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Targeting the poor using community information

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Abstract

Governments and aid agencies target transfers to the poor, but audits to deter the rich are costly. This paper analyzes how community information can improve targeting. If each community is given a hard budget constraint, then targeting costs can be substantially reduced by asking recipients to make reports about each other. Audits are threatened in the event of a disagreement but never carried out in equilibrium. This scheme is immune to collusion.
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1. Introduction

Transferring resources to the poor is the most direct and immediate way to reduce poverty. Since governments and aid agencies are uninformed about who is rich and who is poor, however, the rich can misrepresent themselves and claim transfers. In practice, many public spending programs intended for the poor either enrich the ineligible or incur high administrative costs.[1] Innovative targeting schemes have the potential to relieve poverty and substantially increase the effectiveness of public spending.

One potential innovation is the use of community information. Villagers and close-knit urban communities have information about who is poor and who is rich that is far superior to the information possessed by outsiders, such as governments or development agencies. Poverty reduction programs often use local informants to determine who should receive transfers. Conning and Kevane (in press) review several such programs including one in

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[1] In a study of 30 social programs in Latin America, Grosh (1994) finds that 20% to 40% of benefits go to the top three fifths of the population, and 5% to 15% of program expenditures are used for administrative costs.

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Mexico where village meetings are used to ratify a list of recipients.[2] Villagers may collude against the government, however, and this might limit the government's access to community information. The purpose of this paper is to show how community information can be useful in reducing targeting costs *even if* villagers collude and to point out its limitations.

Standard approaches to targeting exploit differences in preferences or abilities to separate the rich from the poor. Besley and Coate (1992) use work requirements and a low wage rate to deter the rich. Blackorby and Donaldson (1988) show how in-kind transfers can help in targeting if they cannot easily be resold. In this paper, by contrast, the rich and the poor are assumed to have the same preferences and abilities. Agents are informed about each other's wealth but the only way for a government to distinguish rich from poor is by conducting audits. Since these audits are costly, they reduce the transfers available for the poor. The main result is that if the government commits to a hard budget constraint, the poor can be targeted with just the *threat* of an audit by using community information. Agents are asked to report on each other, and audited only if their reports disagree. The hard budget constraint ensures that such a scheme is immune to collusion. It implies that poor agents in poor communities will receive less than poor agents in rich communities, however. So community information is of no help if the government is constrained to equalize transfers to the poor across communities or if villagers are very risk averse.

This paper uses an implementation theory framework to study targeting with community information (for a political economy approach, see Bardhan and Mookherjee, 2001). Implementation theory studies the efficient design of mechanisms with unique equilibrium outcomes (surveyed by Jackson, in press; Moore, 1992). It is explicit about strategic interaction in economies with several agents and about the information that agents possess about each other. Many of the general results in implementation theory use mechanisms with unattractive features such as integer games, large out-of-equilibrium penalties and infinite chains of weak domination. In contrast, this paper looks at a specific application in which the efficient mechanism is a simple one.[3]

The paper is divided into the following sections. The economy is described in Section 2. The benchmark case of efficient targeting when agents are uninformed is in Section 3. Efficient targeting when agents have community information is analyzed in Section 4. Extensions are discussed in Section 5, and Section 6 concludes.

2. The economy

Consider an economy with a very large number of communities. Each community has two agents, at least one of whom is poor.[4] A proportion α of the communities in the economy

[2] In another version, the names of all the households in the village are written on cards and villagers are asked to sort the cards into different piles based on household wealth. These wealth ranking schemes are popular with NGOs to target food, education and microcredit (Chambers, 1994; Gibbons et al., 1999; Robb, 1999; International Institute for Environment and Development, 1991).

[3] In the implementation literature, either preferences or effort levels are usually unobserved (see Ma, 1988, for the latter), while in this paper endowments are unobserved. Another difference is that this paper solves for collusion-proof mechanisms.

[4] This assumption is convenient, and the results would be unaffected without it.

have two poor agents, while a proportion $1-\alpha$ have one poor agent, where $0<\alpha<1$. Poor agents have wealth 0, and rich agents have wealth y. Agents have identical utility functions U, where U is strictly increasing, differentiable and concave. For convenience normalize $U(0)=0$. There is a government (or an aid agency) that wishes to make transfers to the poor. The government has resources T per community to give out as transfers. As is standard in the targeting literature, these resources are assumed to have been collected through taxes on individuals who are not part of the target population or as foreign aid.

If the government were fully informed, it would choose τ_1, a transfer to a poor agent in a community with one poor agent and τ_2, a transfer to a poor agent in a community with both poor agents, to maximize

$$(1-\alpha)U(\tau_1)+2\alpha U(\tau_2)$$

subject to a per-community break even constraint

$$(1-\alpha)\tau_1+2\alpha\tau_2\leq T$$

The *first best* solution is therefore

$$\tau_1=\tau_2=\tau^*\frac{T}{1+\alpha}. \tag{1}$$

For the rest of paper, assume that the government is uninformed. From the point of view of the government, a typical state of the world for a randomly picked community is $\theta\in\Theta$ where $\Theta=\{(0, 0), (0, y), (y, 0)\}$ with associated probabilities $\{\alpha, (1-\alpha)/2, (1-\alpha)/2\}$. The government can conduct an audit that reveals the state perfectly but the audit costs $C<T$.[5] This cost can be interpreted as the administrative cost of conducting an audit (e.g. by checking land records or employment status) or more loosely, as the wage paid to an auditor. The government can impose a fine on agents found to be cheating. Assume that the maximum fine that can be imposed on a rich agent is y, and assume $y\geq C$ so that a rich agent could pay for the audit cost if necessary.

An audit mechanism is denoted (M, a, g) where $M=M_1\times M_2$ is the message space, $a(\cdot)$ specifies when audits will occur and $g(\cdot)$ specifies transfers and fines. The government commits to audit depending on the message received by an audit function $a(m)$. So $a(m)\in\{0, 1\}$ depending on whether or not an audit is conducted. For all m, where $a(m)=1$, the government learns the state and $g(\theta)$ maps states into transfers. For all m where $a(m)=0$, $g(m)$ maps messages into transfers.

For a given mechanism (M, a, g) suppose $q(\theta)$ is the total payoff to the agents in the state θ and $q_i(\theta)$ is the total payoff to agent i in the state θ, where $i\in\{1, 2\}$. A mechanism (M, a, g) preserves *horizontal equity* if poor agents receive the same transfer in each state, i.e. $q_1(0, 0)=q_2(0, 0)=q_1(0, y)=q_2(y, 0)$. Suppose that the agents can collude by signing binding side contracts on the messages to report and by making side transfers. Denote the

[5] If the principal was unable to audit, targeting would be impossible since the agents have preferences that do not vary across states.

highest possible collusion payoff in the state θ by $\tilde{q}(\theta)$. A mechanism (M, a, g) is *collusion proof* if $\tilde{q}(\theta) \leq q(\theta)$ for all $\theta \in \Theta$.

3. No community information

Consider first the case where the agents observe only their own wealth. A rich agent in this simple economy can of course infer that infer the state θ, but a poor agent cannot. Using a version of the Revelation Principle, attention can be restricted to direct mechanisms in which agents report their own wealth, so $M_i = \{y, 0\}$. In any efficient mechanism, the government will impose the maximum fine of y on any rich agent found to be reporting himself as poor, and make no transfers and conduct no audits if both agents report themselves as rich. The government's problem is then to choose transfers to poor agents $\tau_1 \geq 0$ and $\tau_2 \geq 0$, audit decisions a_1 and a_2, and a transfer t to an agent who reports himself as rich but is not audited (subscripts on τ and a denote the number of agents who have reported themselves as poor). The government maximizes

$$(1-\alpha)U(\tau_1) + 2\alpha U(\tau_2)$$

subject to a break even constraint

$$(1-\alpha)\tau_1 + 2\alpha\tau_2 \leq T - a_1(1-\alpha)C - a_2\alpha C - (1-\alpha)t \tag{2}$$

subject to an incentive constraint for the rich agent

$$U(y+t) \geq (1-a_2)U(y+\tau_2) \tag{3}$$

and subject to the constraint that the mechanism is collusion proof.

Depending on the parameters, Universal Transfers or Means Testing are efficient among the class of collusion proof mechanisms, and both preserve horizontal equity.

1. *Universal Transfers*. The government will choose not to audit in equilibrium. Instead each agent receives $T/2$ in every state. Since rich agents receive the same transfer as the poor, they have no incentive to cheat but the transfer to each poor agent is lower than the first best as a consequence.

2. *Means Testing*. Agents make reports about their own wealth and the government conducts an audit if both agents report themselves as poor. This prevents the rich agent from cheating. Since the government knows that at least one agent in each community is poor, it does not need to audit when the reports are $(y, 0)$ and $(0, y)$. Poor agents receive a transfer of $(T - \alpha C)/(1+\alpha)$ in every state and rich agents receive nothing. The distortion relative to the first best is that audits are conducted in equilibrium lowering the transfer to the poor.[6]

[6] Grosh (1994) surveys 30 transfer programs in Latin America, and over half use a version of this audit mechanism in which individuals are assessed based on income tests, nutritional status of the applicant and other criteria.

Proposition 1. *Suppose agents are uninformed and can collude. Universal Transfers is efficient if* $C \geq (1-\alpha)/(2\alpha)T$ *and Means Testing is efficient otherwise.*

All proofs are in Appendix A.

4. Community information

Assume for the rest of the paper that agents know the state of the economy.[7] The case where government's targeting mechanism need not be collusion proof will be considered first, and then the case where the government must design a collusion proof mechanism.

4.1. No collusion

If agents cannot collude, then it is easy to induce them to reveal their shared information. This section will show that a simple cross reporting mechanism targets the first best transfer τ^* to each poor agent. Agents are asked to report the state, and if their reports agree, then transfers are made to those reported as poor. If an agent reports himself as poor, but the other contradicts his report, then a costly audit is conducted and if an agent who reported himself as poor is found to be rich then he is fined. Such a threat is enough to ensure that rich agents tell the truth.

This *Cross Reporting* scheme is described more formally as follows. The message space is $M_1 = M_2 = \Theta$. Reports are made simultaneously. Let m_{ii} denote agent i's report about himself and m_{ij} denote agent i's report about agent j. For any i, j if $m_{ii} = 0$ and $m_{ji} = y$ then $a(m) = 1$ and $g(\theta)$ is given by

$$g(0,0) = \left(\tau^* - \frac{C}{2}, \tau^* - \frac{C}{2}\right)$$

$$g(y,0) = (-C, 2\tau^*)$$

$$g(0,y) = (2\tau^*, -C)$$

For all other $m \in M$, $a(m) = 0$ and $g(m)$ is given by

$$g(m) = \begin{cases} (\tau^*, \tau^*) & \text{if } m_1 = m_2 = (0,0) \\ (0, \tau^*) & \text{if } m_1 = m_2 = (y,0) \\ (\tau^*, 0) & \text{if } m_1 = m_2 = (0,y) \\ (0,0) & \text{otherwise} \end{cases}$$

[7] A weaker assumption—agents in a community have an information advantage over the government—would suffice. For instance, if agents could audit each other at a cost lower than C, the results would be unaffected.

Proposition 2. *Suppose agents are informed and cannot collude. A Cross Reporting scheme is efficient, and it implements the first best.*

4.2. Collusion

It is reasonable to imagine that agents who live in the same community may collude against the government. For instance, we can think of villagers who receive a one-time transfer from the government, but rely on each other for risk sharing, and so can enforce side contracts on what reports to make, and on side transfers within the community. The cross reporting scheme described in Section 4.1 is not collusion proof, however. In the state $(y, 0)$, the Nash equilibrium outcome is $(0, \tau^*)$ but agents are better off if they jointly agree to report $(0, 0)$ and instead receive $2\tau^*$. Consequently, in this section, attention will be restricted to audit mechanisms that are collusion proof.

Suppose that the government can commit to a hard budget constraint, i.e. can commit ex ante to make a total transfer of T to each community. This eliminates any incentive for communities to exaggerate the number of poor, and so prevents collusion. A modification of the cross reporting scheme described in Section 4.1 with a hard budget constraint targets the poor without any audits occurring in equilibrium. As before, an audit is conducted if an agent reports himself as poor but the other agent contradicts his report. If a rich agent is found to be misrepresenting himself as poor or is found to have made an untruthful report, then he is fined to cover the audit cost. If both agents are found to be poor, then transfers are reduced to cover the audit cost. In equilibrium, the reports always agree and transfers are made to agents who are reported to be poor.

This *Hard Budget* scheme uses cross reporting and is described more formally as follows. The message space is $M_1 = M_2 = \Theta$. For any i, j if $m_{ii} = 0$ and $m_{ji} = y$ then $a(m) = 1$ and $g(\theta)$ is given by

$$g(0,0) = \left(\frac{T-C}{2}, \frac{T-C}{2}\right)$$

$$g(y,0) = (-C, T)$$

$$g(0,y) = (T, -C)$$

For all other $m \in M$, $a(m) = 0$ and $g(m)$ is given by

$$g(m) = \begin{cases} \left(\frac{T}{2}, \frac{T}{2}\right) & \text{if } m_1 = m_2 = (0,0) \\ (0, T) & \text{if } m_1 = m_2 = (y,0) \\ (T, 0) & \text{if } m_1 = m_2 = (0,y) \\ (0,0) & \text{otherwise} \end{cases}$$

Though the total transferred to the poor using the Hard Budget scheme is higher than with Means Testing, poor agents in poor communities receive $T/2$ than while poor agents in rich

Table 1
An example

γ	1/10	1/3	1/2	2/3	9/10
$\overline{C}$	0.05	0.15	0.23	0.3	0.4
First Best	2.69	2.88	3.27	4.16	11.03
Hard Budget	2.67	2.85	3.22	4.11	10.97
Means Testing	2.59	2.81	3.20	4.10	10.99

communities receive T. So for a given α and C, the Hard Budget scheme is efficient unless agents are extremely risk averse. For a given level of risk aversion, the Hard Budget scheme is efficient only above some threshold audit cost $\overline{C}$. Notice that this scheme clearly dominates Universal Transfers, because it eliminates the leakage to the rich.

Proposition 3. *Suppose agents are informed and can collude. The Hard Budget scheme is efficient if $C \geq \overline{C}$, where $\overline{C}$ is the solution to*

$$U\left(\frac{T-\alpha\overline{C}}{1+\alpha}\right)=\frac{1-\alpha}{1+\alpha}U(T)+\frac{2\alpha}{1+\alpha}U\left(\frac{T}{2}\right) \tag{4}$$

and Means Testing is efficient otherwise.

The following example makes the comparison between the targeting schemes precise for a particular class of utility functions. Suppose $T=4$, $\alpha=0.5$, and $C=0.32$ or 8% of the per community transfer. Suppose agents have preferences with constant relative risk aversion, $U(x)=(1/(1-\gamma))x^{1-\gamma}$, where γ is the coefficient of relative risk aversion. For a given γ, the threshold $\overline{C}$ from Eq. (4) and the expected utility for a poor agent in the first best case and for the Hard Budget and the Means Testing scheme are computed below. Notice there is a welfare gain when agents have community information relative to the case when they do not if $\overline{C}<0.32$ or equivalently, if $\gamma<0.71$ (Table 1).

Notice that $\overline{C}$ approaches 0 as if agents are less risk averse and a poor agent's expected utility from the Hard Budget scheme approaches the first best level.[8] So when agents are informed, the Hard Budget scheme is efficient if $\gamma<0.71$, and otherwise Means Testing is efficient. If agents were uninformed as in Section 3, Means Testing is efficient while Universal Transfers is not (since in this example $C<T/2$).

Proposition 3 shows how community information can improve targeting if the government can commit to a hard budget constraint. But it may be politically infeasible for the government to make unequal transfers to poor agents in different parts of the country or the government may be unable to commit not to give additional transfers if a community turns out to have a higher than average poverty rate. If transfers must satisfy horizontal equity, Means Testing or Universal Transfers are efficient, and so there is welfare gain from asking agents to make reports about each other.

[8] At the extreme, if agents were risk neutral then the Hard Budget scheme and Cross Reporting would achieve the first best level of welfare, there would then be no efficiency loss from restricting the targeting mechanism to be collusion proof.

Proposition 4. *If transfers must satisfy horizontal equity, then community information is not useful. Universal Transfers are efficient if $C \geq ((1-\alpha)/(2\alpha))T$ and Means Testing is efficient otherwise.*

5. Discussion

This section discusses extensions of the basic model.

5.1. Random audits

The government could only conduct deterministic audits in the previous sections. If the government could audit randomly instead, it would lower the audit costs, increase the threshold $\overline{C}$ and make means testing more attractive relative to Universal Transfers (Proposition 1) and relative to the Hard Budget scheme (Proposition 3). The limited liability constraint in Section 2 rules out schemes in which the government approximates the first best by auditing with an extremely small probability and imposing arbitrarily large penalties on rich agents found to be cheating. Consequently, just as in Proposition 3, the Hard Budget scheme will be preferred to Means Testing if $C > \overline{C}$, where $\overline{C}$ is now the solution to

$$(1+\alpha)U\left(\frac{T - p\alpha\overline{C}}{1+\alpha}\right) = (1-\alpha)U(T) + \alpha U\left(\frac{T}{2}\right)$$

and p is the audit probability chosen to be just high enough to deter the rich.[9] Therefore, allowing random audits would not change the basic result: community information would still be useful for targeting if audit costs were sufficiently high.

5.2. Many agents

The results would be unaffected if each community had N agents instead of just two. The Hard Budget scheme described in Section 4.2 works in same way with many agents. Each agent is asked to report his own wealth and the wealth of all the other agents. If reports agree then only agents who are reported to be poor will receive a transfer T/N_θ, where N_θ is the number of poor agents in the community in state θ. If an agent i reports himself as poor, but j reports that i is rich, then an audit will be conducted. If agent i is found to be rich ($\theta_i = y$), then agent i is fined C to cover the cost of the audit. If agent j is found to be lying ($\theta_i = 0$), then agent j is fined to cover the audit cost if $\theta_j = y$. If $\theta_i = \theta_j = 0$ then the transfer to each poor agent is reduced to $(T-C)/N_\theta$ cover the audit cost. Such a scheme is collusion proof and no audits are conducted in equilibrium.

[9] For a general treatment of random audit schemes when agents are uninformed, see Mookherjee and Png (1989).

5.3. Delegation

The Hard Budget scheme has been described with both agents making simultaneous reports about each other. A sequential scheme with the same outcome would be for agent 1 to first report the state, and then agent 2 could either agree (keep silent) or contradict. For example, agent 1 could be the village headman and agent 2 could be other villagers. In such a scheme, the headman is the informant, yet is kept honest by the possibility that other villagers might call an audit. In equilibrium, no villager will ever be observed contradicting the headman's report. So in equilibrium the scheme would look as if it were delegated to the village with only the headman making reports to the central government. Such a delegated scheme would reduce the message space, particularly in the case where there are many agents, and would be especially useful if sending reports were costly. Reinikka and Svensson (2001) describe a successful attempt by the Ugandan central government to reduce district level bureaucratic corruption by broadcasting information on the transfer of funds and encouraging households to report discrepancies in funds received. That scheme can be interpreted as an example of cross reporting to discipline the delegate.

5.4. Geographic targeting

The design of an anti-poverty program that combines geographic targeting with intra-community targeting is of policy relevance in several countries (see Galasso and Ravallion, 2000, for an example). Consider an extension of the model with two regions, North and South. Suppose the South is poorer than the North, or equivalently $\alpha_S > \alpha_N$, where α_S and α_N are the proportion of communities in the South and in the North where both agents are poor. Then the efficient collusion proof mechanism is the Hard Budget scheme in each region if audit costs are sufficiently high. The total transfer to each community in the South is lower than the total transfer to each community in the North. So $T_S > T_N$, where T_S and T_N are the per-community transfers in each region, and they are chosen to satisfy the government's overall budget constraint. Suppose the government is informed about the poverty rates in different regions, say through census data. Then geographic targeting (giving communities in poorer regions a larger transfer) can be combined with community information to reduce targeting costs.

6. Conclusions

This paper has shown how inducing villagers to make reports about each other can reduce targeting costs if the government can commit to a hard budget constraint for each community and can threaten a costly audit. In practice, some community-based targeting schemes impose hard budget constraints. For instance, the government of Uzbekistan targets social assistance through local neighborhood committees called Mahallas. But "once the funds are allocated, no further funds are available from the central government even if a Mahalla claims to have insufficient money to cover applications for assistance" (Coudouel et al., 1998). In another example, the government of Albania targets social assistance by giving block grants to local councils. These local councils determine which families should receive the benefits and face a hard budget constraint (Alderman, in press).

If the government has no information on whether one community is poorer than another, both communities should receive the same total transfer in an efficient collusion-proof targeting scheme. An implication is that poor villagers in the poorer community will receive a lower transfer than poor villagers in the richer community. The crucial trade-off in designing a community-based targeting scheme is between reducing costs and preserving horizontal equity. For a government that wants to ensure that a poor villager receives the same transfer no matter where she is living, asking villagers to make reports about each other is not useful.

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Appendix A

Proof of Proposition 1. Clearly, $a_1=0$ in any solution. Then notice that $\tau_2 \leq \tau_1$ in any solution else we could increase welfare without affecting (3). The following are the two cases.

1. Suppose $a_2=0$. Constraint (3) must bind (else reducing t and increasing τ_2 will increase welfare). So $t=\tau_2$. Collusion proofness implies that $2\tau_2=\tau_1+t$ and so $\tau_1=\tau_2=t=T/2$ (Universal Transfers).

2. Suppose $a_2=1$. Then constraint (2) implies $t=0$, (3) is always satisfied and so $\tau_2=\tau_1$ (else we could increase welfare by increasing τ_2). Constraint (2) implies $\tau_2=\tau_1=(T-\alpha C)/(1+\alpha)$ (Means Testing), and this scheme is clearly collusion proof. Universal Transfers is preferred if $T/2 \geq (T-\alpha C)/(1+\alpha)$.

Proof of Proposition 2. To show that the Cross Reporting scheme Nash implements the first best, consider the game played in each state θ. The game played in the state (0, 0) is below. The assumption $C \leq T$ implies $\tau^*-(C/2)>0$ and so the unique Nash equilibrium outcome is (τ^*, τ^*):

	$(0,0)$	$(y,0)$	$(0,y)$
$(0,0)$	τ^*, τ^*	$\tau^*-\dfrac{C}{2}, \tau^*-\dfrac{C}{2}$	$0, 0$
$(y,0)$	$0, 0$	$0, \tau^*$	$0, 0$
$(0,y)$	$\tau^*-\dfrac{C}{2}, \tau^*-\dfrac{C}{2}$	$\tau^*-\dfrac{C}{2}, \tau^*-\dfrac{C}{2}$	$\tau^*, 0$

In the state (y,0), the game played by the agents is below, and the unique Nash equilibrium outcome is (0, τ*):

$$\begin{array}{cccc} & (0,0) & (y,0) & (0,y) \\ (0,0) & \tau^*,\tau^* & -C,2\tau^* & 0,0 \\ (y,0) & 0,0 & 0,\tau^* & 0,0 \\ (0,y) & -C,2\tau^* & -C,2\tau^* & \tau^*,0 \end{array}$$

Similarly in the state (0, y), the unique Nash equilibrium outcome is (τ*, 0). □

Proof of Proposition 3. The proof is in two parts. First, notice the Hard Budget scheme Nash implements (T/2, T/2) in the state (0, 0), (0, T) in the state (y, 0), and (T, 0) in the state (0, y). The unique Nash equilibrium outcome of the game played in the state (0, 0) is (T/2, T/2):

$$\begin{array}{cccc} & (0,0) & (y,0) & (0,y) \\ (0,0) & \frac{T}{2},\frac{T}{2} & \frac{T-C}{2},\frac{T-C}{2} & 0,0 \\ (y,0) & 0,0 & 0,T & 0,0 \\ (0,y) & \frac{T-C}{2},\frac{T-C}{2} & \frac{T-C}{2},\frac{T-C}{2} & T,0 \end{array}$$

The unique Nash equilibrium outcome of the game in the state (y, 0) is (0, T):

$$\begin{array}{cccc} & (0,0) & (y,0) & (0,y) \\ (0,0) & \frac{T}{2},\frac{T}{2} & -C,T & 0,0 \\ (y,0) & 0,0 & 0,T & 0,0 \\ (0,y) & -C,T & -C,T & T,0 \end{array}$$

And similarly, the unique Nash equilibrium outcome of the game in the state (0, y) is (T, 0). This Hard Budget scheme is clearly collusion proof. In any state θ, the total equilibrium payoff $q(\theta)=T$. Agents may choose to collude and send an alternative message m' but for each θ and for each $m' \in M$, the highest possible collusion payoff $\bar{q}(m') \leq T$. The expected utility for a poor agent from the Hard Budget scheme is $(1-\alpha)/(1+\alpha)U(T)+(2\alpha/(1+\alpha))U(T/2)$. Provided $C \geq \overline{C}$, where $\overline{C}$ is defined in Eq. (4), the poor are better off under the Hard Budget scheme than with Means Testing.

To prove that either the Hard Budget scheme or Means Testing is efficient: suppose there is an alternative mechanism that achieves higher welfare and is collusion proof. Then there are two possibilities.

1. No audits are conducted in equilibrium. For the alternative to achieve higher welfare than the Hard Budget scheme, transfers to the poor must be less unequal across states. So the total equilibrium payoffs for the alternative must be $q(0, 0) > q(y, 0)$ or $q(0, 0) > q(0, y)$ or both. But then the alternative is not collusion proof.

2. Audits are conducted in equilibrium. So in the alternative, audits must be held in either $(0, y)$ or in $(y, 0)$ or in both, but not in state $(0, 0)$ to achieve higher welfare than Means Testing. If audits are only held in the state $(0, y)$, collusion proofness implies $q(0, y) \geq q(0, 0)$ and $q(y, 0) = q(0, 0)$. If audits are only held in the state $(y, 0)$, collusion proofness implies $q(0, y) = q(0, 0)$ and $q(y, 0) \geq q(0, 0)$ and if audits are held in both states, collusion proofness implies $q(0, y) \geq q(0, 0)$ and $q(y, 0) \geq q(0, 0)$. So this alternative can do no better than $q_1(0, y) = q_2(y, 0) = q(0, 0) < T$. So the alternative does no better than the Hard Budget scheme. □

Proof of Proposition 4. Suppose there is an alternative mechanism that achieves higher welfare than either Universal Transfers or Means Testing yet preserves horizontal equity. Let $q(0, 0) = (\tau, \tau)$, $q(y, 0) = (t_1, \tau)$ and $q(0, y) = (\tau, t_2)$ for the alternative. There are two possibilities.

1. No audits are conducted in equilibrium. To achieve higher welfare than Universal Transfers, the alternative must have $\tau > T/2$ and so $t_1 < T/2$ or $t_2 < T/2$. But such a scheme is not collusion proof.

2. Audits are conducted in equilibrium. So the alternative must have $\tau > (T - \alpha C)/(1 + \alpha)$ to dominate Means Testing. This implies audits are conducted in either state $(0, y)$ or $(y, 0)$ or both. But collusion proofness implies that $2\tau = t_1 + \tau = t_2 + \tau < T$. So the alternative can do no better than Universal Transfers. □

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