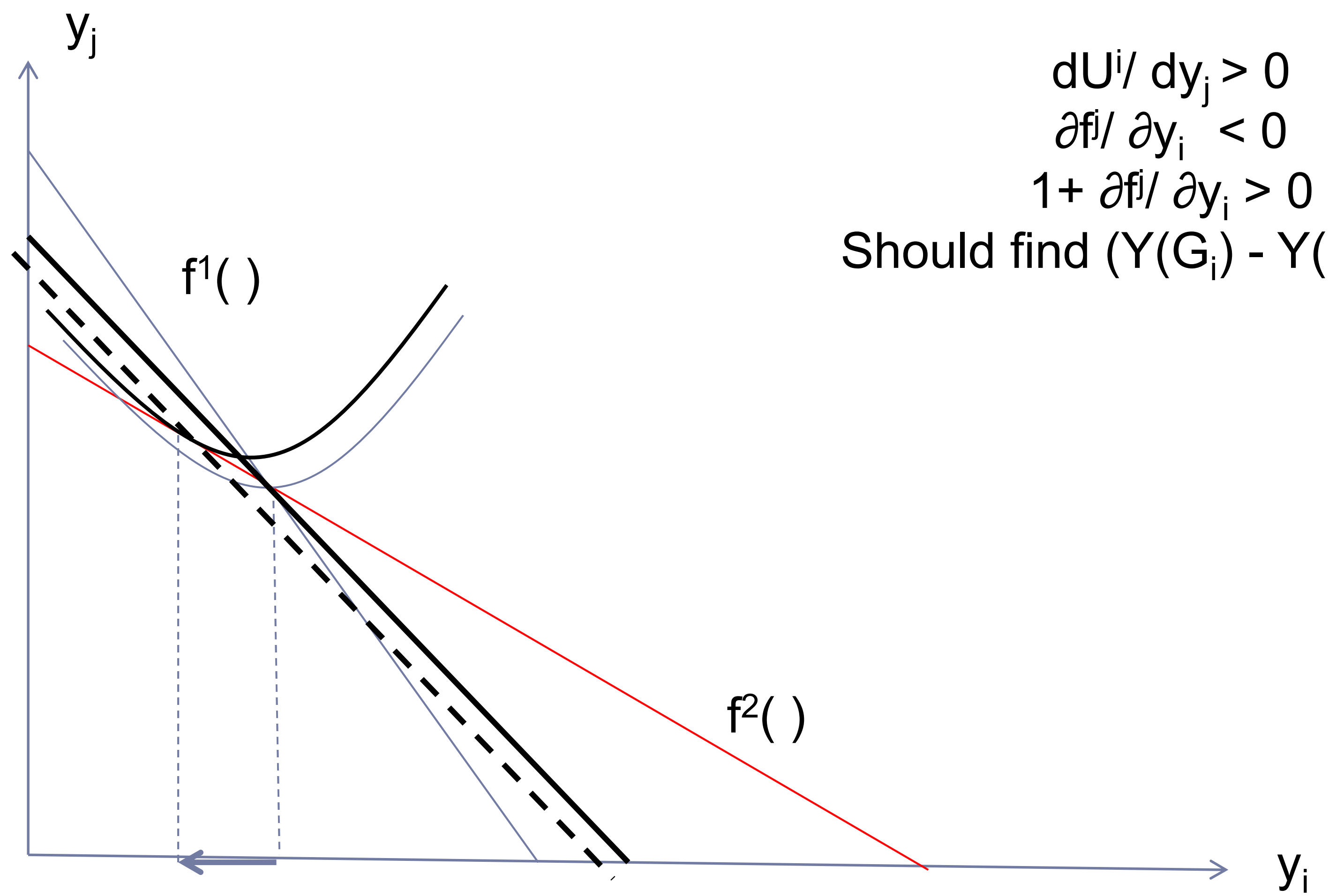
$dU^i/ dy_j > 0$

$\partial f^j/ \partial y_i < 0$

$1 + \partial f^j/ \partial y_i > 0$

Should find $(Y(G_i) - Y(G_0)) < 0$

When public good aspect dominates sequential giving decreases giving



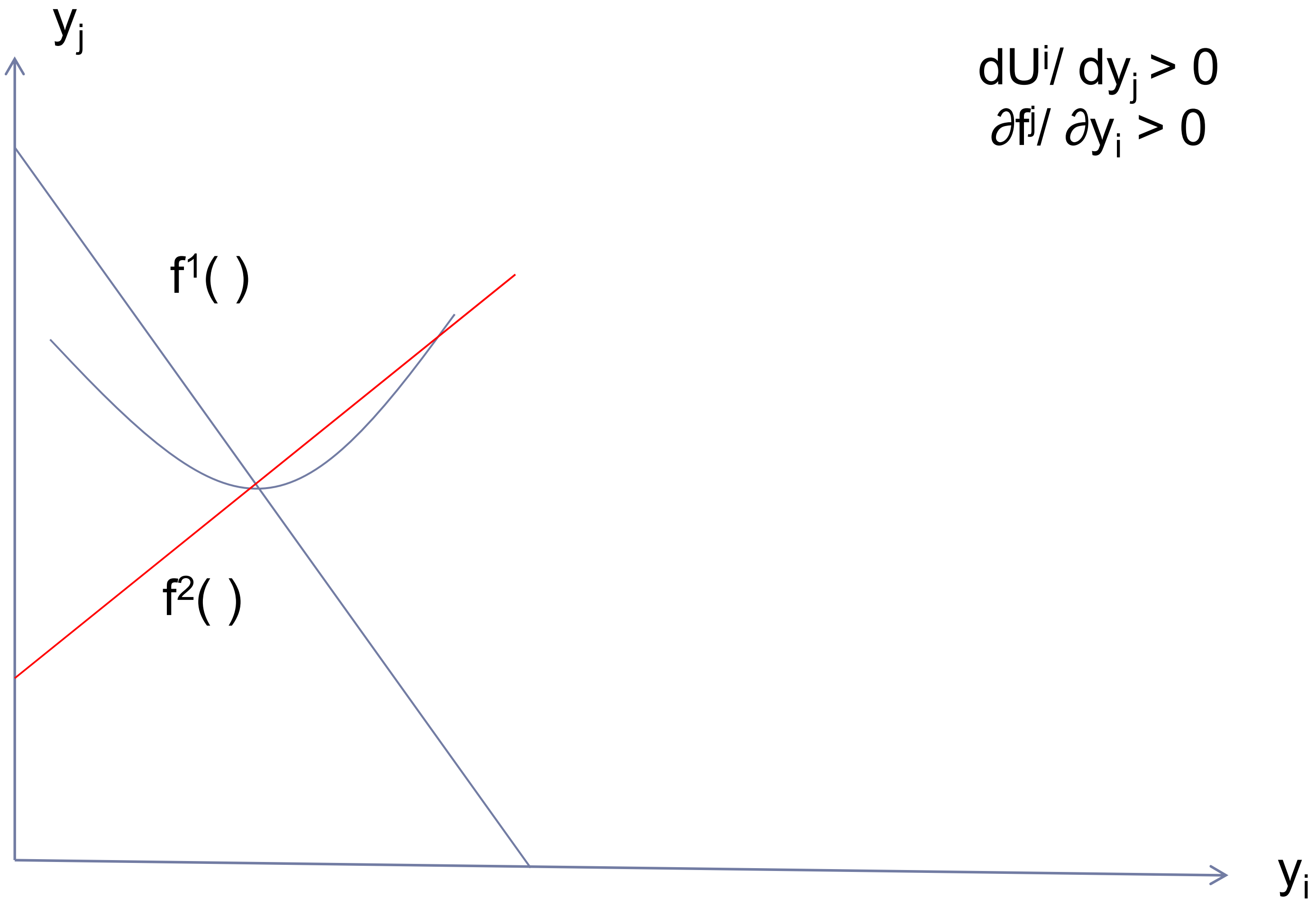
$dU^i / dy_j > 0$

$\partial f^j / \partial y_i < 0$

$1 + \partial f^j / \partial y_i > 0$

Should find $(Y(G_i) - Y(G_0)) < 0$

Sequential moves can increase giving when best response function upward sloping



$dU^i / dy_j > 0$

$\partial f^j / \partial y_i > 0$

Sequential moves can increase giving when best response function upward sloping

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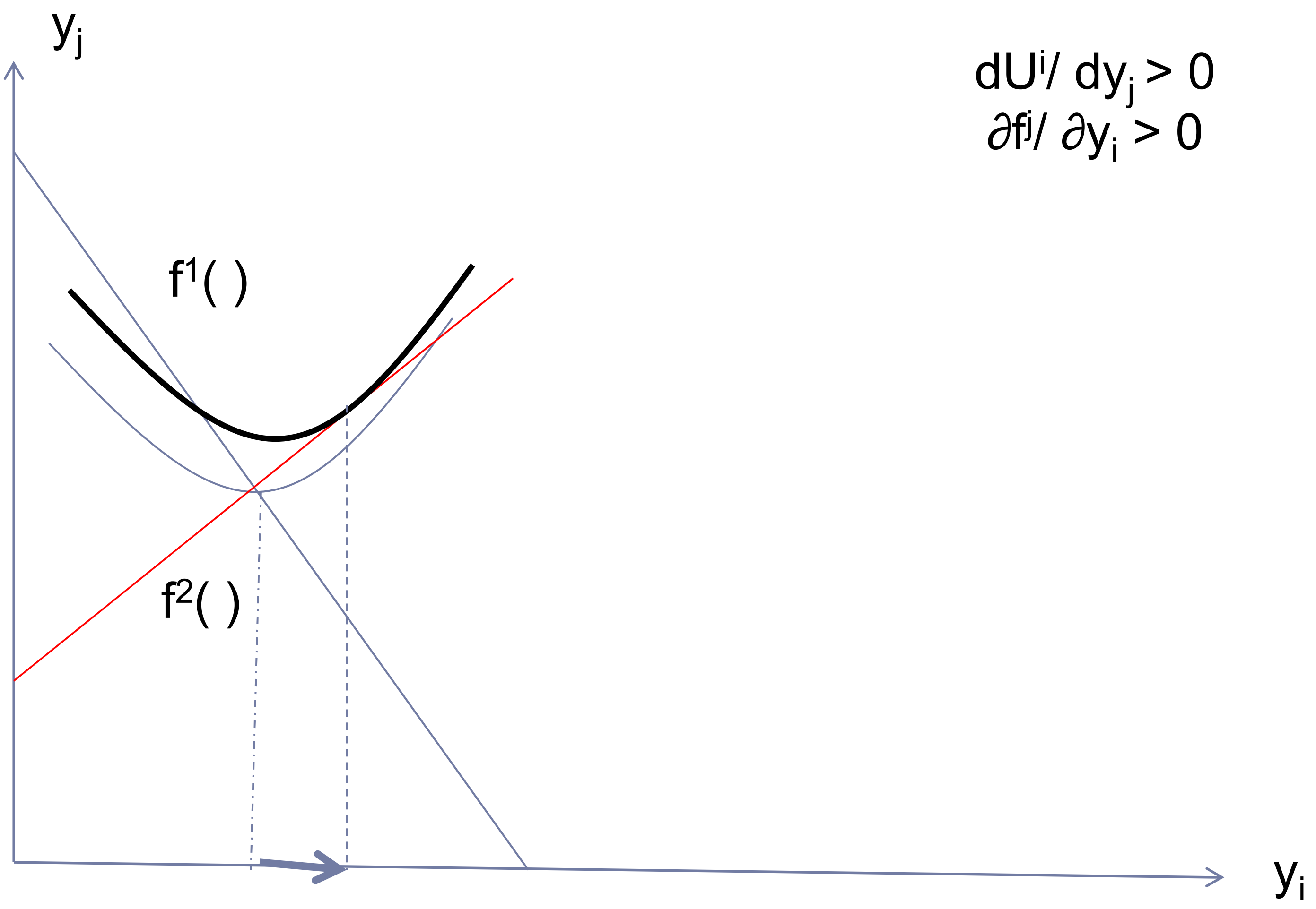


Laboratory evidence on sequential giving

- Lab experiments: mixed evidence on sequential giving increasing contributions
  - Andreoni, Brown, and Vesterlund, (*GEB* 2002)
    - Quasi linear preferences
    - Smaller contributions with sequential giving
  - Gaechter and Renner, (*JCR* 2003)
    - No effect in linear public good environment
  - Gaechter, Nosenzo, Renner and Sefton (*JPubE* 2010)
    - Quasi linear preferences
    - Smaller contributions with sequential moves
  - Moxnes and Van der Heijden (2003)
    - Leader improves outcome in public bad setting
  - Meidinger and Villeval (WP)
    - leading-by-example effective

So why might we see announcements?

- Does not appear that preferences alone give rise to upward sloping best response functions

- Need to have a theory for what might give rise to “upward sloping best response functions”

- Chairman of trustees, Johns Hopkins:
  - “Fundamentally we are all followers. If I can get somebody to be the leader, others will follow. I can leverage that gift many times over.”

- Explanation involves increasing leader and follower contribution
  - Changes the set of equilibria
  - Information
  - Reciprocity
  - Status

Today

- Examine explanations which rely on the fact that the set of equilibria may change when moving sequentially.
- Arise when production of public good not continuous

1. Discrete provision and refunds (Bagnoli and Lipman, 1989)
2. Fixed cost of production and sequential moves (Andreoni, 1998)
3. Refunds and seeds in the field (List and Lucking-Reiley, 2002)
4. Fixed cost in the lab (Bracha, Menietti and Vesterlund, 2009)
5. [Completion benefit (Marx and Matthews, 2000; Duffy, Ochs, and Vesterlund, 2007)]

1. Discrete provision of public good (Bagnoli and Lipman, 1989)

- The one street light problem: D = {0,1}
- Let
  - $U(x_i , D)$
  - $U(w_i,0) =0$
  - c denote the cost of providing the street light
  - v_i denote i's maximum willingness to pay such that $U(w_i- v_i,1) =0$
  -
- Efficiency requires that D=1 when $\sum_i v_i > c$ and 0 otherwise

Bagnoli and Lipman, 1989

- Fundraiser 1:
  - if $\sum_i g_i \geq c$ let D=1 and keep any proceeds $\sum_i g_i - c$
  - if $\sum_i g_i < c$ let D=0 and keep $\sum_i g_i$
- Equilibria :
- $\sum_i v_i < c$:
  - Zero provision: $g_i^* = 0 \ \forall i$

Bagnoli and Lipman, 1989

- Fundraiser 1:
  - if $\sum_i g_i \geq c$ let D=1 and keep any proceeds $\sum_i g_i - c$
  - if $\sum_i g_i < c$ let D=0 and keep $\sum_i g_i$
- Equilibria :
- $\sum_i v_i \geq c$:
  - If $v_i < c \ \forall i$ two possible equilibria
  - Zero provision: $g_i^* = 0 \ \forall i$
  - Positive provision: $\sum_i g_i^* = c$

  - If $v_i \geq c$ some i
  - There is a unique Nash equilibrium where $\sum_i g_i^* = c$

Bagnoli and Lipman, 1989

- Fundraiser 2:
  - if $\sum_i g_i \geq c$ let D=1 and keep any proceeds $\sum_i g_i$ - c
  - if $\sum_i g_i < c$ let D=0 and **refund** $\sum_i g_i$
- Equilibria :
- $\sum_i v_i < c$:
  - Zero provision: $g_i^* = 0\ \forall i$
- $\sum_i v_i \geq c$:
  - If $v_i \geq c$ some i
  - Positive provision: $\sum_i g_i^* = c$

  - If $v_i < c\ \forall i$ many possible equilibria
  - Zero provision: $\sum_i g_i^* < c$ and $v_i < c - \sum_{j \neq i} g_j^*\quad \forall i$
  - Positive provision: $\sum_i g_i^* = c$

Bagnoli and Lipman, 1989

- $\sum_i v_i \geq c$:
  - If $v_i < c \ \forall i$ many possible equilibria
  - Zero provision: $\sum_i g_i^* < c$ and $v_i < c - \sum_{j \neq i} g_j^* \quad \forall i$
  - Positive provision: $\sum_i g_i^* = c$

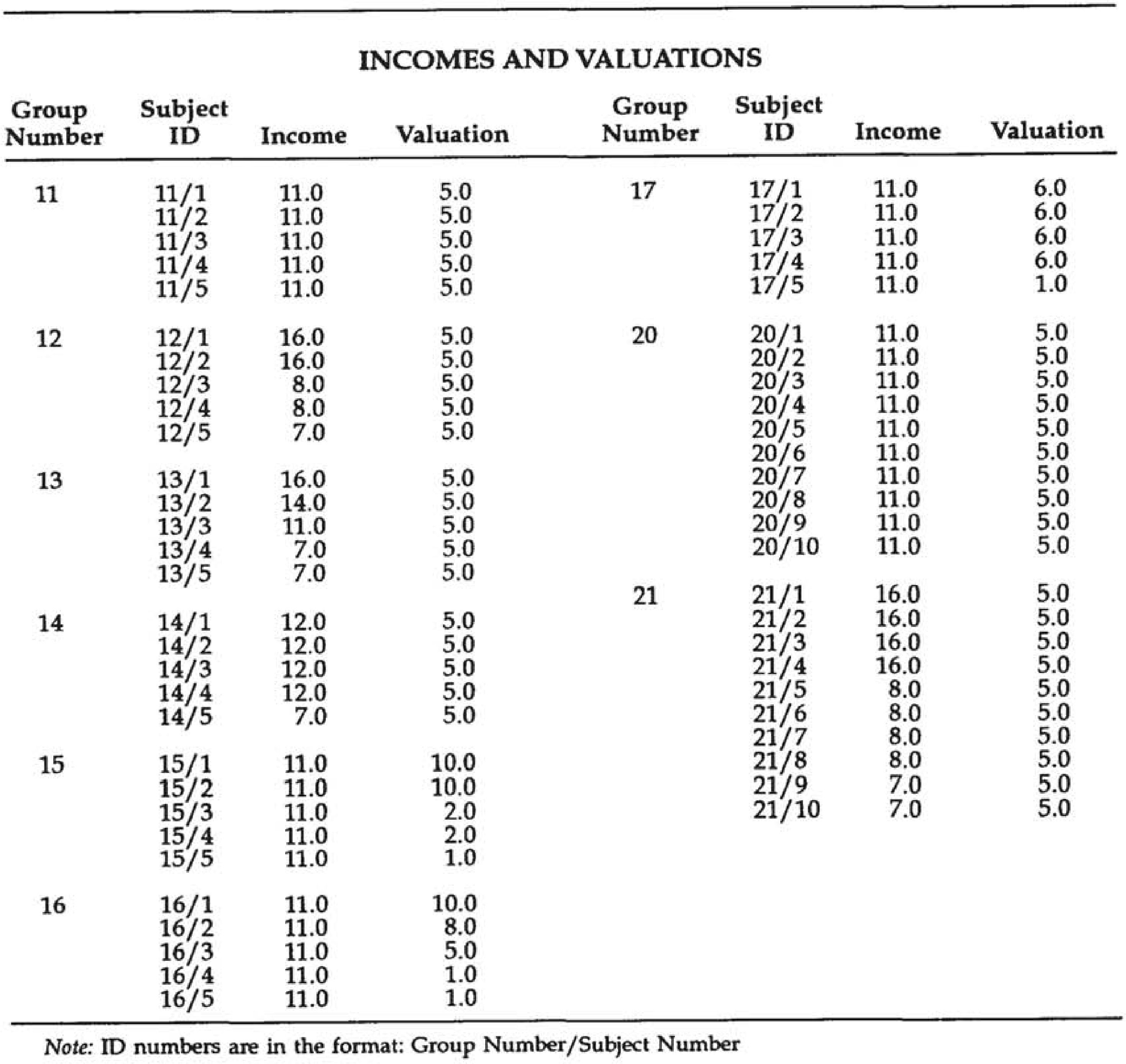
- Are the zero provision equilibria perfect?
  - Is each agent's strategy robust to small probabilities of 'mistakes'?
  - No Nash with $g_i^* > v_i$ is perfect
  - Some inefficient equilibria are however perfect
  - Suppose $c=1$, $n=2$, $v_1 = v_2 = 0.6$, then $g_i^* = 0$ is a perfect equilibrium
  - Need to construct trembles supporting it. Put $1- \varepsilon$ on 0, and $k\varepsilon/(1+k)$ on 1 and the rest of the probability on the remaining strategies. Choose k to be large. Then virtually certain partner plays 0 or 1, thus best response is to give 0

Bagnoli and Lipman, 1989

- Put 1- ε on 0, and kε/ (1+k) on 1 and the rest of the probability on the remaining strategies.
- Is it reasonable to consider this type of tremble?
- Require partner most likely to tremble to contribute more than valuation
- Consider instead undominated perfect equilibria (UPE): Eliminate dominated strategies even as trembles
- Eliminate contributions in excess of 0.6 as trembles. Then contributions below 0.4 are strictly dominated.
- The UPE of the refund game are efficient

Experimental evidence on refunds

- Bagnoli and McKee, 1991
  - Treatment 1: N = 5, C=12.5 and $\sum_i v_i = 25$
  - Treatment 2: N = 10, C=25 and $\sum_i v_i = 50$
  - Baseline: $v_i = 5$ and $w_i = 10$, but varied income and valuations as well
  - Contributions in excess of cost kept (no rebate)



INCOMES AND VALUATIONS

Group Number	Subject ID	Income	Valuation
11	11/1	11.0	5.0
	11/2	11.0	5.0
	11/3	11.0	5.0
	11/4	11.0	5.0
	11/5	11.0	5.0
12	12/1	16.0	5.0
	12/2	16.0	5.0
	12/3	8.0	5.0
	12/4	8.0	5.0
	12/5	7.0	5.0
13	13/1	16.0	5.0
	13/2	14.0	5.0
	13/3	11.0	5.0
	13/4	7.0	5.0
	13/5	7.0	5.0
14	14/1	12.0	5.0
	14/2	12.0	5.0
	14/3	12.0	5.0
	14/4	12.0	5.0
	14/5	7.0	5.0
15	15/1	11.0	10.0
	15/2	11.0	10.0
	15/3	11.0	2.0
	15/4	11.0	2.0
	15/5	11.0	1.0
16	16/1	11.0	10.0
	16/2	11.0	8.0
	16/3	11.0	5.0
	16/4	11.0	1.0
	16/5	11.0	1.0
17	17/1	11.0	6.0
	17/2	11.0	6.0
	17/3	11.0	6.0
	17/4	11.0	6.0
	17/5	11.0	1.0
20	20/1	11.0	5.0
	20/2	11.0	5.0
	20/3	11.0	5.0
	20/4	11.0	5.0
	20/5	11.0	5.0
	20/6	11.0	5.0
	20/7	11.0	5.0
	20/8	11.0	5.0
	20/9	11.0	5.0
	20/10	11.0	5.0
21	21/1	16.0	5.0
	21/2	16.0	5.0
	21/3	16.0	5.0
	21/4	16.0	5.0
	21/5	8.0	5.0
	21/6	8.0	5.0
	21/7	8.0	5.0
	21/8	8.0	5.0
	21/9	7.0	5.0
	21/10	7.0	5.0

Note: ID numbers are in the format: Group Number/Subject Number

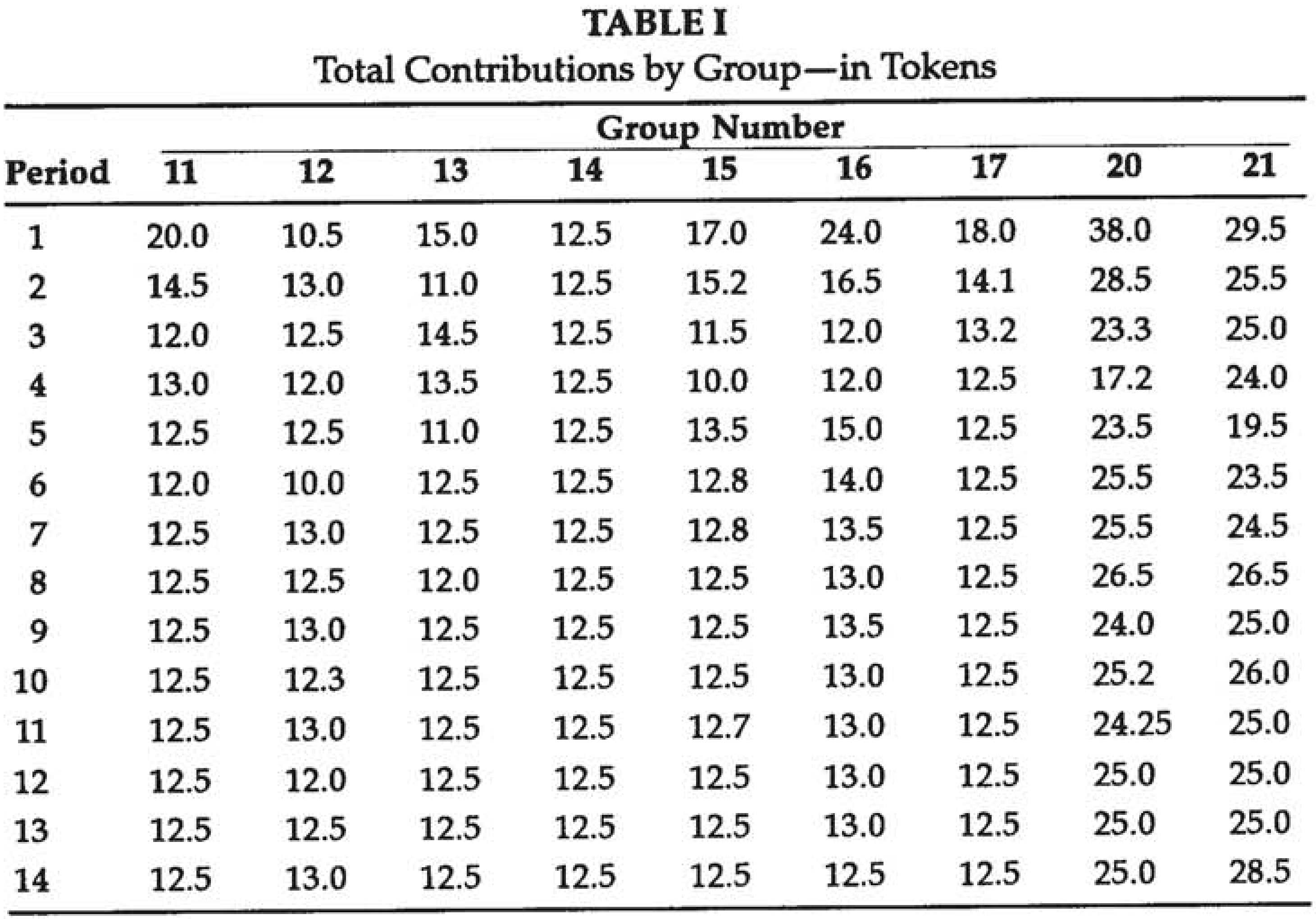


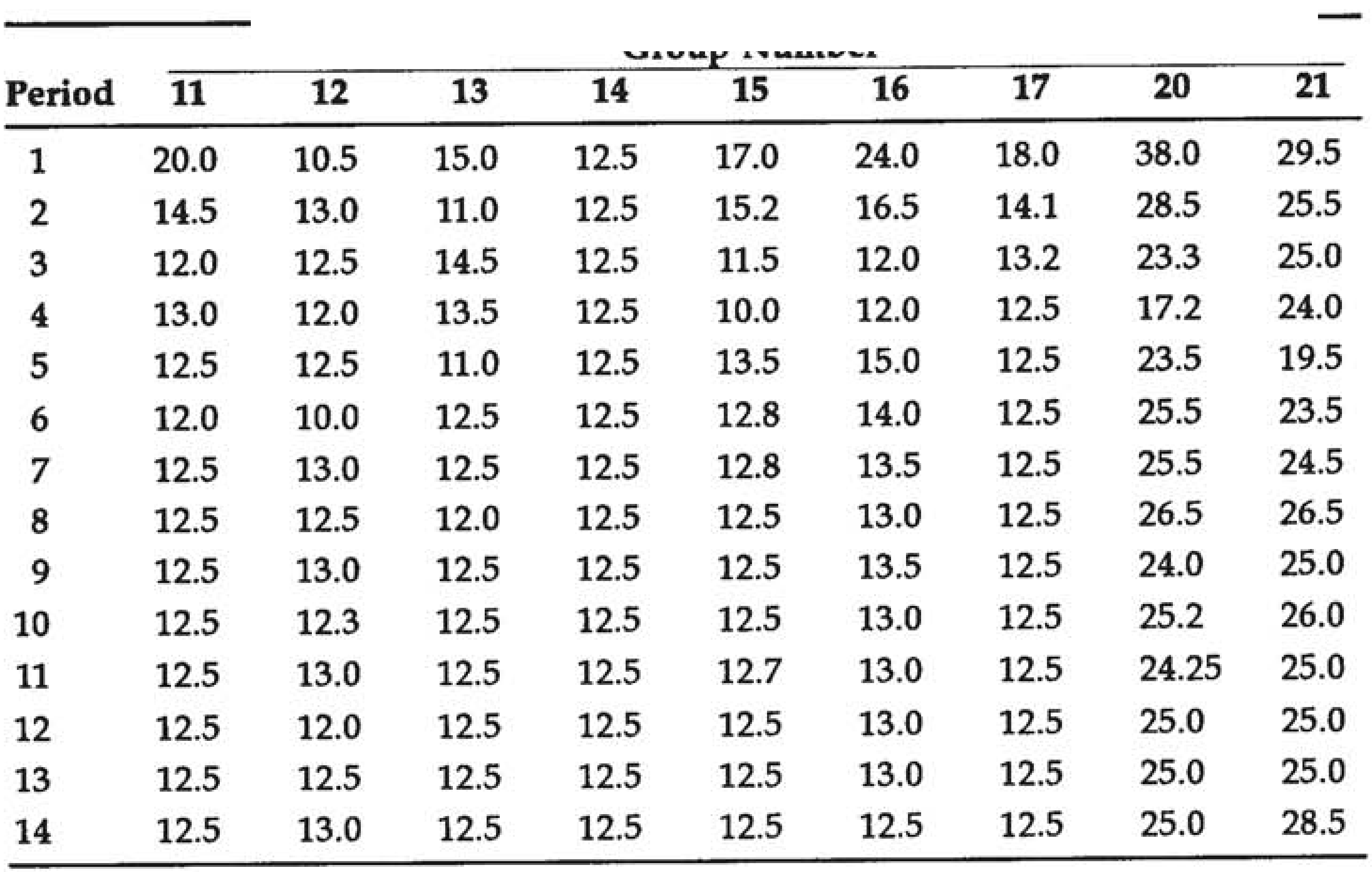
TABLE I

Total Contributions by Group—in Tokens

	Group Number								
Period	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**20**	**21**
1	20.0	10.5	15.0	12.5	17.0	24.0	18.0	38.0	29.5
2	14.5	13.0	11.0	12.5	15.2	16.5	14.1	28.5	25.5
3	12.0	12.5	14.5	12.5	11.5	12.0	13.2	23.3	25.0
4	13.0	12.0	13.5	12.5	10.0	12.0	12.5	17.2	24.0
5	12.5	12.5	11.0	12.5	13.5	15.0	12.5	23.5	19.5
6	12.0	10.0	12.5	12.5	12.8	14.0	12.5	25.5	23.5
7	12.5	13.0	12.5	12.5	12.8	13.5	12.5	25.5	24.5
8	12.5	12.5	12.0	12.5	12.5	13.0	12.5	26.5	26.5
9	12.5	13.0	12.5	12.5	12.5	13.5	12.5	24.0	25.0
10	12.5	12.3	12.5	12.5	12.5	13.0	12.5	25.2	26.0
11	12.5	13.0	12.5	12.5	12.7	13.0	12.5	24.25	25.0
12	12.5	12.0	12.5	12.5	12.5	13.0	12.5	25.0	25.0
13	12.5	12.5	12.5	12.5	12.5	13.0	12.5	25.0	25.0
14	12.5	13.0	12.5	12.5	12.5	12.5	12.5	25.0	28.5

Can we conclude that refunds work?

TABLE I



	Group Number								
Period	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**20**	**21**
1	20.0	10.5	15.0	12.5	17.0	24.0	18.0	38.0	29.5
2	14.5	13.0	11.0	12.5	15.2	16.5	14.1	28.5	25.5
3	12.0	12.5	14.5	12.5	11.5	12.0	13.2	23.3	25.0
4	13.0	12.0	13.5	12.5	10.0	12.0	12.5	17.2	24.0
5	12.5	12.5	11.0	12.5	13.5	15.0	12.5	23.5	19.5
6	12.0	10.0	12.5	12.5	12.8	14.0	12.5	25.5	23.5
7	12.5	13.0	12.5	12.5	12.8	13.5	12.5	25.5	24.5
8	12.5	12.5	12.0	12.5	12.5	13.0	12.5	26.5	26.5
9	12.5	13.0	12.5	12.5	12.5	13.5	12.5	24.0	25.0
10	12.5	12.3	12.5	12.5	12.5	13.0	12.5	25.2	26.0
11	12.5	13.0	12.5	12.5	12.7	13.0	12.5	24.25	25.0
12	12.5	12.0	12.5	12.5	12.5	13.0	12.5	25.0	25.0
13	12.5	12.5	12.5	12.5	12.5	13.0	12.5	25.0	25.0
14	12.5	13.0	12.5	12.5	12.5	12.5	12.5	25.0	28.5

- Bagnoli and McKee (1989) do not have a no refund treatment
- Cadsby and Maynes (1999)
  - As in Bagnoli and McKee permit continuous rather than binary “all-or-nothing” contributions (many threshold models use all or nothing contributions e.g., van de Kragt et al., 1983; Dawes et al., 1986; Rapoport and Eshed-Levy, 1989)
  - Continuous contributions significantly increases contributions and facilitates provision.
  - Refund encourages provision, especially when the threshold is high. A high threshold discourages provision in the absence, but not in the presence of a refund.

- Coats, Gronberg and Grosskopf (2009)
  - Sequential and simultaneous giving to threshold public good
  - Greater efficiency with refunds (and sequential)
- Treatment of excessive funds
  - Isaac et al. (1989): Provision point high (100% endowment), medium (87%) and low (44%). Excess contributions used to provide public good (Utilization Rebate). Find that refunds increase efficiency, provision secured: 57% in high, 53% in medium, 43% low
  - Marks and Croson (1998) examine effect of rebate rules, i.e., treatment of excess donations

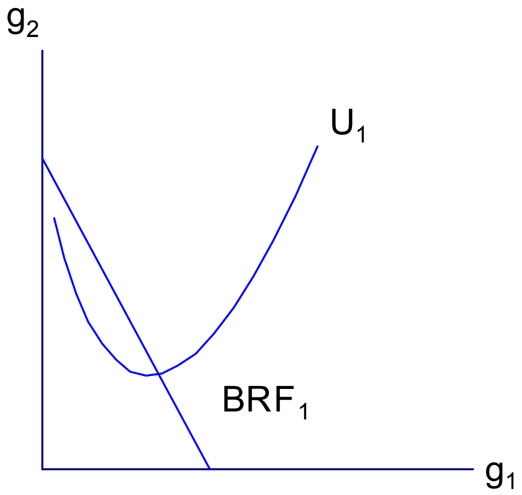
Side note – strategic goal setting

- Is the underlying production technology discrete or does the nonprofit make it discrete?
- If fundraisers can truncate the production function will they choose to do so? And how will they do it?
- Example
  - New Democratic Party (Manitoba, Canada)
  - 1980 and 1985 sent letters to its larger contributors to solicit funds to mount an upcoming election campaign
  - Letters stipulated that target had been set at $200,000 and funds would be refunded if not reached by a certain date
  - Both campaigns succeeded

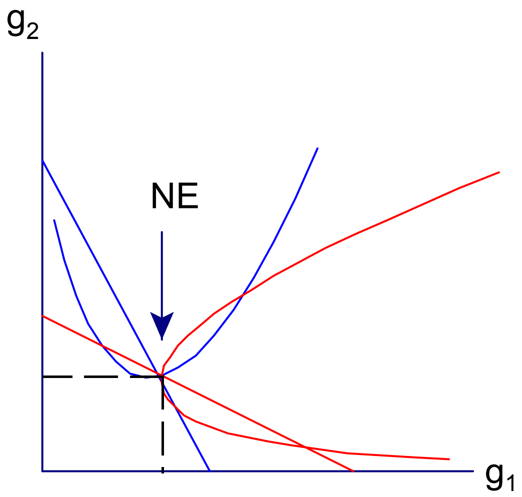
Menietti, Morelli, and Vesterlund, 2009

- The true technology is often continuous and the charity/fundraiser opts to truncate it
- What are the incentives to truncate an otherwise continuous production technology?
  - Fundraiser sets a threshold for total contributions
  - Donors make contribution pledges contingent on the threshold being reached / collect funds and refund if short of goal
- What are the consequences of such a strategy? Is the outcome efficient?

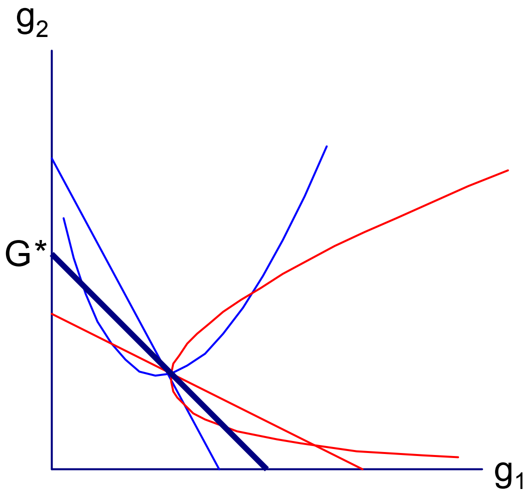
Continuous production technology



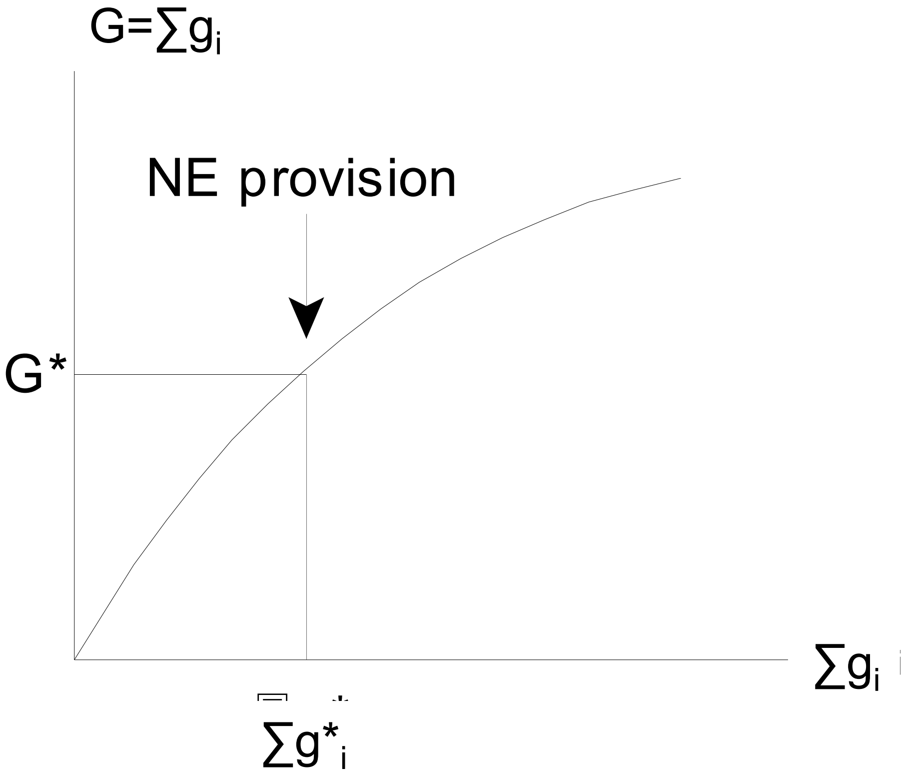
Continuous production technology



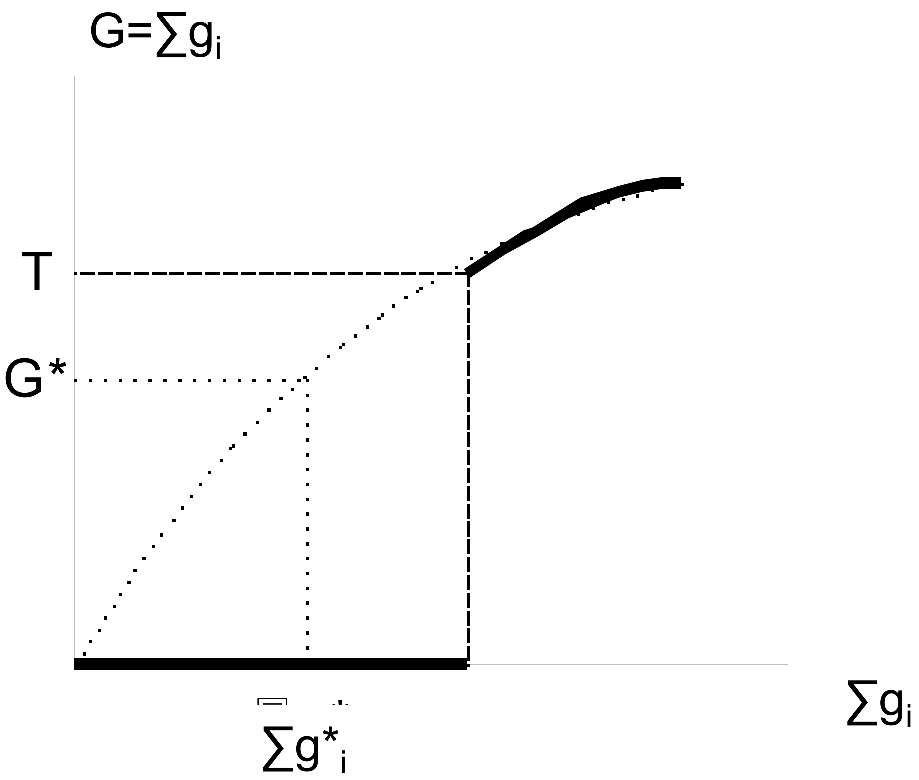
Continuous production technology

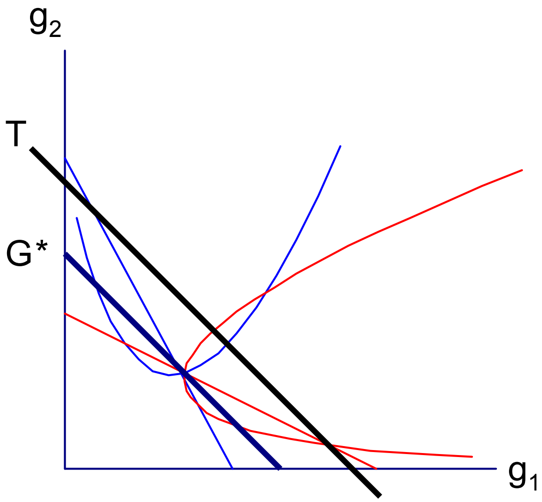


Continuous production technology



Truncated production technology





g2
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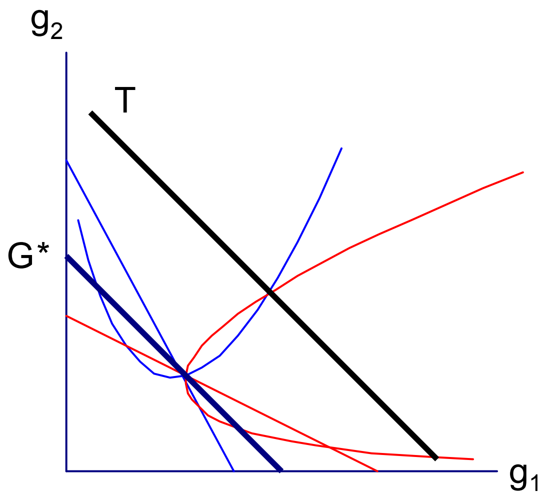
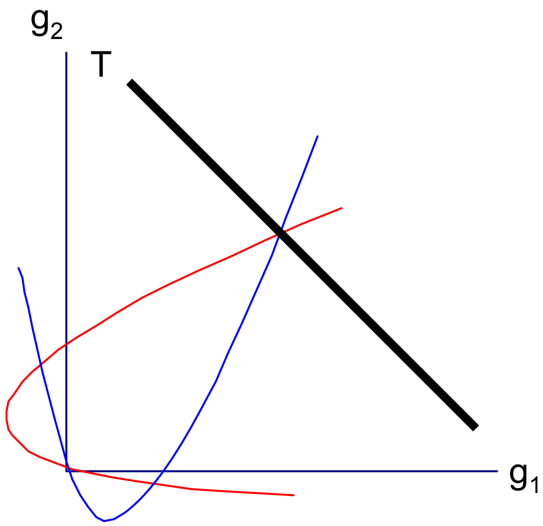
G*
g1

Truncated production technology



Truncated production technology w/commitment to produce nothing absent reaching goal



Endogenous Truncation

- Provided UPE
- Fundraisers who may truncate an otherwise continuous production function will choose to do so
- The selected threshold will result in *overprovision* of the public good
- Result relies on equilibrium refinements – is it reasonable to focus on the UPE?
- Does truncation of the production function increase contributions and provision? Is provision inefficiently large?

Experimental Design (MMV 2009)

- Desired Payoff Characteristics
  - Absent threshold
    - Interior Nash Solution
    - Interior Pareto Optimal
    - Strictly Dominant Nash

$$U_i(x_i, G) = s(x_i) + \alpha G$$

$$s(x_i) = \begin{cases} \beta x_i & x_i \epsilon [0, a) \\ \delta x_i + (\beta - \delta) a & x_i \epsilon [a, b) \\ \gamma x_i + (\beta - \delta) a + (\delta - \gamma)(b - a) & x_i \epsilon [b, w_i] \end{cases}$$

Payoffs

- $4 endowment
- Can invest any amount in group account
- Payoff from the group account depends on sum invested by you and the person you are paired with:
  - You and the other member of your group will each get a payoff of 50 cents per unit invested in the group account.
- Investment cost depends on the number of units invested
  - Cost 10 cents per unit for units 1-3
  - Cost 70 cents per unit for units 4-7
  - Cost $1.3 per units 8 and greater
- Earnings equal initial $4 plus the payoff from the group account minus the cost of your individual investment.

Your earnings given investment by you and the other group member

	Investment by other group member												
Your Investment	0	1	2	3	4	5	6	7	8	9	10	11	12
0	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
1	4.4	4.9	5.4	5.9	6.4	6.9	7.4	7.9	8.4	8.9	9.4	9.9	10.4
2	4.8	5.3	5.8	6.3	6.8	7.3	7.8	8.3	8.8	9.3	9.8	10.3	10.8
3	5.2	5.7	6.2	6.7	7.2	7.7	8.2	8.7	9.2	9.7	10.2	10.7	11.2
4	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0
5	4.8	5.3	5.8	6.3	6.8	7.3	7.8	8.3	8.8	9.3	9.8	10.3	10.8
6	4.6	5.1	5.6	6.1	6.6	7.1	7.6	8.1	8.6	9.1	9.6	10.1	10.6
7	4.4	4.9	5.4	5.9	6.4	6.9	7.4	7.9	8.4	8.9	9.4	9.9	10.4
8	3.6	4.1	4.6	5.1	5.6	6.1	6.6	7.1	7.6	8.1	8.6	9.1	9.6
9	2.8	3.3	3.8	4.3	4.8	5.3	5.8	6.3	6.8	7.3	7.8	8.3	8.8
10	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
11	1.2	1.7	2.2	2.7	3.2	3.7	4.2	4.7	5.2	5.7	6.2	6.7	7.2
12	0.4	0.9	1.4	1.9	2.4	2.9	3.4	3.9	4.4	4.9	5.4	5.9	6.4

Your earnings given investment by you and the other group member

Investment by other group member

Your Investment	0	1	2	3	4	5	6	7	8	9	10	11	12
0	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
1	4.4	4.9	5.4	5.9	6.4	6.9	7.4	7.9	8.4	8.9	9.4	9.9	10.4
2	4.8	5.3	5.8	6.3	6.8	7.3	7.8	8.3	8.8	9.3	9.8	10.3	10.8
3	5.2	5.7	6.2	6.7	7.2	7.7	8.2	8.7	9.2	9.7	10.2	10.7	11.2
4	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0
5	4.8	5.3	5.8	6.3	6.8	7.3	7.8	8.3	8.8	9.3	9.8	10.3	10.8
6	4.6	5.1	5.6	6.1	6.6	7.1	7.6	8.1	8.6	9.1	9.6	10.1	10.6
7	4.4	4.9	5.4	5.9	6.4	6.9	7.4	7.9	8.4	8.9	9.4	9.9	10.4
8	3.6	4.1	4.6	5.1	5.6	6.1	6.6	7.1	7.6	8.1	8.6	9.1	9.6
9	2.8	3.3	3.8	4.3	4.8	5.3	5.8	6.3	6.8	7.3	7.8	8.3	8.8
10	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
11	1.2	1.7	2.2	2.7	3.2	3.7	4.2	4.7	5.2	5.7	6.2	6.7	7.2
12	0.4	0.9	1.4	1.9	2.4	2.9	3.4	3.9	4.4	4.9	5.4	5.9	6.4

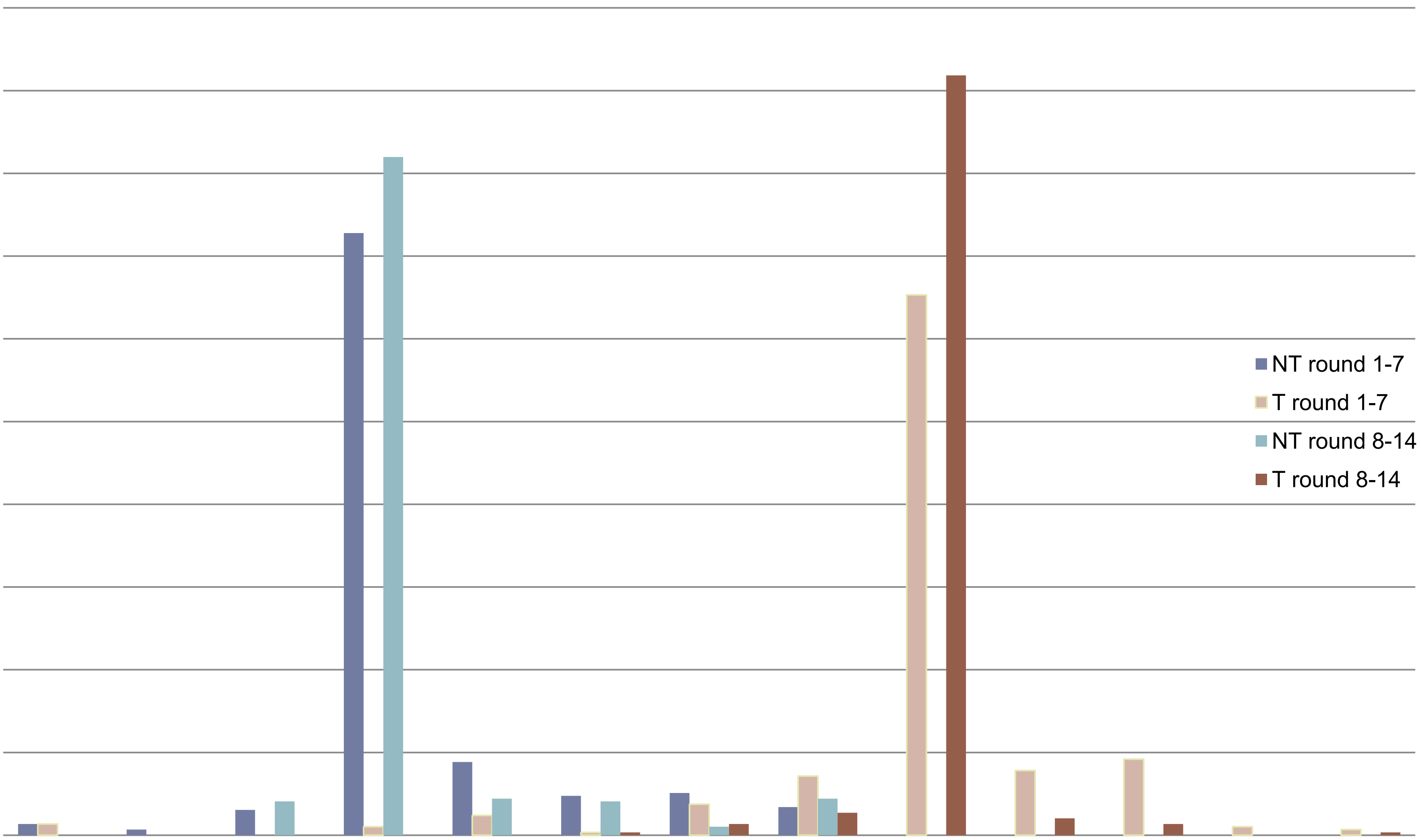
Your earnings given investment by you and the other group member

Your Investment	Investment by other group member												
	0	1	2	3	4	5	6	7	8	9	10	11	12
0	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
1	4.4	4.9	5.4	5.9	6.4	6.9	7.4	7.9	8.4	8.9	9.4	9.9	10.4
2	4.8	5.3	5.8	6.3	6.8	7.3	7.8	8.3	8.8	9.3	9.8	10.3	10.8
3	5.2	5.7	6.2	6.7	7.2	7.7	8.2	8.7	9.2	9.7	10.2	10.7	11.2
4	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0
5	4.8	5.3	5.8	6.3	6.8	7.3	7.8	8.3	8.8	9.3	9.8	10.3	10.8
6	4.6	5.1	5.6	6.1	6.6	7.1	7.6	8.1	8.6	9.1	9.6	10.1	10.6
7	4.4	4.9	5.4	5.9	6.4	6.9	7.4	7.9	8.4	8.9	9.4	9.9	10.4
8	3.6	4.1	4.6	5.1	5.6	6.1	6.6	7.1	7.6	8.1	8.6	9.1	9.6
9	2.8	3.3	3.8	4.3	4.8	5.3	5.8	6.3	6.8	7.3	7.8	8.3	8.8
10	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
11	1.2	1.7	2.2	2.7	3.2	3.7	4.2	4.7	5.2	5.7	6.2	6.7	7.2
12	0.4	0.9	1.4	1.9	2.4	2.9	3.4	3.9	4.4	4.9	5.4	5.9	6.4

Thresholds increase individual contributions

	All rounds 1-14	First seven 1-7	Last seven 8-14
Treatment 1			
Session 1	3.3	3.2	3.4
Session 2	3.3	3.5	3.1
Session 3	3.4	3.4	3.4
Average	3.3 (0.04)	3.4 (0.07)	3.3 (0.06)
Treatment 2			
Session 1	7.9	7.8	7.9
Session 2	8.1	8.1	7.0
Session 3	7.9	7.8	8.0
Average	8.0 (0.05)	7.9 (0.09)	8.0 (0.03)

Individual Contribution Frequency



MMV Conclusion

- A payoff maximizing fundraiser will truncate the production function
- The provision point mechanism will result in overprovision
- Experimental evidence shows
  - Participants do play the UPE
  - Thresholds increase
    - Individual contributions
    - Group provision
    - Individual earnings

Andreoni, 1998

- Fundraising for a capital campaign
- Project will often have fixed costs below which the return from giving is zero
- Fundraising and in particular sequential giving may play a unique role in this environment

Private provision with fixed cost: $\overline{G}$

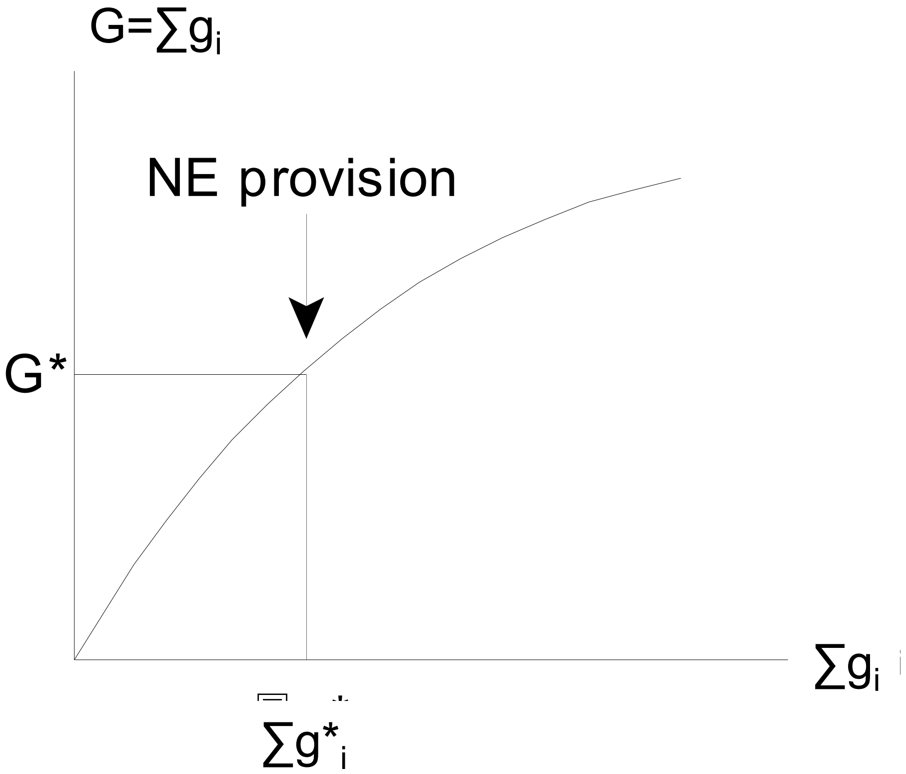
$$\max_{x_i, G} u_i(x_i, G)$$

$$\text{subject to } x_i + G = m_i + G_{-i},$$

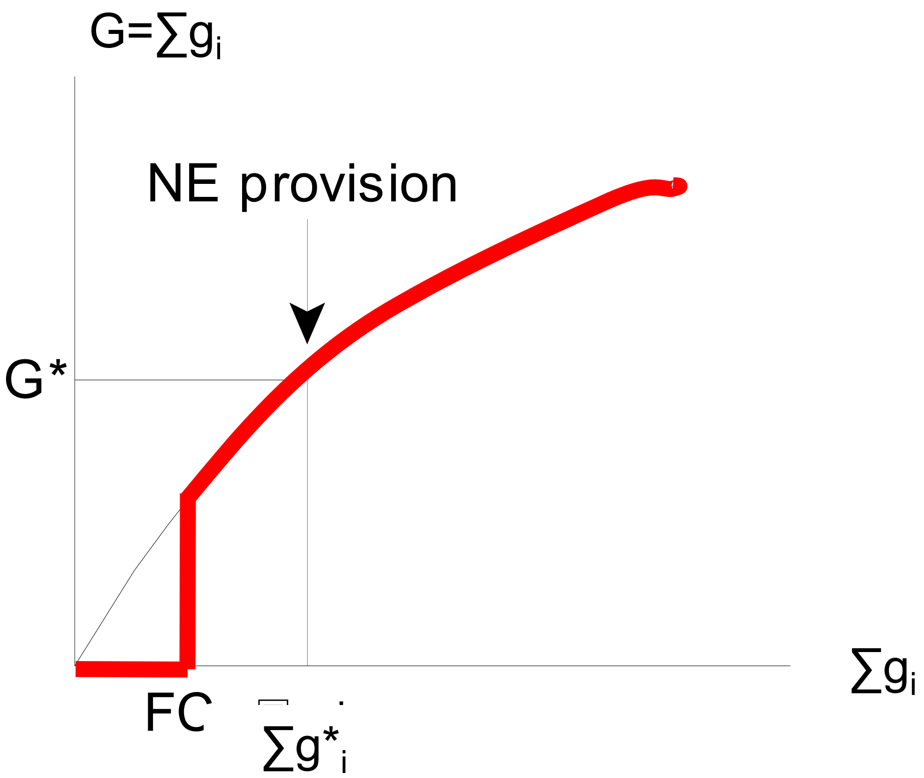
$$G \geq G_{-i}.$$

$$G = \begin{cases} \sum_{i=1}^{n} g_i & \text{if } \sum_{i=1}^{n} g_i \geq \overline{G} \\ 0 & \text{if } \sum_{i=1}^{n} g_i < \overline{G}. \end{cases}$$

Simultaneous w/ FC=0: unique NE



Simultaneous w/ FC>0



- Let g_i^o be the solution to the following for all i: $u_i(m_i, g_i^o) = u_i(m_i, 0)$
- Let $g_{max}^o = \{g_1^o, g_2^o, \ldots., g_n^o)$

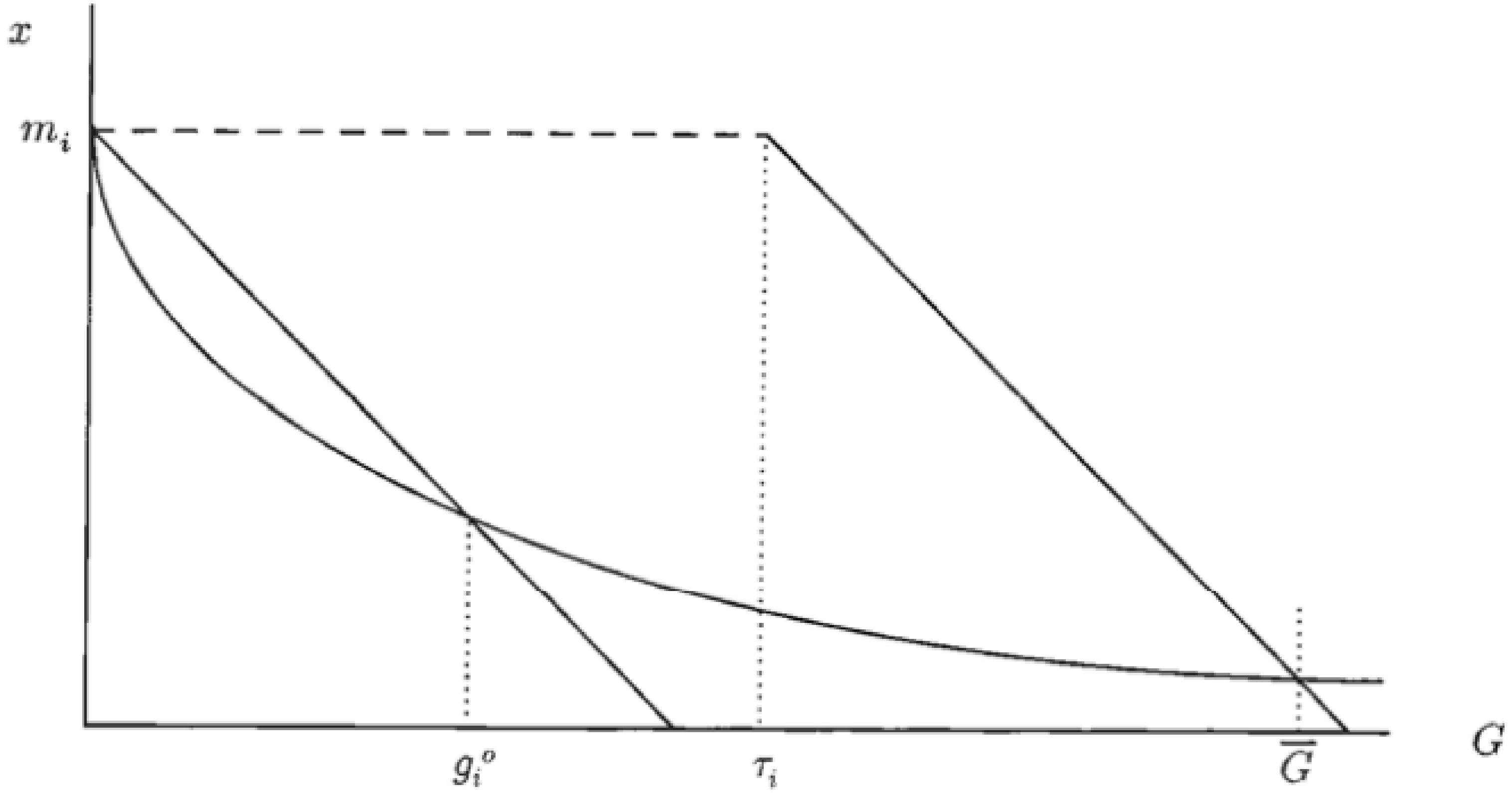


FIG. 1.—Defining g_i^o and τ_i

- Let τ_i be the solution to the following for all i $u_i(m_i + \tau_i - \overline{G}, \overline{G}) \equiv u_i(m_i, 0)$
- τ_i is the provision at which i is willing to complete the project

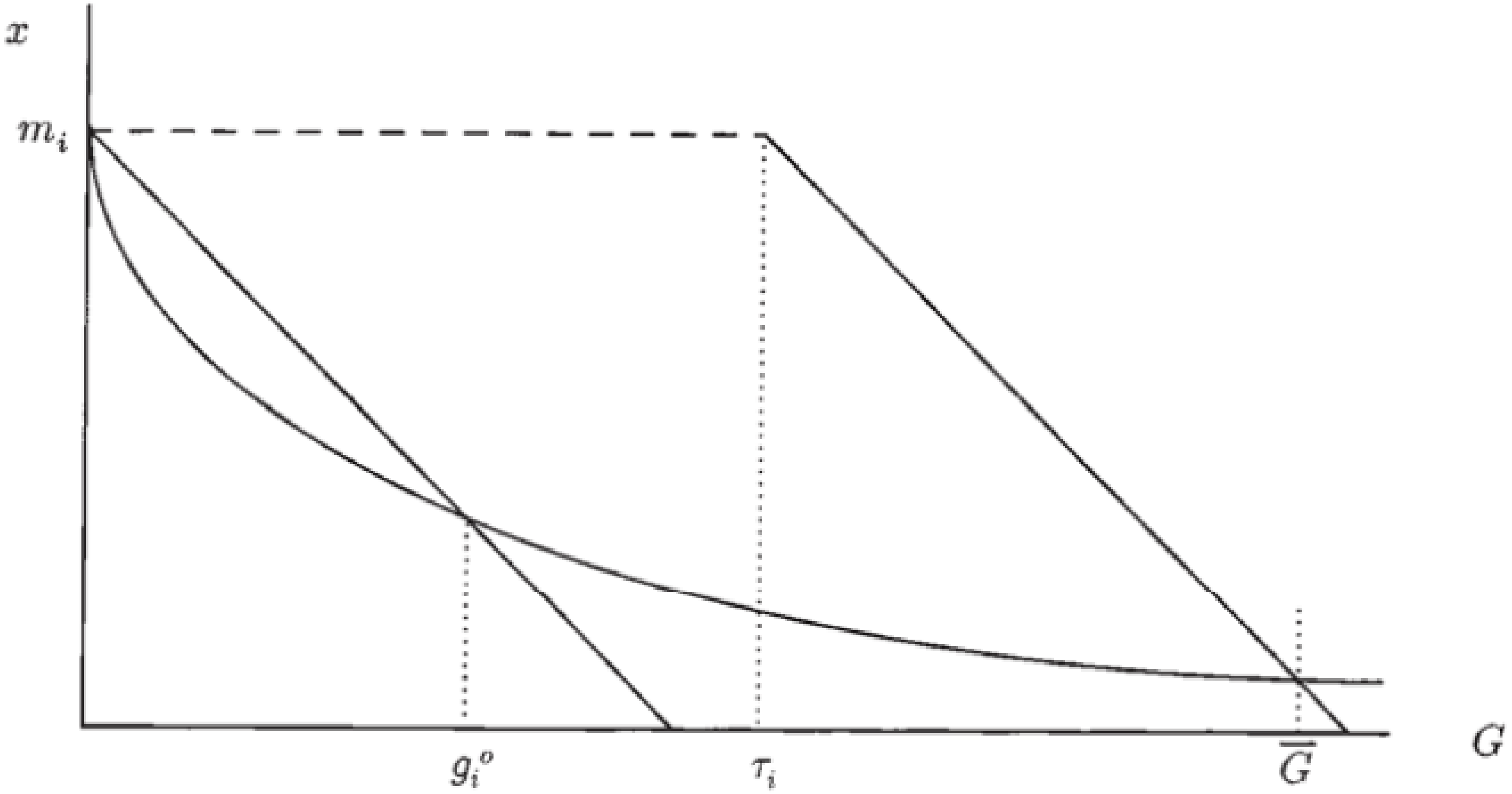
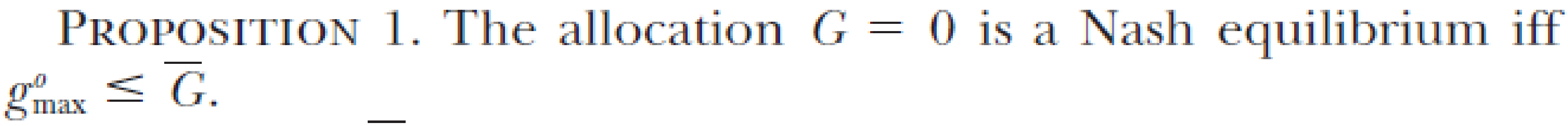
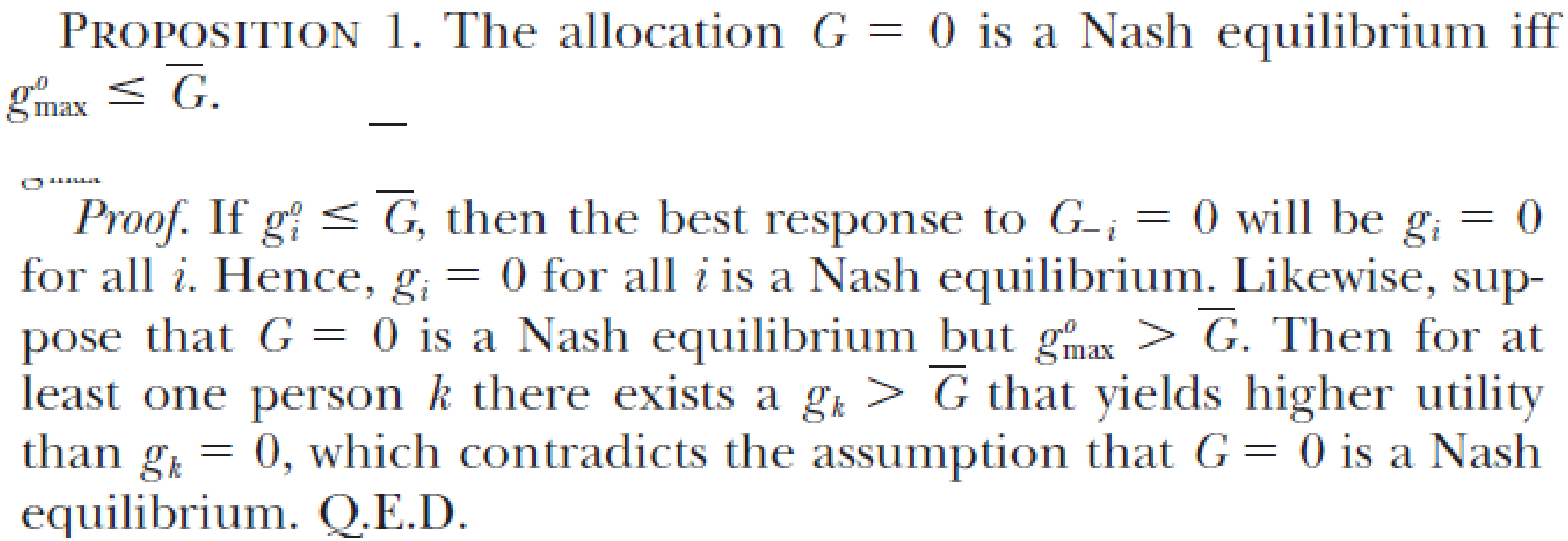


FIG. 1.—Defining g_i^o and τ_i



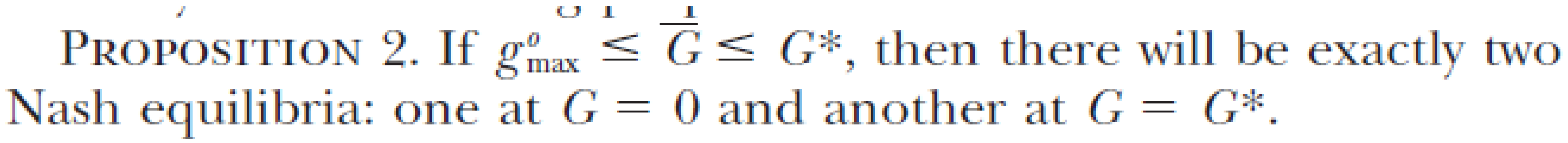
PROPOSITION 1. The allocation $G = 0$ is a Nash equilibrium iff $g^{o}_{\max} \leq \overline{G}$.

Proof?

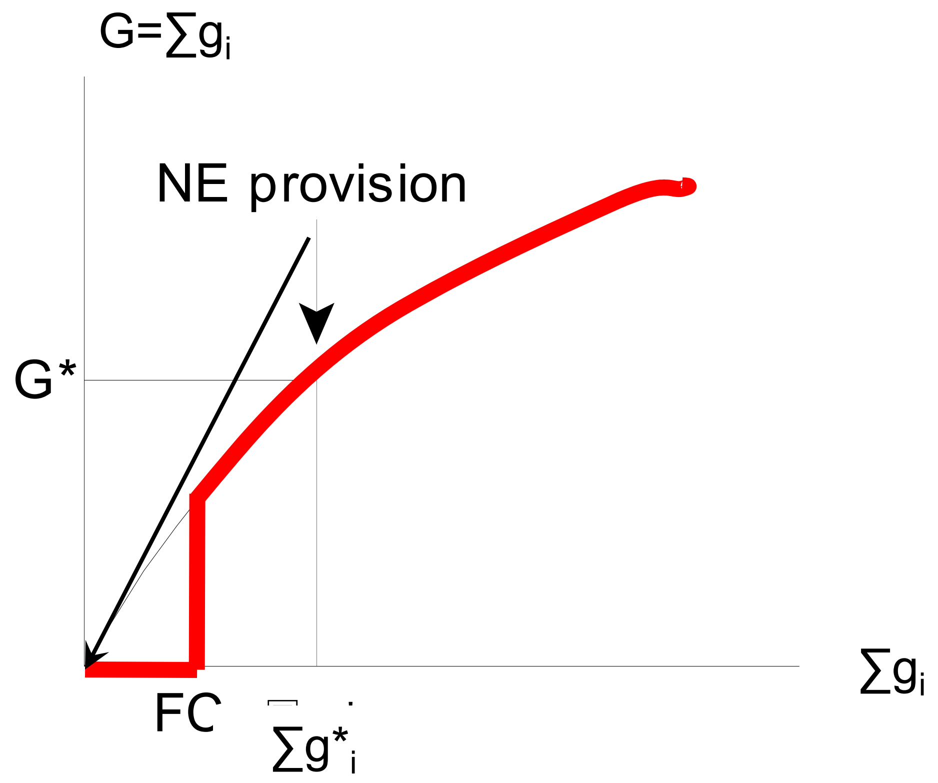


PROPOSITION 1. The allocation $G = 0$ is a Nash equilibrium iff $g^{o}_{\max} \leq \overline{G}$.

Proof. If $g^{o}_{i} \leq \overline{G}$, then the best response to $G_{-i} = 0$ will be $g_i = 0$ for all i. Hence, $g_i = 0$ for all i is a Nash equilibrium. Likewise, suppose that $G = 0$ is a Nash equilibrium but $g^{o}_{\max} > \overline{G}$. Then for at least one person k there exists a $g_k > \overline{G}$ that yields higher utility than $g_k = 0$, which contradicts the assumption that $G = 0$ is a Nash equilibrium. Q.E.D.



PROPOSITION 2. If $g^{o}_{\max} \leq \overline{G} \leq G^{*}$, then there will be exactly two Nash equilibria: one at $G = 0$ and another at $G = G^{*}$.



Corollary 2. If $g^o_{\max} > \overline{G}$, then $(g_1^*, g_2^*, \ldots, g_n^*)$ is the unique Nash equilibrium.

Proposition 3. Assume $\overline{G} > G^*$. If there exists a $(\overline{g}_1, \overline{g}_2, \ldots, \overline{g}_n)$ such that $g_i^* < \overline{g}_i \leq g_i^o$ for each i and $\sum_{i=1}^{n} \overline{g}_i = \overline{G}$, then $(\overline{g}_1, \overline{g}_2, \ldots, \overline{g}_n)$ is a Nash equilibrium.

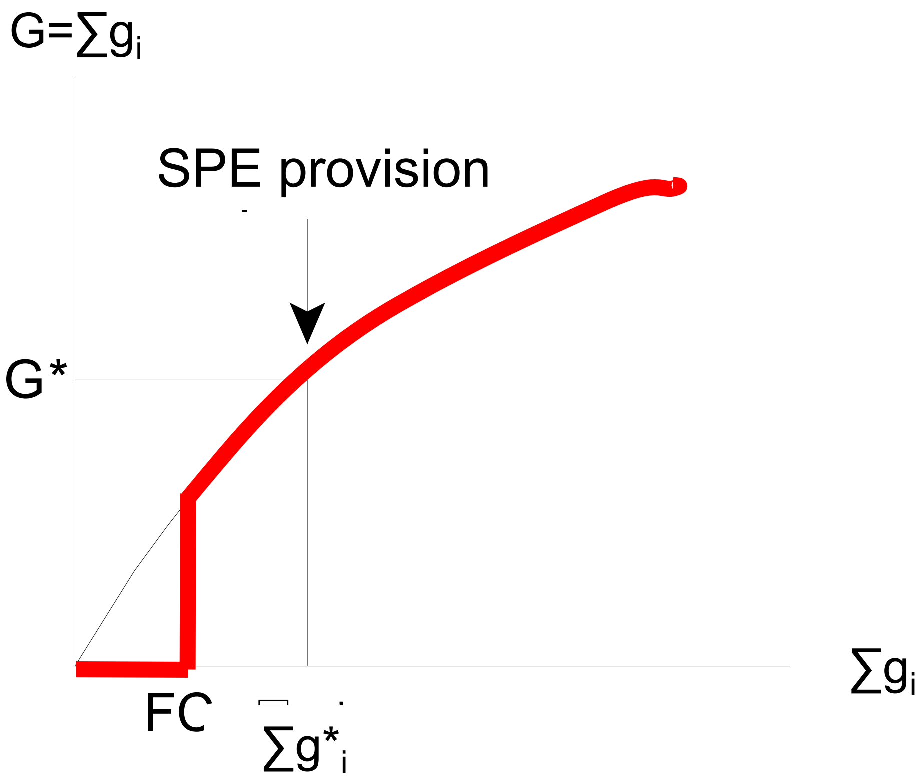
Andreoni, 1998

- With simultaneous moves and fixed costs we may get stuck in an inefficient equilibrium with zero provision
- This introduces a unique role for fundraisers as they may help donors coordinate on the positive provision outcome
- By using a sequential fundraising strategy the fundraiser can eliminate the zero provision outcome

Role of fundraising

- Three phases:
- Selection:
  - charity selects a subset of the population to act as leaders.
- Leadership:
  - charity organizes the leaders and allows them to make binding pledges of contributions.
- Contribution:
  - charity turns to the general public for massive fund-raising. Modeled as a simultaneous contribution public goods game. The charity announces the leadership pledges and then collects contributions to the public good.

Sequential w/ FC>0: Unique equilibrium



Andreoni, 1998

- Zero provision outcome can be eliminated by securing that leaders jointly contribute an amount which is greater than the minimum τ_i among the followers $\tau_{min} = \min\{\tau_j\}$ where $j \notin L$
- i.e. $\sum_{i \in L} g_i = \tau_{min}$
- Summary:
  - In the presences of fixed costs simultaneous giving may give rise to multiple equilibria:
    - one that fails to provide the project
    - others that secure provision
  - Simultaneous giving may cause individuals to get trapped in an inefficient equilibrium
  - Sequential fundraising eliminates zero provision as an equilibrium

List and Lucking-Reiley (*JPE* 2002)

- Title: “The Effects of Seed Money and Refunds on Charitable Giving: Experimental Evidence from a University Capital Campaign”
- Motivation:
  - Testing two theories
    - Seed money increases giving (Andreoni 1998 JPE)
    - Refunds can secure efficient outcomes (Bagnoli and Lipman REStud1989)
- Solicit funds for UCF Environmental lab
  - Treatments:
    - 3 variations on Seed money: 10%, 33% or 67%
    - Refund vs No Refund
  - Six conditions: 10, 10R, 33, 33R, 67, 67R
  - Solicit money for six different $3000 computers

Experimental Design

- Buy list of 3,000 names from fund-raising consultant.
- Send 500 solicitation letters per experimental condition.
- Send a brochure to each household that is identical except for a few lines explaining seeds or refund
- SEED:
  - “We have already obtained funds to cover 10 (33, 67) percent of the cost of this computer, so we are soliciting donations to cover the remaining $2,700 (2,000/1,000) ”
- REFUND
  - “if we fail to raise the $2,700 from this group of 500 individuals, we will not be able to purchase the computer, so we will refund your donation to you”

Results LL

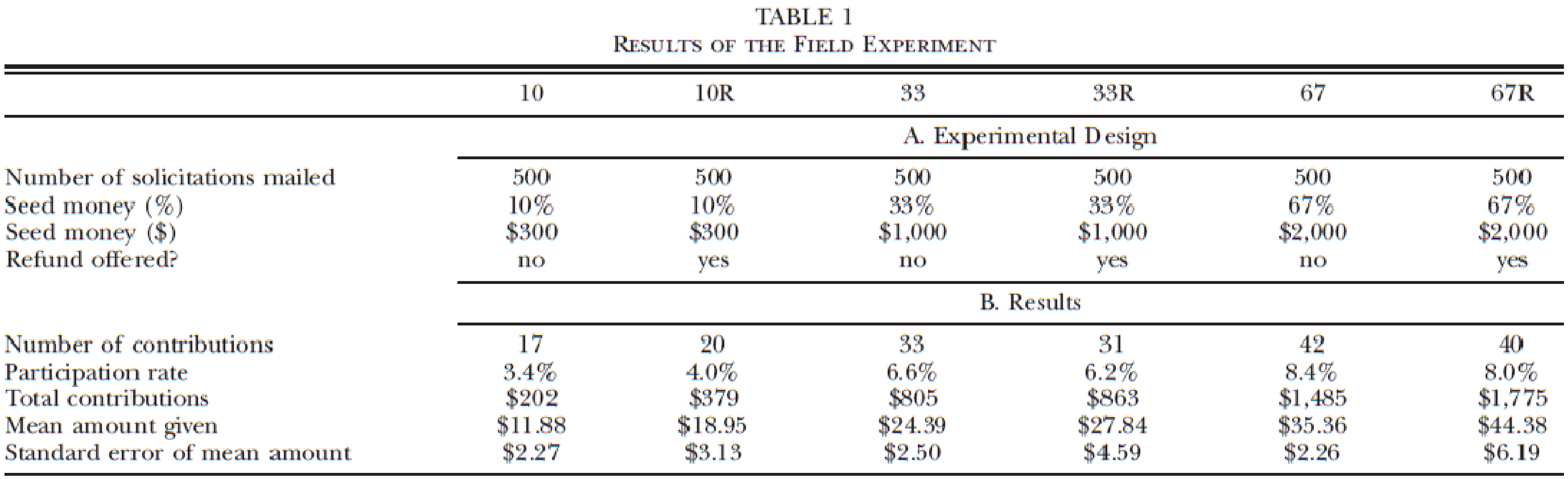
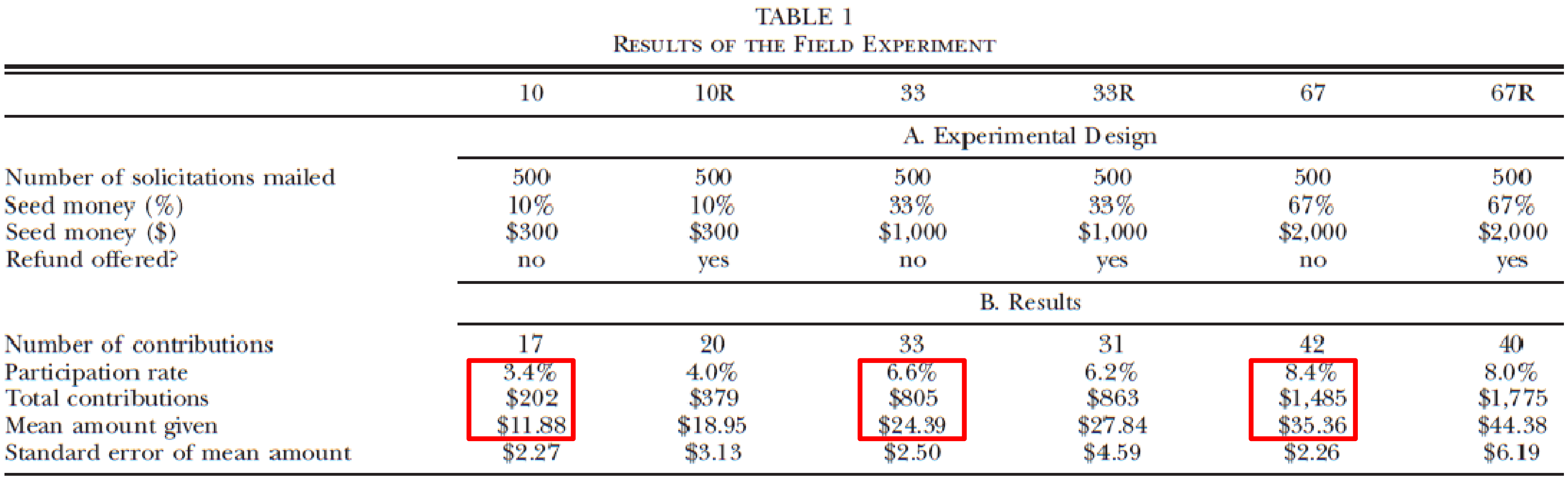


TABLE 1
RESULTS OF THE FIELD EXPERIMENT

	10	10R	33	33R	67	67R
	A. Experimental Design					
Number of solicitations mailed	500	500	500	500	500	500
Seed money (%)	10%	10%	33%	33%	67%	67%
Seed money ($)	$300	$300	$1,000	$1,000	$2,000	$2,000
Refund offered?	no	yes	no	yes	no	yes
	B. Results					
Number of contributions	17	20	33	31	42	40
Participation rate	3.4%	4.0%	6.6%	6.2%	8.4%	8.0%
Total contributions	$202	$379	$805	$863	$1,485	$1,775
Mean amount given	$11.88	$18.95	$24.39	$27.84	$35.36	$44.38
Standard error of mean amount	$2.27	$3.13	$2.50	$4.59	$2.26	$6.19

Results LL



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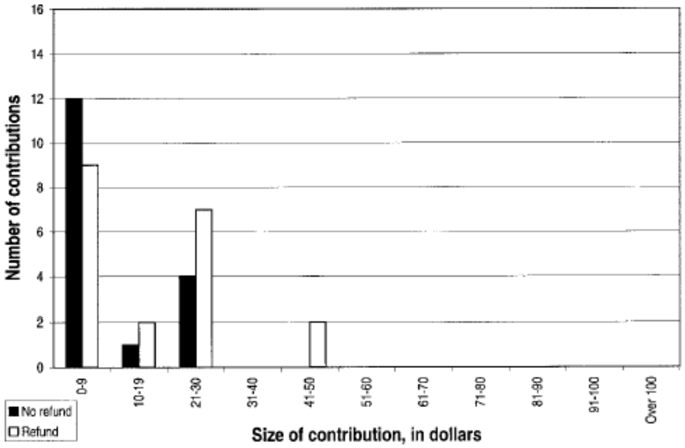


Fig. 1.—Contributions with 10 percent seed money

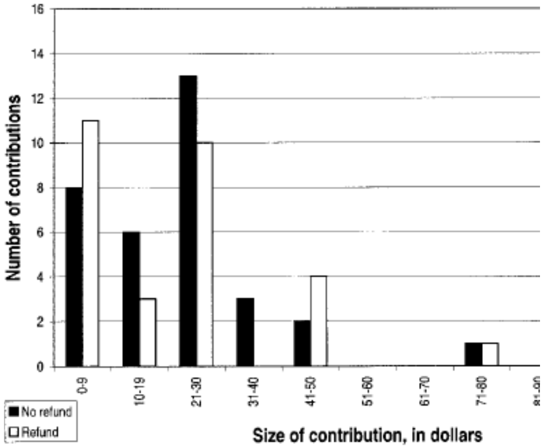


Fig. 2.—Contributions with 33 percent seed mone

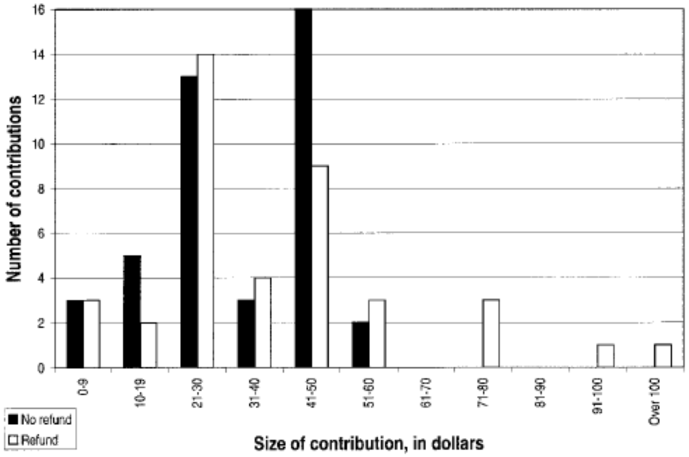
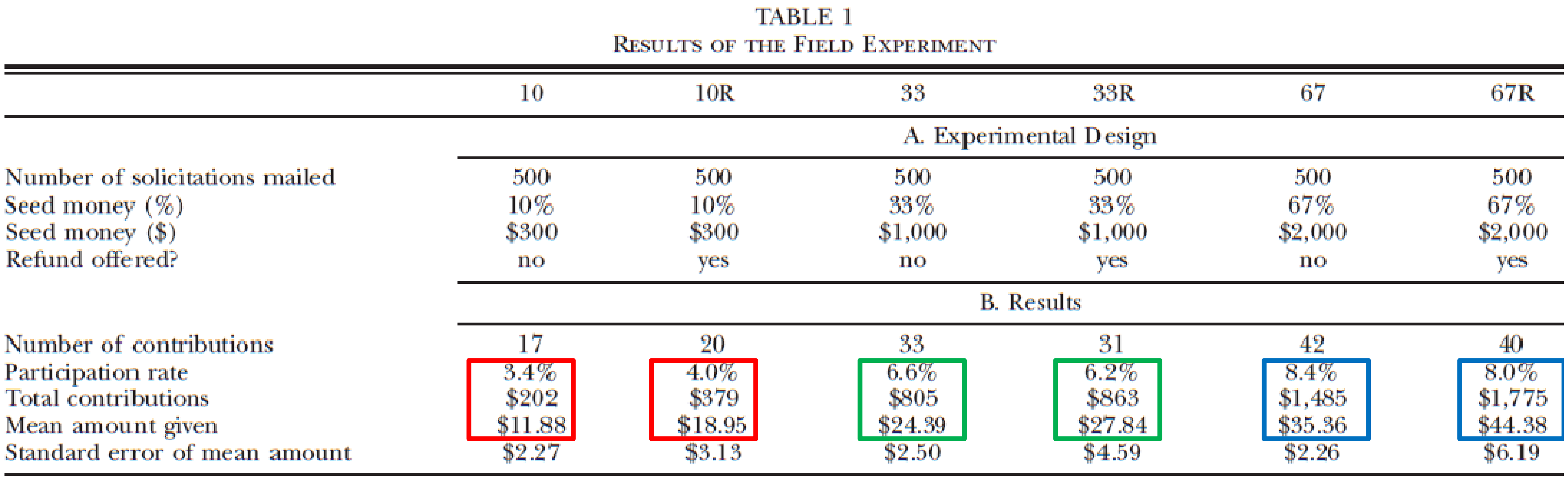


Fig. 3.—Contributions with 67 percent seed money

- Increasing seed shifts contributions to the right
- Increases mean contribution from $291, $834, to $1,630

Results LL



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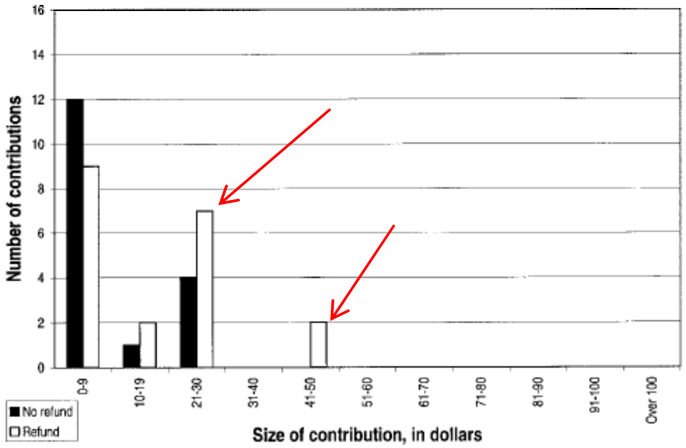

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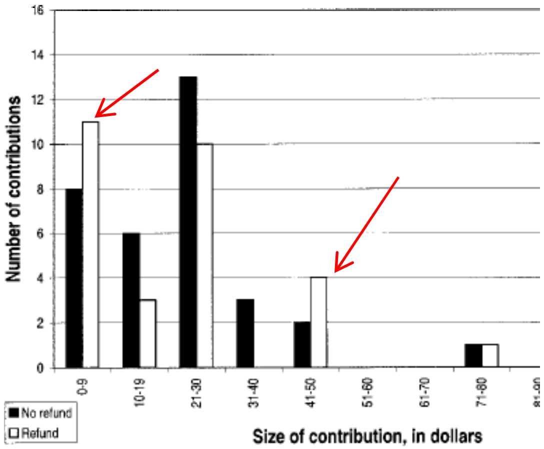

Fig. 2.—Contributions with 33 percent seed mone

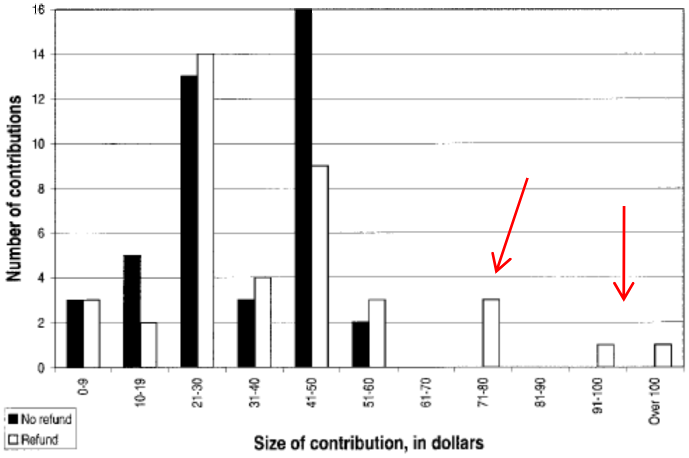

Fig. 3.—Contributions with 67 percent seed money

- Refunds
  - No effect on participation
  - Limited effect on giving - contributions shift to the right. Difference only significant at 10% level, but combined the effect is significant.

Result

- Refund:
  - Increases average donation not participation – but relatively limited effect
- Seed:
  - Increasing seed from 10 to 67 percent increases contributions six fold (consistent with the prediction by Andreoni, 1998)
  - Also consistent with other models – signaling, reciprocity etc
  - Concerning that the effect of seed arises both with and without refund. If seeds serve to facilitate coordination on the positive provision outcome then we should only see an effect when there is no refund
  - Suggest that other factors may be driving the results
  - The unique feature of Andreoni is not that seeds increase contributions, but rather that it increases contributions when there are sufficiently high fixed costs. Difficult to vary fixed costs in the field and have comparable treatments.

Bracha, Menietti, Vesterlund (2009)

- Title: Seeds to Succeed: Sequential Giving to Public Projects
- Purpose
  - Directly examine role of fixed costs in Andreoni's model
- Questions
  - Does the introduction of fixed costs give rise to inefficient outcomes?
  - Do sequential moves eliminate inefficient outcomes?
  - Is the role of sequential moves greater in the presence of fixed costs?
- 2x2 Design
  - Fixed costs x no fixed costs
  - Sequential x simultaneous

Experimental payoffs

- Paired in groups of two
- $4 endowment
- Can keep or invest in group account
- Group account payoff depends on sum invested by group
  - [Provided the total amount invested by you and by your group member equals or exceeds 6 units,] you and your group member will each get a payoff of 50 cents per unit invested in the group account.
- Investment cost depends on individual's investment
  - 40 cents per unit for units 1-3
  - 70 cents per unit for units 4-7
  - $1.1 per unit for units 8 and greater
- Earnings: initial $4 plus payoff from the group account minus the cost of individual investment.
- Both sequential and simultaneous are 'sequential' in moves, but the first movers contribution is only known in the sequential treatment

BMV 2010

- Design
  - 2x3 (Sim, Seq)x(FC=0, FC=6, FC=8)
  - 14 participants per session
  - 14 rounds per session: randomly paired with another participant each round (strangers)
  - Payoffs:
    - Return from provided public good: 50 cents per unit
    - Cost of public good: 40 cents 1-3, 70 cents 4-7, $1.1 8+

BMV Conclusion

- FC=6: Simultaneous moves increase giving and earnings
- FC=8:
  - Consistent with theory:
  - Simultaneous: provision frequently fails
  - Sequential moves increase likelihood of provision and earnings
- Size of seed:
  - Sequential moves with FC introduces a substantial first mover advantage
  - Perhaps the fundraisers recommendation for a sufficiently large seed (15-25%) is an attempt to reduce the first mover's ability to free ride on subsequent donors