Roscas as financial agreements to cope with social pressure*

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Abstract

In developing countries, traditional social obligations often press rich individuals to share their income. In this paper, we posit a "model of social pressure" in which people can sign binding financial agreements among them. These agreements may help to escape social obligations. It turns out that an anonymous and efficient agreement corresponds to one of the most developed and puzzling financial institution in developing countries: Rotating savings and credit associations (Roscas).

1 Introduction

Rotating savings and credit associations (Roscas) are the most developed informal financial institutions in developing countries, particularly in Africa and Asia. The basic principle of Roscas is almost the same everywhere. A group of people gather for a series of meetings. At each meeting, everybody contributes to a common pot. The pot is given to one member of the group. This member is then excluded from receiving the pot in

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future meetings, while still contributing to the pot. This process is repeated until every member receives the pot. Afterwards, the Rosca is disbanded or begin another cycle.

Roscas are very specific types of agreements. They drive a huge part of savings in countries where formal financial institutions do not exist.[1] They thus respond in some way to the needs of the population living in these countries. Given the long-standing and worldwide prevalence of Roscas, our presumption is that these agreements should probably resemble to *the best agreement* that people can design within their economic environment and social context. Yet, so far, such a presumption has never been examined. Besley, Coate and Loury (1994) have shown that a random Rosca is sometimes better than organizing a credit market. But they agree that Roscas are in general inefficient, meaning that there exists another financial agreement that strictly Pareto dominates Roscas. So why people do not agree on it? The contribution of this paper is to put forward a "model of social pressure" in which a Rosca is the best financial agreement on which people can agree on.

The literature distinguishes in general three different types of Roscas, depending on how the pot is allocated. The pot may be allocated randomly *(random Roscas)*, through a bidding process *(bidding Roscas)* or according to pre-determined order *(deterministic Roscas)*. In the latter case, while the original allocation order might have been chosen randomly, the order of the winners is repeated throughout the cycles.

The literature has then identified two main justifications for the existence of Roscas. First, Roscas are often presented as a substitute to insurance, particularly in developing countries where markets for insurance do not exist. Yet, this interpretation applies for bidding Roscas but not for random or deterministic Roscas in which the allocation process does respond to some individual specific shocks.[2] Moreover, people that group together in a Rosca generally belong to the same village and have similar occupations and revenues. This is not really compatible with risk-sharing activities.

Second, Roscas may facilitate the purchase of lumpy durable goods, such as a house or the financing of a wedding. In their seminal contribution, Besley, Coate and Loury (1993) show that, on average, Roscas allow individuals to receive the pot earlier. As a result, individuals can buy the good sooner in their lifetime by participating to the Rosca rather than by accumulating private savings. This interpretation applies for

[1] For example, Roscas drive one-half of national savings in Cameroon (Anderson and Baland, 2000)

[2] A Rosca is often inflexible in the sense that it is not easy for an individual to change his position. In a survey on Kenyan (deterministic) Roscas, Gugerty (2000) pointed out that only 2% of Rosca members did exchange place with another participant.

random Roscas but not for deterministic Roscas whereby, at least after one full cycle, there is no randomness in receiving the pot. Indeed, the member who receives the pot last could do as well by privately accumulating savings, while not suffering from the lack of flexibility in its allocation. This member is thus in general worse-off. By backwards induction, the Rosca breaks down.

Yet, two pieces of work have recently provided additional rationale for the durable goods explanation. The first one, Anderson and Baland (2000), relies on intra-household conflicts in consumption decisions. Participation in a Rosca is a strategy a wife employs to protect against husbands' tendencies to splurge. Rosca is thus a commitment device that will permit the household to purchase the durable good. Their model relies on the assumption that the wife has control over the household revenue during the first period, but not in subsequent periods.

Second , Gugerty (2000) relies on intra-personal time-inconsistency. Using a simple illustrative example, she shows, as in Anderson and Baland (2000), that participating to a Rosca helps individuals to commit to the purchase of the durable good. Interestingly though, Gugerty (2000) recognized in the same paper that, in Western Kenya, Rosca participants generally use the pot for various purposes, not necessarily for the purchase of a single durable good. She finds that *"over half of Roscas participants use their Rosca winning for more than one purpose, and one fifth use their winning for more than two purposes"*. And, in conformity with that observation, most of the survey participants say that they would not necessarily prefer to receive the pot sooner than later. This cast some doubt on the durable good's explanation.

In this paper, we take another path with respect to the existing literature. First, our explanation does not rely on the purchase of a durable good. Second, we do not simply show that people are better-off if they save in a Rosca rather than at home. We compare revenues from Roscas to revenues from *any other kind of financial agreements* that can be designed among a group of people. More precisely, we allow for any random transfers performed among agents. People choose a finite set of states of natures, a probability distribution on this set and transfer schemes performed in each state, providing that they are budget balanced state-by-state. We then show that random and deterministic Roscas (with a random first round) are efficient financial arrangements.

Our result relies on two assumptions. First, there exists social obligations asking for income sharing. Rich people are pressed to spread part of their revenue within their community. This amount can be viewed as "informal tax" that finances wealth redistribution, social insurance or public goods. In developing countries, due to market failures and the lack of efficient public institutions, most of these activities are performed informally by the community. By informal, we mean that no court can legally force individuals to pay the tax. It is therefore collectively enforced through peer-pressure so that people derive a social gratification from fulfilling this social obligation or undergo a social sanction from not doing so. Documented evidences of such sharing obligations in developing countries can be found in the anthropological literature (e.g. Scott, 1976, James, 1979, Parkin, 1972,) as well as in economics (e.g. Fafchamps, 1992, 1995 Platteau, 2000,).

The second assumption is that the social gratification or sanction has no "economic value" per se. As such, gratification or sanction can be viewed as an emotion. Individuals would ideally prefer not to give, but at the time they face some social pressure, they feel guilty if they do not respond to social demands from relatives. They enjoy acknowledges, tokens of affections when they do so. Our approach for modelling such emotions is related to present-biased preferences (Akerlof, 1991, O'Donogue and Rabin, 1999). It thus relies on time-inconsistency, as in Gugerty (2000) or Anderson and Baland (2000). Yet, the source of time-inconsistency is different in our model. It is not due to an intra-household conflicts nor to an intrapersonal conflict but to social pressures. Individuals cannot resist to day-to-day social pressure. Yet, they are willing to find a device to restrain future over-spending in social obligations. A Rosca then provides the individual with such a commitment technology. In Platteau's words (page 231): *"[Roscas] provide a socially accepted alibi to protect people's saving against all sorts of social pressures".*

2 The model of social pressure

Consider an economy populated by a large number[3] of identical agents. An individual lives for several periods indexed by t. In each period, he earns a revenue y but he is asked to contribute an amount m to the community. The contribution is indivisible: We assume the "informal tax" is bounded downward.[4]

[3] By large we mean that agent's choices are never restricted by the size of the population.

[4] The idea is that people have expectations about how much any individual should give to the community. Social pressure is exerted as long as the amount paid is less than the expected contribution. In practice, a large part of these contributions are paid during social and ritual events through traditional gifts (e.g. Parkin, 1972,). People have no choice but offer (at least) the customary gift or nothing. For instance, in West Africa, during the traditional muslim feast called *"Tabaski"*, each adult male, head of a household, is supposed to sacrifice a sheep and share the meat with relatives, neighbors and

For any individual, giving m to the community provides him with a nonpecuniary social gratification $\delta > 0$. The individual gets no gratification ($\delta = 0$) if he gives less than m; and no extra gratification if he gives more than m. If utility of pure consumption is denoted $u(.)$, we get that it is optimal for the individual to spend m if and only if[5]

$$u(y-m)+\delta > u(y). \tag{1}$$

We assume that $u(.)$ is increasing and concave. In words, this means that poorer people attach relatively less value to social gratification with respect to immediate consumption. Let y be high enough so that 1 holds.

Importantly, we assume that preferences are present-biased (Akerlof, 1991) and that the individuals are sophisticated (O'Donogue and Rabin, 1999). Formally, this means that, from an ex ante point of view, δ has no value. Hence, it will never be optimal to spend money in period t since

$$u(y-m) < u(y). \tag{2}$$

However the individual anticipates that, when arriving in period t, inequality 1 will apply and it will turn out to be optimal to spend money m. This is the standard time-inconsistency process. In other words, the individual cannot resist to day-to-day social pressure. Yet, he knows it and want to able to resist to it.

Note that there exists a unique revenue $\underline{y}$ that makes an agent indifferent between fulfilling his social obligation or not:

$$u(\underline{y}-m)+\delta = u(\underline{y}). \tag{3}$$

Clearly, $\underline{y}$ exists and is unique because the marginal gain of renouncing to δ, $u(y) - u(y-m)$, is decreasing with y. To summarize, for any $y \in \mathbb{R}^+$, one can define an agent *ex ante utility* by:

$$v(y) = \begin{cases} u(y-m) & if \quad y > \underline{y} \\ u(y) & if \quad y \leq \underline{y} \end{cases} . \tag{4}$$

This function is drawn in thick line in Figure 1 below.

poor members of the community. The individual derives social gratification from killing the "bigger sheep" and no gratification form offering half or a quarter of a sheep (personal observation). Another explanation relies on asymmetrical information. Progressive taxation is not feasible when information on individual's wealth is imperfect.

[5]Notice that δ can also be interpreted as a social sanction from not fulfilling traditional solidarity obligations. In this case, it appears as negative in the right-hand side of the inequality.

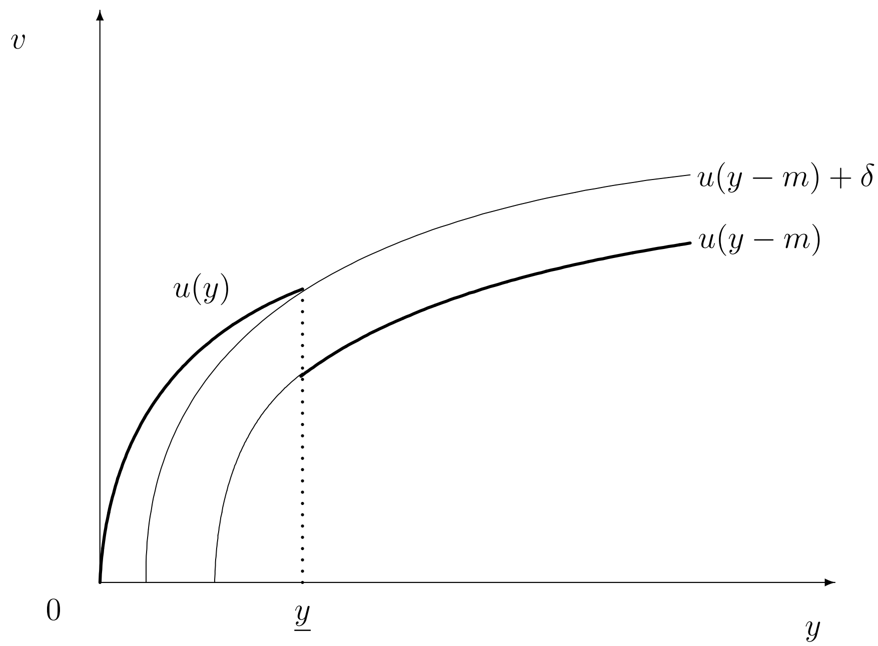

Figure 1: Utility levels

Notice that there is a downward jump in the ex ante utility function, thereby generating a non-concavity. This implies that people could be better off by randomizing their revenue like in a Rosca. Since agents are risk-averse, randomizing has a cost. Yet, we will see that this cost is outweighed by the benefice of reducing social obligations.

3 A static analysis

As a first step, we restrict our attention to a static framework. Suppose that all individuals live for one period and face social pressure as described in the previous section. Yet at the beginning of the period (say at date 0) they may sign financial contracts. When the contract is carried out, each agent performs transfers as specified in the contract and then respond or not to the social contribution m, depending on his remaining wealth after transfers.

Before pursuing the analyze, we need to introduce some definitions. First, let us formally define what we call "financial agreement" (FA). In short, a financial agreement is a contract among a group of agents assigning random payments among them. It is assumed binding: People cannot default (or at infinite cost).[6] The random procedure and payment structures are freely chosen by agents so that no restrictions are imposed on the contract space. Formally, a FA is defined as follow.

Definition 1 *A financial agreement $\mathcal{C} = (N, K, p, \mathcal{T})$ is defined by:*

- *A set of agents $N \subset \mathbb{N}^+$.*
- *A set of states of nature $K = \{1, ..., k\}$.*
- *A probability measure p on K where $p(l)$ denotes the probability of state l for any $l \in K$.*
- *A set of transfers $\mathcal{T} = \{t_i^l\}_{l\in K, i\in N}$ where t_i^l is the transfer assigned to agent i in state l.*
- *Transfers are budget balanced in each state of nature: $\sum_{i\in N} t_i^l \leq 0$ for every $l \in K$.*

In words, a financial agreement defines a group of members N who performs transfers among them. $\mathcal{T}$ is the set of transfers. Each element $t_i^l \in \mathcal{T}$ denotes the transfer *received* by individual i in state l. The state of nature l occurs with probability $p(l)$. The transfer scheme $\{t_i^l\}_{i\in N}$ performed in every state l must be budget balanced in the precise sense that the money distributed within the group N must be enterally financed by its members.

As a member of a FA, an individual cares only on how much he has to pay or to receive and how often. Therefore, his expected payoff can be expressed in term of "lotteries" defined by a transfer scheme $T_i = \{t_i^l\}_{l\in K}$ and a probability measure p on a set of states of nature K. A FA $\mathcal{C}$ can be viewed as a collection of "budget balanced" lotteries (T_i, p, K) for every $i \in N$ with common probability measure p. Each lottery gives to an agent an expected payoff

$$U(T_i, p) = \sum_{l\in K} p(l) v(y + t_i^l). \tag{5}$$

We impose two criteria on FAs: efficiency and anonymity. Both concepts are now formally defined.

[6] Although we are convinced that enforcement problems are important, we do not address this issue in this paper.

Definition 2 *A financial agreement $\mathcal{C}$ is* <u>*efficient*</u> *or (Pareto) optimal if and only if no other financial agreement $\mathcal{C}'$ is such that:*

- $U(T_i', p') \geq U(T_i, p)$ *for every* $i \in N$.
- $\exists j \in N$ *such that* $U(T_j', p') > U(T_j, p)$.

A FA is efficient if no other FA can make at one member better off without reducing the other member's payoff. If such a $\mathcal{C}'$ exists, we will say that $\mathcal{C}'$ (Pareto) dominates $\mathcal{C}$. This is the standard definition of efficiency.

Definition 3 *A financial agreement $\mathcal{C}$ is* <u>*anonymous*</u> *if and only if its lotteries are equivalent. Two lotteries (T_i, p) and (T_j, p) are equivalent if and only if for any $l \in K$, $\exists h \in K$ such that $t_i^l = t_j^h$ and $p(l) = p(h)$.*

In other words, two lotteries are equivalents when for any transfer in T_i, the same transfer in T_j occurs with same probability. To be anonymous, the FA must assign equivalent lotteries to its members.

We now proceed in several steps to characterize the anonymous and efficient FAs labelled $\mathcal{C}^* = (N^*, K^*, p^*, \mathcal{T}^*)$. All proofs are relegated to the Appendix.

Lemma 1 *A financial agreement that assigns randomly n transfers among n persons with equal probabilities weakly dominates any other anonymous FA.*

Lemma 1 allows us to restrict our attention to FAs that assign randomly n transfers among n persons with equal probabilities. In our framework, this set of FAs is such that $k = n!$, $p(l) = \frac{1}{n!}$ for every $l \in K$, and $|\mathcal{T}| = n$. The probability that agent j receives t_i is $\frac{(n-1)!}{n!} = \frac{1}{n}$. Individual transfers schemes are equals: $T_i = T_j = T$ for every $i, j \in N$. This FA yields a payoff $\frac{1}{n} \sum_{i \in N} v(y + t_i^l)$ to any member. A draw order the n transfers $T = \{t_i\}_{i \in N}$, each ordering occurs with same probability $\dfrac{1}{n}$.

So far, we have identify the set of states of nature and the probability distribution. We need now to find out the optimal set of agents N^*, or equivalently, the optimal size of the group n^* (remember that people are identical); as well as the set of n^* transfers $\mathcal{T}^* = \{t_i^*\}_{i \in N^*} = T^*$.

Define $\underline{t} = y - \underline{y}$ as the minimum transfer that makes an agent resist to social pressure. Let us partition any arbitrary set of transfers $T = \{t_i\}_{i \in N}$ into two subsets $T_- = \{t_i \in T | t_i \leq -\underline{t}\}$ and $T_+ = \{t_i \in T | t_i > -\underline{t}\}$. We now identify three intuitive properties on optimal transfers scheme T^*.

Lemma 2 $u(y+t_i^*) < u(y-m+t_j^*)$ *for every* $t_i^* \in T_-^*$ *and* $t_j^* \in T_+^*$.

Lemma 2 asserts that the optimal FA assigns a higher payoff to people who give m. If it is not the case, all individuals would be better off if they are asked to give an amount lower than $\bar{t}$ while the money collected is throw down the drain. Obviously, it is optimal to find someone to give the money, providing that he gets an higher payoff. Notice that Lemma 2 implies that the FA does not achieve perfect consumption smoothing.

Lemma 3 *If* $t_i^* \in T_-^*$ *then* $t_i^* = -\bar{t}$.

Lemma 3 tells us that if an agent has to give money to escape social pressure, he will give the minimum. Any increase of the transfer to be given reduces consumption smoothing.

Lemma 4 *If* $t_i^* \in T_+^*$ *and* $t_j^* \in T_+^*$, *then* $t_i^* = t_j^*$.

Lemma 4 is the image of Lemma 3 in the subset T_+^*. It asserts that, in order to smooth consumption, all transfers higher than $\bar{t}$ must be equal. Put differently, all agents who cannot escape social obligation receive the same amount.

Combining Lemmata 3 and 4, we conclude that the FA asks l persons to give $\underline{t}$ whereas the remaining $n-l$ agents share equally the money collected. Now, we need to find out the optimal size of the group n^* and the optimal number of contributors.[7] Denoting $\mu = \frac{l}{n}$ the fraction of contributors, the second period expected payoff of any member of the FA becomes:

$$U(T,p) = \mu u(y-\bar{t}) + (1-\mu)u(y-m+\frac{\mu}{1-\mu}\bar{t}). \tag{6}$$

The optimal fraction of contributors μ^* maximizes 6. It satisfies the following first order condition:[8]

$$u(y-m+\frac{\mu^*}{1-\mu^*}\underline{t}) - u(y-\bar{t}) = \frac{\underline{t}}{1-\mu^*}u'(y-m+\frac{\mu^*}{1-\mu^*}\underline{t}). \tag{7}$$

[7] Clearly, we have $l^* > 0$ and $n^* - l^* > 0$. Otherwise, first $l^* = 0$ means that nobody give money and therefore no money is received so there is no FA agreement which contradicts that people could benefit from a FA. Second, $n^* - l^* = 0$ means that everybody give money and nobody receive the amount collected. Agents are better off if the group is extended up to a size n such that $n > \frac{\underline{t}}{2\underline{t}-m}$ and the money collected is given to one agent.

[8] The second order condition is $-\frac{2\underline{t}}{(1-\mu^*)^2}u'(y-m+\frac{\mu^*}{1-\mu^*}\underline{t}) + \frac{\underline{t}^2}{(1-\mu^*)^3}u''(y-m+\frac{\mu^*}{1-\mu^*}\underline{t}) < 0$.

With more contributors, less money is lost through sharing obligations (less people give m) but the size of the "pot" increases to the prejudice of consumption smoothing. Hence, the optimal proportion of contributors solve a trade-off between minimizing the dead-weight loss due to sharing obligations and smoothing consumption. If $\underline{t}$ is close to 0, then μ^* is close to 1: saving on sharing obligations is worthwhile. As $\underline{t}$ increases, it becomes more costly to escape sharing obligation in term of income smoothing. Less people are asked to give, or more people get the pot, to minimize the utility gap. We have established the following result.

Theorem 1 *The efficient financial agreement with equal expected payoff i) asks a proportion μ^* of persons to contribute a fix amount $\underline{t}$ ii) the money collected is shared equally among the remaining persons, iii) each agent face same probability μ^* to contribute and $1-\mu^*$ to receive the pot collected.*

Theorem 1's FAs have intrinsic features common with Roscas: inflexible contribution equal for all, same probability to give or receive. Indeed, one theorem 1's FAs is precisely the *one-period Rosca* of size $n^* = \dfrac{1}{1-\mu^*}$ and contribution $\underline{t}$. Of course, the size n^* is generally not an integer but it can be argued that a one-period Rosca approximates quite well the welfare achieved by a Theorem 1 's FA. And it is quite simple to implement since it needs only to draw the winner of the pot.

A graphic analysis can be useful to understand the intuition leading to theorem 1. Any arbitrary lottery (T,p) part of a FA can be depicted in Figure 1. The outcome of any draw is an ex post revenue $y+t_l$ which translates into ex ante utility $v(y+t_l)$. Graphically, it is a point on v. The set of expected utilities that can be achieved is the convex hull of $v(y+t^l)$ for every $t^l \in T$. It can be represented by drawing lines linking points $(y+t_l, v(y+t_l))$ for every $t^l \in T$. A probability measure p defines an unique point in this set. Or, put differently, any point in this set can be achieved with the right probability measure.

The lottery defined in Theorem 1 randomizes between transfers $-\underline{t}$ and $\dfrac{\mu^*\underline{t}}{1-\mu^*}$. We denote the later expression $\bar{t}$. This lottery yields respective ex post revenues $\underline{y}$ and $\bar{y} = y + \bar{t}$, where $\bar{y}$ is formally defined by the first order condition 7 re-expressed as:

$$\frac{u(\bar{y}-m) - u(\underline{y})}{\bar{y} - \underline{y}} = u'(\bar{y}-m). \tag{8}$$

These two outcomes are represented by points A and B in Figure 2. [9]

[9] Notice that equation 8 states that at point B with coordinates $(\bar{y}, v(\bar{y}))$, the line starting from A with coordinates $(\bar{y}, v(\bar{y}))$ is tangent to the utility function.

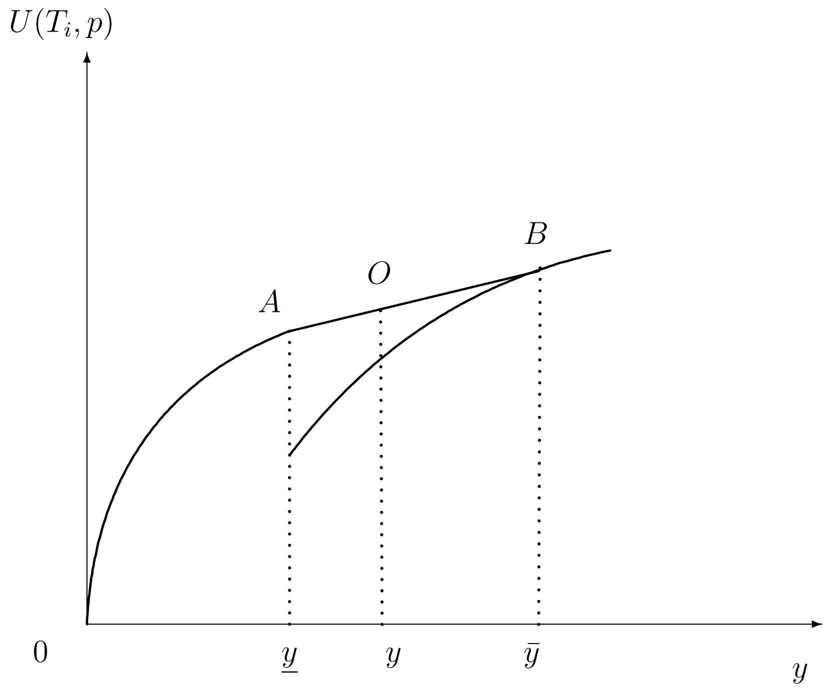

Figure 2: Upper Bound on Expected Utility Levels

This lottery yields an expected utility $\mu u(\underline{y}) + (1-\mu)u(\bar{y}-m)$ located along the line AB. Clearly, it is welfare improving for any individual whose revenue y lies between $\underline{y}$ and $\bar{y}$. But it also dominates any other lottery which, indeed, would yield an expected payoff strictly below the line AB. In particular, adding any other transfers to transfers $\underline{t}$ and $\bar{t}$ yields an expected payoff strictly below AB. This remains true for any transfer other than $\underline{t}$ or $\bar{t}$.

In Figure 2, the upper envelope of the graph represents an upper bound on agent's expected payoff that can be achieved with lotteries. It implies those who have revenue below $\underline{y}$ and above $\bar{y}$ cannot improve their welfare with lotteries. Now, these lotteries must be feasible within an anonymous FA. This imposes restrictions on the probability distribution and the size of the FA. First, anonymity forces agents to face identical probability distribution μ. This is satisfied if, in each draw, a proportion of members μ contribute. Second, transfers must be budget balanced state by state. Hence, the proportion of contributors must μ^* such that $\mu^*\underline{t} = (1-\mu^*)\bar{t}$.

Graphically, anonymity and budget constraints force the expected utility to be at most O along the line AB is Figure 2. Some people could get an expected utility on the right-hand side of O by winning more often $\bar{t}$ than others. However, this violates anonymity. The expected utility level in O can be achieved with a Rosca of size n^* defined by $\bar{t} = (n^* - 1)\underline{t}$. It corresponds to an amount:

$$U(T^*, p^*) = \frac{n^* - 1}{n^*} u(y - \underline{t}) + \frac{1}{n^*} u(y + (1 - n^*)\bar{t} - m)\}. \tag{9}$$

4 Extension to multi-periods

The objective of this section is to extend previous results to a multi-periodic framework. Time is thus divided in several periods. Every individual values time according to a discount factor β. Yet, as before, at date 0, individuals can design and sign binding financial agreements.

First, observe that a one-period Rosca can be extended easily to a multi-periodic framework. This can be done by simply repeating the random procedure identically in each period, without taking into account the results of previous draws. This FA is obviously still anonymous and efficient. But there obviously exist various multi-periods extensions of the static solution. The point is to show that a random Rosca and a deterministic Rosca (with random initial ordering) are two of them.

Obviously, these two FA are anonymous. Now, in a Rosca, winners are excluded from the draw in subsequent periods during a cycle. So, each cycle, each agent is sure to get the pot. But when he joins the Rosca (at date 0) he does not know when he will have it.[10] There is a probability $\frac{1}{n^*}$ that he will have the pot at date h for each date of the cycle. In this case, his payoff will be $v(y + (n^* - 1)\underline{t}) = u(y - m + (n^* - 1)\underline{t})$ at date h and $u(y - \underline{t})$ at the other dates $t = 1, ..., n^*, t \neq h$. Hence, the payoff at date 0 for the first cycle of any member of the Rosca is,

$$\sum_{h=1}^{n^*} \frac{1}{n^*} [\beta^h u(y - m + (n^* - 1)\underline{t}) + \sum_{t \neq h} \beta^t u(y - \underline{t})]. \tag{10}$$

This payoff simplifies to

$$\sum_{t=1}^{n^*} \beta^t [\frac{1}{n^*} u(y - m + (n^* - 1)\underline{t}) + \frac{n^* - 1}{n^*} u(y - \underline{t})]. \tag{11}$$

Since, viewed at date 0, the expected outcome of all cycles are identical, the extension to an infinity of periods is straightforward. The payoff at date 0 of any member of the

[10]This matters because people have discounted preferences on time.

Rosca of an infinity of periods is equal to

$$\sum_{t=1}^{\infty} \beta^t \{ \frac{n^* - 1}{n^*} u(y - \underline{t}) + \frac{1}{n^*} u(y - m + (n^* - 1)\underline{t}) \}. \tag{12}$$

The random Rosca and deterministic Rosca with random initial ordering reproduces the per-period payoff of theorem 1's one-round Rosca (the term in brackets of 12 is equal to 9) for an infinity of periods. Hence, these two type of Rosca are efficient on top of being anonymous. This leads to our main result.

Theorem 2 *Random Roscas and deterministic Roscas with random initial ordering are anonymous and efficient financial agreements.*

Theorem 2 establishes that a Rosca is one of the best anonymous agreement that a group of agents can sign together to resist to social pressure for sharing obligations. It rises a question: Why random Roscas and deterministic Roscas with random initial ordering are preferred to, say, a straight multi-periods extension of Section 3's one-period Rosca? The main difference is that with Roscas, winners are excluded so that members are sure to get the pot during each round.[11] In this sense, these FAs appear somewhat less risky, even though this aspect is not reflected in the expected utility framework. Furthermore, without excluding winners, wealth inequality after a draw can be potentially higher. Put differently, Roscas minimizes wealth inequality of each draw, which is a nice fairness property.

5 Discussion

We now discuss the robustness of our result to alternative assumptions. First, we ask to what respect anonymity can be relaxed or replaced by another restriction on FA. Our result holds (in particular Lemma 1) as long as people member of a FA have same expected utility (when the benefit from contracting is shared equally among members of the FA). As a result, other normative principles (such as no cross-subsidy, no inequality or no envy) would certainly lead to the result as well. Moreover, this could be sustained by a more positive principle: Stability. Suppose indeed that one member of a FA gets less than $\frac{1}{n}$ of the sum of expected utilities. He or she could simply refuse the agreement

[11] This argument is consistent with in Gugerty's finding that 25% of people reported that the main reason to for joining a Roasca is to make sure that each member had a certain item.

and sign another FA (with equal divide of the surplus) with others agents. Hence, a FA assigning different expected payoff to identical persons would not be stable.

Second, we have assumed that people have same revenue. Our result still holds in an economy is populated by people with heterogeneous revenues. It is so because anonymity forces FAs to include agents with same revenue. Suppose it is not true. Suppose that two members of a FA have different revenues. They must perform different transfers to reach ex post revenues $\underline{y}$ and $\bar{y}$. Therefore FA is not anonymous. Hence, efficient and anonymous FAs contain agents with equal revenue. Notice that this result is consistent the empirical evidence that people's revenues are homogeneous within Roscas (see Handa and Kirton 1999).

6 Concluding remark

In this paper, we have motivated the practice of Roscas, one of the most popular informal financial institutions around the world. We argue that a Rosca is the best anonymous agreement that a group of agents can sign to resist to social pressure for sharing obligations.

Notice that our motivation does not rely on the purchase of a lumpy durable good as Besley, Coate and Loury's seminal papers. It therefore consistent with Gugerty's empirical evidence that the pot is sometimes spent on other purchases, such as clothing, food or social events. Beyond the purchase of indivisible good, our result is robust to any use of the pot, particularly social related uses such as baptisms, weddings and funerals. Nevertheless, in our model, it is easy to see that people would benefit even more from a Rosca if the financial agreement is explicitly devoted to the purchase of this good (see Gugerty 2000 for empirical evidences of such Roscas). If the agreement is binding, the good is purchased. Then it can hardly de divided among among his relative (or at the cost of selling it) so that the person can resist to social pressure even when winning the pot.

A Proof of Lemma 1

Consider any arbitrary anonymous FA $\mathcal{C}$. Since individual are identical, anonymity implies that $\mathcal{C}$ yields same payoff to any individual $i, j \in N$: $U(T_i, p) = U(T_j, p)$ The expected payoff of any members i is therefore $\dfrac{1}{n}$ the sum of expected payoffs:

$$U(T_i, p) = \frac{1}{n} \sum_{l \in K} p(l) \sum_{i \in N} u(C(t_i^l)). \tag{13}$$

We show that $\mathcal{C}$ is weakly dominated by a FA $\mathcal{C}^h$ that assigns randomly with equal probability $\frac{1}{n}$ the set of transfers $\{t_i^h\}$ that maximizes the sum of utilities (i.e. h is defined $h = Argmax_{l \in K} \sum_{i \in N} u(C(t_i^l))$). This FA yields to any agent i a payoff $\frac{1}{n} \sum_{i \in N} u(C(t_i^h))$. By definition of h, we have,

$$\frac{1}{n} \sum_{i \in N} v(y + t_i^h) \geq \frac{1}{n} \sum_{i \in N} v(y + t_i^l), \tag{14}$$

for any $i \in K$. Multiplying 14 by $p(l)$ for every $l \in K$, summing up for every $l \in K$, and combining with 13 we obtain:

$$\frac{1}{n} \sum_{i \in N} u(C(t_i^h)) \geq U(T_j, p), \tag{15}$$

for every arbitrary agent $j \in N$. Since the left-hand side of 15 is the payoff of any individual under FA $\mathcal{C}^h$, Equation 15 states that $\mathcal{C}^h$ weakly dominates $\mathcal{C}$.

B Proof of Lemma 2

Suppose that $u(y + t_i^*) > u(y - m + t_j^*)$, then the agents are better off if t_j^* is set to t_i^* while the other transfers remain unchanged, which contradicts that T^* is optimal. Therefore $u(y + t_i^*) \geq u(y - m + t_j^*)$ for every $t_i^* \in T_-^*$ and $t_j^* \in T_+^*$. Suppose now that $u(y + t_i^*) = u(y - m + t_j^*)$. First, suppose that T_+^* contains another element say t_k^*. We know that $u(y - m + t_k^*) \geq u(y + t_i^*)$. Thus T^* is dominated by T' such that $t'_j = t_i^*$, $t'_k = t_k^* + t_j^* - t_i^*$ and $t'_l = t_l^*$ for every $l \neq j, k$. Second, suppose now to the contrary that T_+^* contains only j. Then each agent in the group is better off if the group includes one more person with a FA T' such that $t'_l = t_i^*$ for every $l = 1, ..., n$ and $t'_{n+1} = -\sum_{i \in N} t_i^*$. This contradicts that n^* is optimal.

C Proof of Lemma 3

Suppose that this is not true. Suppose that $\exists t_l^* < -\bar{t}$ and then consider two cases. First, suppose that T_+^* is empty. Then individuals are better off if t_l^* is increased up to $-\bar{t}$ while the other transfers remain unchanged. Second, suppose that T_+^* is not empty and contains, say t_k. Then $\exists \epsilon > 0$ sufficiently small such that $t_k^* - \epsilon \in T_+^*$ and $t_l^* + \epsilon \in T_-^*$. It is easy to show that the FA T' defined as $t'_l = t_l^* + \epsilon$, $t'_k = t_k^* - \epsilon$, and $t'_i = t_i^*$ for every $i \neq l, k$ dominates T^*. Indeed, we have,

$$E[U(T')] - E[U(T^*)] = \frac{1}{n} \{u(y + t_l^* + \epsilon) - u(y + t_l^*) + u(y - m + t_k^* - \epsilon) - u(y - m + t_k^*)\}.$$

Since u is strictly concave, then,

$$u(y+t_l^*+\epsilon)-u(y+t_l^*)>u'(y+t_l^*+\epsilon)\epsilon,$$

and,

$$u(y-m+t_k^*)-u(y-m+t_k^*-\epsilon)<u'(y-m+t_k^*-\epsilon)\epsilon.$$

The last three equations imply:

$$E[U(T')]-E[U(T^*)]>\frac{1}{n}\{u'(y+t_l^*+\epsilon)-u'(y-m+t_k^*-\epsilon)\}\epsilon.$$

Since $u(y+t_l^*+\epsilon)<u(y-\bar{t})<u(y-m+t_k^*-\epsilon)$ by assumption and due to Lemma 2, the left-hand side is strictly positive.

D Proof of Lemma 4

Suppose this is not true. Then T^* is dominated by T' defined by $t_i'=t_j'=\frac{1}{2}(t_i^*+t^j)$, $t_l'=t_l^*$ for every $l\neq j,i$.

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