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PROMISES KEPT: ENFORCEMENT AND THE ROLE OF ROTATING SAVINGS AND CREDIT ASSOCIATIONS IN AN ECONOMY

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Abstract: Rotating savings and credit associations (roscas) are a popular form of informal finance in developing countries. This paper examines the rosca's ability to enforce its terms of membership and the implications that this has for their existence in an economy. A connection between enforcement costs and the desirability of rosca formation is illustrated using a framework that focuses on the nature of the financial contract that the rosca offers, allowing inferences to be drawn about the likely viability of roscas throughout the development process and the implications this has for debates about financial dualism. Copyright © 2002 John Wiley & Sons, Ltd.

Much of the recent research on informal finance in developing countries focuses on rotating savings and credit associations (roscas), with several studies examining different aspects of rosca operations. This includes the effect that roscas have on the time that it takes an individual to obtain financing (Callier, 1991; Besley *et al.*, 1993); the role the associations play in solving intertemporal allocation problems and in facilitating the acquisition of durable goods (Besley *et al.*, 1993; Levenson and Besley, 1996); the relative merits of different mechanisms for distributing rosca funds (Besley *et al.*, 1993; Kovsted and Lyk-Jensen, 1999); the potential for risk sharing in roscas (Besley, 1995a; Calomiris and Rajaraman, 1998); and the way the rosca allocation compares to that produced by banks or formal credit markets (Besley *et al.*, 1994; Van den Brink and Chavas, 1997). The literature covering roscas also can be divided into studies that have emphasized broad, conceptual matters, and others that examine roscas in individual countries, with an emphasis on institutional details and the political history of the associations in specific country contexts (for example, Besley and Levenson, 1996 for Taiwan; Handa and Kirton, 1999 for Jamaica; Kimuyu, 1999 in East Africa; and Dekle and Hamada, 2000 for Japan).

One common characteristic of the existing research is that the rosca's ability to enforce its terms of membership is a *deus ex machina* that is not subject to much discussion. This

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paper examines enforcement in more detail in an effort to facilitate greater understanding of the nature of the rosca's ability to force compliance with the terms of membership, and to discern the implications that the ability to enforce its contract has for the existence of the association.

The paper is organized as follows. Section 2 provides a description of the rotating savings and credit association, the financing dilemma that it solves, and the nature of the enforcement problem that it faces. This section also lays the foundation for the framework that will be used to analyse enforcement and the role that it plays in defining the structure of the financial system. Section 3 provides a detailed look at the ability to enforce the terms of membership. Section 4 examines the relationship between enforcement ability and the existence of roscas in settings with and without banks. It also provides a brief discussion of the implications of this analysis for discussions of financial dualism. Section 5 concludes.

1 THE ROSCA'S STRUCTURE, THE FINANCING DILEMMA, AND THE PROBLEM OF ENFORCEMENT

A rosca emerges when a number of entrepreneurs agree to meet a specific number of times and to merge funds at each meeting date in order to make the sum available to some member. The defining characteristic of the rosca is that it relies on the pooled funds of its members to make loans. Why might a group of individuals agree to organize such an association? The standard way to model roscas is to begin with the assumption that the economy is composed of individuals who seek to acquire a good that is indivisible but have insufficient funds to do such immediately. Rosca formation presents a potential solution to this problem because the pooled funds can be used to extend loans that enable individuals to obtain the indivisible good. While existing models typically focus on a consumer durable good, in what follows we consider an example in which the indivisible good presents the prospect of earning additional income, since there is sufficient evidence in the empirical literature to suggest that roscas also are used to finance entrepreneurial activities.[1]

Accordingly, consider an economy in which there are individuals whose personal resources are insufficient to allow the purchase of an indivisible good, who would like to begin a project in an attempt to generate income. Let the cost of the indivisible good be represented by B, with $B > 0$.

For simplicity, each project is assumed to have only two possible outcomes: failure or success, with the yield for successful projects being represented by $w > 0$ per unit invested, while the yield for projects that fail is presumed to be zero. Although each project is identical to others in terms of the maximum and minimum possible return, the likelihood of success p_i is assumed to differ for each entrepreneur. These probabilities are well-behaved, i.e., $0 < p_i < 1$; and they range in value from p^L to p^u; and are assumed to be distributed uniformly over the interval $[p^L, p^u]$.

Every project in the economy commands a positive expected return. Any project i started at the beginning of the first period has an expected return equivalent to [2]

[1] See Das Gupta *et al.* (1989), Bouman (1995), Ardener and Burman (1995), and Kirton (1996) for example.
[2] Provided that $Bwp_i - B > 0$, project costs are less than the expected return from project investment, creating the incentive for the relevant individuals to invest in the available production technology.

$$Bwp_i > 0. \quad (1)$$

Projects started late during the investment period are presumed able to generate fractional returns in the amount of τw per unit invested, where $\tau < 1$, and its actual value depends upon how long the project is in operation during the investment period.

As is standard in the literature, individuals are assumed to have outside income (separate from the project), which flows in discrete intervals over the investment period.[3] Specifically, this income is assumed to accrue in Γ discrete intervals, with each increment denoted by y^e and the first increment is presumed to be available at the beginning of the investment period. The sum of these increments is Γy^e, where $\Gamma y^e = B$. Accordingly, while this income is insufficient to permit entrepreneurs to finance themselves independently at the start of the investment period, it does accrue so as to allow self-finance by the end of the period.[4]

Despite the fact that individuals have the option of waiting until they can finance their projects independently, it is clear that if there are enough entrepreneurs whose individual y^e can be combined to attain the B dollars required to start a project during the investment period, a better outcome can be achieved if funds are pooled on a periodic basis, so that each individual does not have to wait until the end of the investment period to begin his project. As noted elsewhere, a rosca offers a potential solution to this intertemporal allocation problem because it provides a means for entrepreneurs to put their separate funds into one 'pot' on a regular basis, and to mobilize sufficient funds to allow one member to purchase the indivisible good at every date that the rosca meets as a result.[5] Members benefit as participation gives them the ability to obtain a loan that allows their projects to be started earlier than would be the case under self-finance.[6] And, society benefits as production is able to begin earlier than it would if each individual were forced to wait until he was able to save up to acquire the indivisible good.

Because the rosca facilitates borrowing and lending, it is possible to talk about the terms of finance embedded in the 'contract' that this financial institution offers. In the literature on banking and finance, it is standard to model financial intermediaries as emerging endogenously as an optimal solution to a contracting problem. Our paper treats roscas in a similar light. In what follows, we view roscas as being required to solve an optimization problem for the entrepreneur. While this type of approach has not been applied previously in analyses of roscas, its implementation allows us to highlight critical features of the financial contract that the rosca offers its members, and to develop a discussion of the connection between enforcement issues and the attractiveness of the rosca contract. Accordingly, the discussion that follows treats the rosca as facing the task of maximizing entrepreneur expected returns subject to the constraints that the institution faces raising funds.

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[3]For simplicity, these can be thought of as retained earnings from a pre-existing project.

[4]The ultimate feasibility of self-finance is a standard feature of models of roscas, and is also consistent with what is observed in practice.

[5]Letting j index meeting dates, at each meeting date a contribution (S_{ji}) is collected from each individual member i and the sum of contributions at a given meeting date, $\sum_{i=1}^{N} S_{ji}$ is then disbursed to some member, where N is the total number of members in the association. The sum $\sum_{j=1}^{Z} S_{ji}$ represents the total contribution of member i over the lifetime of the association; it is the sum of an entrepreneur's contributions across meeting dates (where Z denotes the number of meetings that the rosca has).

[6]This obtains for all but the final loan recipient. He is in the same position as he would be under self-finance (or—in the Besley, Coate and Loury 1993 model—he may begin his project slightly later).

For any entrepreneur who participates in a rosca, the gross proceeds from undertaking a project with rosca finance are given by:

$$\tau_i B w p_i \tag{2}$$

where τ_i is the fraction of the investment period over which entrepreneur *i*s project is in operation and hence the fraction of the original yield that is generated by the project. The variable τ_i can take on values less than one because, at most, one entrepreneur will obtain a rosca loan at the start of the investment period; the others will take turns later during the period.

Because membership requires each entrepreneur to make regular contributions to the rosca, the net proceeds from undertaking a project using rosca finance must be determined before an optimization problem can be specified. However, because no entrepreneur knows the exact date that he will receive a loan ex ante, actual net proceeds are unknown, and entrepreneur expected net proceeds must be computed. This is the expected value,

$$E[\tau_i B w p_i - R_i] \tag{3}$$

where R_i denotes the repayment obligation established for member *i*. This is the sum of all per-meeting contributions to the association. The first term in the bracketed expression therefore represents the benefit associated with rosca finance, while the second term reflects the presence of a cost to participation. The rosca must maximize (3) for all entrepreneurs.

The rosca also faces constraints, however. The first constraint is a sufficient funding condition. A rosca's ability to ensure that a project is financed at each meeting depends on sufficient funding being procured at each meeting date. This requires the sum of contributions across the members to equal the amount required to undertake a project. Mathematically, the condition can be represented as,

$$\sum_{i=1}^{N} s_{ji} = B \tag{4}$$

with *N* representing the total number of members in the rosca and s_{ji} the contribution of member *i* at meeting *j*. It is from this requirement that an enforcement problem emerges. Because the rosca depends upon repeated contributions, while any individual has an incentive to cease contributing once he has received a loan, the rosca must somehow counter the temptation that a member who already has received financing has to renege on later contributions.[7]

The constraints on the optimization problem affect the structure of the association, and several of the features of the rosca contract can be linked directly to the constraints that it faces in trying to mobilize funds. Here we summarize the standard features of the rosca contract:[8]

[7]The rosca also faces a separate constraint on the total amount repaid to the association. For the total repayment amount to be feasible, it cannot exceed the sum of retained earnings. (See Chiteji, 2000.)

[8]This paper considers roscas in which receipt dates are determined at random, for example the case where numbers are drawn at the first meeting date. With bidding roscas some of the features of the contract, particularly the repayment obligation, will be different. Derivations can be found in Chiteji (2000).

(i) The number of meeting dates equals the number of members in the association.
(ii) The total amount repaid per member does not vary; $R_i = R_{i+1}$ (where R_i is the sum of an individual's contributions across meeting dates).
(iii) Each individual's periodic contribution is the same. In this model, the periodic contribution is set in the amount of y^e.
(iv) The rosca will set its repayment level so that each individual's regular contributions sum to B, meaning that

$$R_i = B. \tag{5}$$

Given the discussion above, the optimization problem solved by the rosca can be re-represented as

$$\max_N \tau^e Bw p_i - B \tag{3'}$$

where $(3') > 0$. This shows the rosca seeking to maximize an entrepreneur's expected net proceeds from rosca finance. As noted earlier, with the first meeting date occurring at the start of the investment period, the first recipient receives the full value of his project's return while others take their turns later, therefore the actual fraction of project proceeds that each entrepreneur receives will vary. However, because no entrepreneur knows the order of loan receipt *ex ante*, each entrepreneur forms an expectation about the receipt date and about how long his project will be in operation once a loan is received. This amounts to an expectation of the fraction of the project's maximum possible proceeds that he will receive. This fraction is represented by τ^e, and it is dependent upon membership size:[9]

$$\tau^e = (N+1)/(2N).^{10} \tag{6}$$

From (6) it is apparent that the fraction of project proceeds that any entrepreneur expects to receive falls as membership size increases. This gives the rosca an incentive to restrict its membership size. Membership size also varies with contribution size through the sufficient funding constraint, however. For a given desired level of funding, membership size can be reduced only as the size of the periodic contribution is raised. A rosca therefore can be viewed as setting membership size in order to maximize expected net entrepreneur proceeds in a manner that is consistent with ensuring sufficient funding at each meeting date.

Incentive Issues in Roscas

As noted earlier, in order to guarantee financing to all members, a rosca must ensure that its members continue to make their promised contributions—even after they have

[9]The intuition for equal payments, discussed above, should now be apparent: As established by Callier (1991), a random allocation mechanism treats all members equally *ex ante*. This implies that each member i has the same expected receipt date and the same *ex ante* expectation about the fraction of the investment period over which his project will be in operation, so there is no incentive for any one entrepreneur to offer to pay more than another.

[10]For the first recipient, the actual fraction of the project's maximum possible proceeds that is received, τ_1 equals one. For the second recipient, $\tau_2 = (N-1)/N$. Fractions for the remainder of the members can be computed similarly. τ therefore takes on a range of values, and the expected value is $(N+1)/2N$.

received a loan. If this does not occur, the rosca will not be 'sustainable', meaning that it will not be able to function throughout its projected lifetime (Besley *et al.*, 1993). If a rosca is not viewed as sustainable, the parties to its contract cannot expect to receive their promised benefit from participation, making it difficult if not impossible to set up a rosca. Ensuring that members find it rational to make all assigned contributions therefore is a critical issue—at least in theory—for the association.

2 ENFORCEMENT OF ROSCA CONTRACTS

In practice, empirical evidence provided by numerous anthropological studies suggests that default in roscas is rare. Yet because it is apparent that a problem exists conceptually, it is important to determine why it does not manifest itself. How and why are roscas able to enforce the terms of membership? The discussion of enforcement in the existing literature has noted that roscas rely on social collateral in order to solve the potential problem of deliberate default. According to this perspective, the facts of life in developing countries—pre-existing relationships among prospective members and the tendency for repeated interaction among individuals—are tapped to hold the rosca together. This social collateral can be used either to obtain information that will allow the associations to properly screen candidates so as to ferret out the dishonest, or to allow the association to repossess property ex post, or to impose social penalties on defaulters, the threat of which can be sufficient to induce compliance. As Besley *et al.* (1993) write, the fact that roscas typically are formed among members from the same community gives them mechanisms for penalizing those who deliberately default via ostracization or shaming the family. Similarly, Kovsed and Lyk-Jensen (1999) list exclusion from future roscas, loss of status and prestige, and physical punishment as sanctions that may be employed in roscas; while Van den Brink and Chavas (1997) state that, in Cameroon, default problems are solved by the promise of advancement in line in future roscas for those who prove their worth, or by social ostracism and peer pressure for those who do not.

Interestingly, while it is common to suggest that roscas use social collateral to ensure repayment, and to delineate the forms that this collateral may take or the types of penalties that may be employed, there has been little analysis of the rosca's ability to use these types of penalties, the factors that affect this ability, and the implications this has for the structure of the financial system in an economy. We find it instructive to view the use of social collateral as a process of cross-subsidization in which pre-existing connections between individuals are used to defray costs that a rosca might otherwise be required to incur in order to enforce the terms of its contract. These connections may be strictly 'social' in the sense of being non-economic ties, or they may be economic but external to the present financial transaction. As noted in the literature, it is the presence of such connections that gives the rosca an ability to enforce its contracts. We view this ability (irrespective of the size of the loss that the association threatens to impose on non-contributors) as being affected by the following considerations:

(i) the ability of members to police one another,
(ii) the value of a good reputation to any one individual and the general awareness of an individual's reputation among other potential members, and
(iii) the presence of relationships between members that can be tapped for information about individual entrepreneur characteristics (for example, their integrity).

This focus on determinants of the ability to enforce contracts reveals that each of these considerations is likely to be affected by membership size. This suggests that what matters is not so much the form that the social collateral takes, but whether its use allows enforcement in roscas of a given size, i.e., for specific values of N. The ability to force compliance therefore need not be viewed in terms of extremes as it is elsewhere in the literature, i.e., as either present or absent, instead the ability to enforce contracts may be defined over a continuum of possible membership sizes.

To relate the capacity to enforce contracts to membership size, it is possible to envision an enforcement function that connects the rosca's ability to enforce its contract to membership size. Intuitively, one can think of this enforcement function as depicting the presence and strength of the community or 'neighborhood' effects that reflect the rosca's ability to inflict a loss upon deviant members. This function would be decreasing in membership size, indicating that that the capacity to enforce the terms of membership falls as membership size increases.[11] Additionally, while adding one member initially might not impinge much on the ability to hold the association together, at larger sizes it will. The ability to enforce contracts therefore falls at an increasing rate.

Whether roscas are able to enforce contracts is one issue. A subsidiary one is what the costs of doing such are to the association. Enforcement costs are to be interpreted as the total cost of holding a rosca together at a given membership size. This function, graphed in Figure 1, is an upward sloping function with an increasing slope: $EC_N > 0$, $EC_{NN} > 0$.[12] This reflects the fact that costs rise as membership size increases, and the magnitude of the addition to cost required to hold the rosca together rises as well.

The enforcement cost function—$EC(N, \cdot)$—is a continuous function with a lower bound of zero. In Figure 1, the upward sloping portion above the horizontal axis reflects the presence of explicit costs that must be incurred at some point, in the form of the expenditure of effort for policing members, for example. There also is a range lying along the horizontal axis, reflecting a 'cross-subsidy' effect. There, the presence of relationships external to the rosca provide the basis for keeping members in the association and the costs are not internalized by the rosca, so that the explicit costs to the rosca therefore are zero in this range.

[11]There are several justifications for assuming that enforcement ability falls as membership size rises. Peer monitoring is harder when the association has more peers to monitor. For example, it is likely to be easier to make sure that all members show up for meetings, even if that means stopping by to collect some of them, when the number of members is small, rather than when there are several to collect. Additionally, it is reasonable to assert that there are a few others that individuals require to think highly of them, but that as more entrepreneurs come into a rosca, the association ultimately may be reaching out to agents whose opinions some members do not care about. The prospects for shaming members would decline as N rises as a result. Finally, the likelihood that an individual would have social or economic relationships with all other members of a rosca undoubtedly falls as a rosca expands ad infinitum, affecting both the rosca's ability to screen applicants and its ability to impose social penalties on defaulters. The potential relevance of membership size for the ability to administer penalties also is noted briefly in Besley (1995b). There, it is stated that an increase in membership size may lead to a decline in the ability to impose collective punishments.

[12]We are indebted to an anonymous reviewer for noting that in some situations the cost of adding an additional member could be fixed, making the second derivative zero. While this does not change the spirit of the analysis, it is worth noting that it could obtain if enforcement ability were rooted largely in punishments that can be administered to any member at the same cost—such as shaming a member by announcing their delinquency in the town newspaper for example. Here the expected costs of punishment would be the same no matter who the prospective member was. However, if the primary source of enforcement ability lies elsewhere, such as in using pre-existing information to choose members, one would expect the cost of adding a new member to vary. (In this instance one would envision the rosca as having to search wide and far for candidates that it has information about as it starts to add more and more members.)

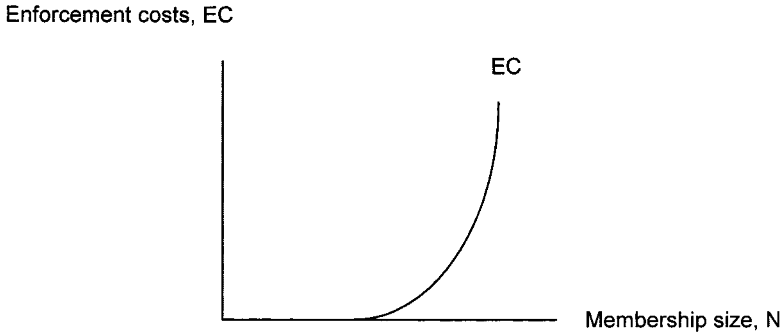

Figure 1. Rosca enforcement costs

When the chosen membership size lies in the range over which the costs to the association are zero, enforcement costs do not need to be incorporated explicitly into the analysis of the rosca contract. Like most analyses of roscas in the existing literature, the analysis presented in Section II implicitly assumed that the optimal membership size lay in the range in which enforcement costs were zero. However, it is clear from Figure 1 that it is possible to conceptualize situations in which this would not obtain. When this is the case, enforcement costs must be represented explicitly in the rosca optimization problem.

Allowance for the possibility that membership size may lie at a point at which enforcement costs are positive requires the objective function being maximized to be modified to include an additional term to represent the costs of enforcing the rosca (per loan or per entrepreneur). The resulting function is,

$$\tau^e Bwp_i - B - EC\ (\cdot)/N \tag{3''}$$

where $EC(\cdot)/N$ represents the per-entrepreneur, or average, cost of enforcing the rosca contract. Both the expected project proceeds ($\tau^e Bwp_i$) and the average enforcement costs [$EC(\cdot)/N$] depend on membership size (N). Because the expected fraction of the project's proceeds received (τ^e) falls as membership size rises, while enforcement costs rise as membership size rises, the objective function remains a decreasing function of membership size.[13] The optimal rosca therefore continues to set membership size as low as possible.

[13]This assumes that the function for average enforcement costs behaves similarly to the total enforcement cost function. This assumption is reasonable because the effects underlying rosca enforcement ability operate at the individual as well as at the institutional level. For example, policing undoubtedly becomes more difficult for the institution because it becomes harder for each individual member as N increases. Similarly, membership size cannot expand indefinitely without the inclusion of members who may be unconcerned with maintaining a favourable standing with other members, making the costs of participation rise from the individual standpoint when N rises. Finally, a member undoubtedly expects that as N rises some of the new members are bound to be entrepreneurs with whom he has no personal relationship. Note, additionally, the following guarantees that (3″) is falling in N: that the derivatives of the total enforcement cost function are such that (a) $EC_N > EC(N)/N$, which is satisfied by any average cost function that is increasing with an increasing slope, and (b) $[N][EC_{NN}]/2 \geq EC_N - EC(\cdot)/N$. Note also that if this average cost function is linear, the spirit of the analysis in Figure 2 remains unchanged. If the total cost function is linear (as discussed in the previous footnote), the average cost function would be increasing but at a decreasing rate, which means that it would have to satisfy Inada conditions (like a utility function) in order for (3″) to be falling in membership size. However, it seems implausible to assert that per entrepreneur enforcement costs would ever fall, so such a restriction would seem reasonable.

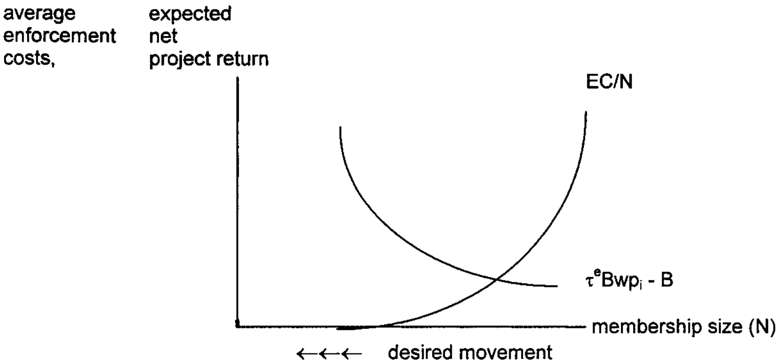

Figure 2. Considerations affecting optimal membership size

3 THE CONNECTION BETWEEN ENFORCEMENT COSTS AND THE EXISTENCE OF ROSCAS

While the ability to enforce contracts makes the rosca sustainable, this only guarantees that rosca formation is feasible. That formation is possible is not enough to fuel the creation of roscas however. Participation also must be desirable. The analysis of the previous section is significant because it indicates that enforcement costs can affect the desirability of rosca formation. Low enforcement costs are key to having this financial arrangement be perceived of as a beneficial way of financing projects, because—even when project investment is desirable—if enforcement costs are high, the net benefit from rosca participation will be low.

Figure 2 depicts an entrepreneur's net expected proceeds from the project when relying on a rosca for financing ($\tau^e Bwp_i - B$), along with average enforcement costs. While an increase in membership size adversely affects the expected fraction of the project's proceeds that any entrepreneur anticipates, it is clear that it is not necessary for membership size to be so large as to drive an entrepreneur's net expected proceeds to zero in order for rosca participation to be undesirable. Rather, it is critical that average enforcement costs be low enough to not offset the net proceeds from project investment. When the average enforcement cost function intersects the net expected proceeds function, the gains from rosca participation will be zero. This analysis provides an additional reason for the rosca to set membership size as low as possible. Restricting membership size is beneficial because it keeps enforcement costs low.

The diagram also can be used to contemplate situations in which roscas will and will not be expected to be formed in an economy. A net expected project proceeds function can be drawn for each individual entrepreneur. Because a range of entrepreneurs exists, it is useful to consider the extremes. In situations in which prevailing enforcement costs are so high that even the entrepreneur with the greatest likelihood of success (p^U) finds his expected net project proceeds exceeded by enforcement costs, no entrepreneur would find it beneficial to form a rosca. To the contrary, provided that enforcement costs are low enough that even the entrepreneur with the riskiest project (p^L) finds his expected net project proceeds to exceed the average costs of enforcement, all entrepreneurs will find participation in roscas to be desirable. What determines the value of enforcement costs that will prevail? Recalling that the rosca is constrained in its attempt to restrict membership size because the sufficient funding requirement puts a lower bound on this variable, it is clear that the association's need to raise enough funds to allow each entrepreneur's project to be undertaken plays an important role in determining the magnitude of enforcement costs that a rosca will encounter in practice.

This analysis highlights the important role that enforcement costs play in determining whether or not roscas can be expected to be in operation in an economy. When drawn for the entrepreneur with the highest probability of success, the intersection of the net expected project proceeds function and the average enforcement costs function can be viewed as determining an N value above which no entrepreneur in the economy will find rosca participation desirable. In an economy in which enforcement costs are unequivocally high (represented by an average enforcement cost function lying everywhere above the one drawn in Figure 2), this limiting value at which participation is not desired by any entrepreneur moves to the left. With an intersection point to the far left, the limiting value can occur where it is impossible for a rosca to mobilize sufficient funds to finance the projects. One would expect to see few roscas as a result.

The analysis presented so far reveals two important facts about the role of enforcement costs in determining whether roscas will exist in an economy. It indicates that when the membership size selected by the rosca is associated with zero enforcement costs, all entrepreneurs stand to benefit from rosca formation. One therefore would expect roscas to be popular.

Additionally, it highlights a point made elsewhere in the literature: that some countries (or communities) have an advantage in forming roscas. Here, it echoes several contentions regarding the way the development process is likely to affect rosca activity, while offering a new way to understand them. For example, one would expect roscas to be common in countries whose residents live in communities in which everyone knows one another and/or those in which people frequently interact in non-market exchange or in social settings because one expects enforcement costs to be low in these communities, allowing rosca formation to be sufficiently utility enhancing to benefit everyone (at a large range of membership sizes). Conversely, in countries in which transactions tend to occur in an anonymous marketplace, or where both labour market and residential mobility are so great that people frequently work or live in areas where they do not know their neighbors, or where relationships are not multi-faceted, enforcement costs would be expected to be unequivocally high (for any given membership size). The argument that the development process erodes the presence of roscas can be assessed more carefully now. Our analysis suggests that it certainly is the case that a rise in market activity, which frequently is attributed to the process of development, can precipitate a decline in rosca activity. Note, however, that the decline in roscas does not necessarily occur because the need for rosca financing vanishes with the development of formal financial markets, or more 'modern' vehicles for supplying loans. Rather, the decline would be expected to be partly attributable to a rise in the cost of forming roscas.[14]

Comparing Roscas and Banks

The literature on banking has long recognized the presence of information imperfections in formal credit markets and the problems that they pose for the bank sector. (See Jafee and

[14]This distinction is important because it is tempting to view the absence of roscas in developed countries as a sign of the omnipotence of a bank sector. Yet, while one does expect banks to replace roscas to some degree, the sheer development of banks cannot provide a complete explanation for the demise of roscas. This is because, as discussed below, economists have strong reasons to believe that the bank sector will not not be able to provide credit to all prospective borrowers.

Stiglitz, 1990, for example.) This literature reveals that information asymmetries lead to credit rationing. Consequently, even a bank sector that is not stifled by interest rate ceilings or other financially repressive government policies cannot be expected to meet the needs of all would-be borrowers in the economy. Below we present a modified version of the Williamson (1987) bank sector model to illustrate this principle, and then consider the implications that this has for rosca formation in an economy with banks. The analysis shows that a bank sector facing monitoring costs will exclude some entrepreneurs from financing, creating an opening for roscas, and that this void can exist even when banks are given the option of deposit-taking. Although the model is highly stylized, it enhances the understanding of the role that rosca enforcement costs play in determining the character of financial intermediation in an economy.

The modified Williamson (1987) bank sector

Following Williamson (1987), in modeling the bank sector it is assumed that the information about entrepreneurs' project outcomes is private information that is not known automatically to banks. Entrepreneurs' pre-existing income flow also is private information. Additionally, as is standard in the literature on banking, banks are treated as offering a financial contract in which repayment is conditional upon project success (see, for example, Diamond, 1984; and Williamson, 1986, 1987). An entrepreneur whose project is successful is obligated to repay a positive amount, while an entrepreneur whose project fails is not required to repay anything. Because actual project outcomes cannot be observed by the bank without incurring a cost, entrepreneurs have an incentive to misrepresent their project outcomes. Banks therefore must incur costs of monitoring, to verify project outcomes when the default state is claimed. As a result the optimal loan contract involves monitoring in certain states of the world and subsequently includes a component for monitoring costs. Additionally, while an entrepreneur's project return is considered to be private information, banks are assumed to be able to observe each entrepreneur's probability of success freely. The bank sector therefore ends up with a system in which entrepreneurs are sorted according to their probability of success.

As is standard in the literature, the bank loan contract is designed to maximize entrepreneur expected return from borrowed funds subject to the constraint that the expected repayment will enable the bank to meet its deposit obligations. Following Williamson (1987), this optimization problem takes the following form:[15]

maximize

$$J[(w-g)\,p_i]$$

subject to (7)

$$Jg\,p_i - \gamma(1-p_i) = Jr^d$$

where g represents the amount that the entrepreneur must repay per dollar borrowed if his project is successful. The objective function presents the entrepreneur's expected net project proceeds from bank finance. The constraint specifies that the expected repayment

[15]The general form of the objective function includes terms for both the expected net proceeds in the success state and the default state. However, because bank contracts specify that the bank acquires any assets remaining from a failed project, the entrepreneur obtains nothing in the default state.

to the bank must be equal to the bank's cost of mobilizing funds. The expression $\gamma(1-p_i)$ represents the bank's expected monitoring costs on any contract (due to the presence of fixed monitoring costs, γ) and the variable J represents the amount that each entrepreneur wishes to borrow.[16] The variable 'r^d' represents the deposit cost of funds (per dollar).

The solution to the maximization exercise provides an optimal loan rate g (the fixed payment level chosen for the success state). If the bank sector is perfectly competitive banks will break even on each loan contract, implying that the selected value of g is that value that solves the constraint. Because this constraint establishes a different loan rate for each entrepreneur, g varies across entrepreneurs due to the different probabilities of success.

The constraint above specifies that any project for which p_i is so low that

$$Jwp_i - \gamma(1-p_i) < Jr^d \tag{8}$$

is refused bank financing. A project that cannot satisfy the constraint is excluded because being unable to do such implies that even if the repayment amount g were set at the maximum feasible level (w), a bank could not expect to recoup its cost of funds.[17] We define the p_i that just meets the requirement in (8) as the cutoff probability p^c. With $p^c > p^L$, some projects do not receive financing from the bank sector.

If roscas are formed by the excluded entrepreneurs, however, the remaining projects can be undertaken. To demonstrate the situations under which this occurs, we compute the total expected utility that an entrepreneur expects to have after undertaking his project under each of the different financing possibilities. Accordingly, Figure 3 depicts total entrepreneur expected utility with (1) rosca finance, (2) bank finance in conditions of imperfect information, and (3) bank finance with perfect information.[18] The perfect information case is presented as a reference point, to show how the presence of information imperfections and the associated monitoring costs disrupt bank sector functioning and contribute to the existence of roscas. The discussion of the diagram initially is presented under the assumption that enforcement costs are zero. Then we show how a rise in enforcement costs alters the analysis.

Recalling that under rosca finance, the total amount that an entrepreneur expects to have available at the end of the first period is equivalent to the proceeds expected from the project, one can obtain the following expression for the total end of period utility that an entrepreneur expects from undertaking a project using rosca financing:

$$\tau^e Bwp_i. \tag{9}$$

This expression is graphed as the rosca total expected utility schedule.

[16] Note that for projects to be the preferred use of borrowed funds, it must be the case that the per dollar expected return from project investment (wp_i) exceeds the deposit rate (r^d). It is assumed that there are numerous projects that are sufficiently profitable to ensure that this condition can hold. Also, note that the amount borrowed is less than project cost. This is because of the assumption that retained earnings start accruing immediately. With the value of retained earnings accruing at any one interval set at y^e, $J \equiv B - y^e$. In Williamson (1987), entrepreneurs have no financial resources of their own at the start of the first period. Our assumption that they do forces equity participation.

[17] As noted in Jaffee and Stiglitz (1990), there is some minor debate as to whether this form of exclusion should be called credit rationing. However, Jaffee and Stiglitz (1990) reveals that it is standard to include it as one of the four types of credit rationing, despite the fact that it is different from the type known as 'pure credit rationing', where borrowers are observationally indistinct from the perspective of banks.

[18] An expression for the utility associated with foregoing investment and depositing one's funds also is graphed as a reference point.

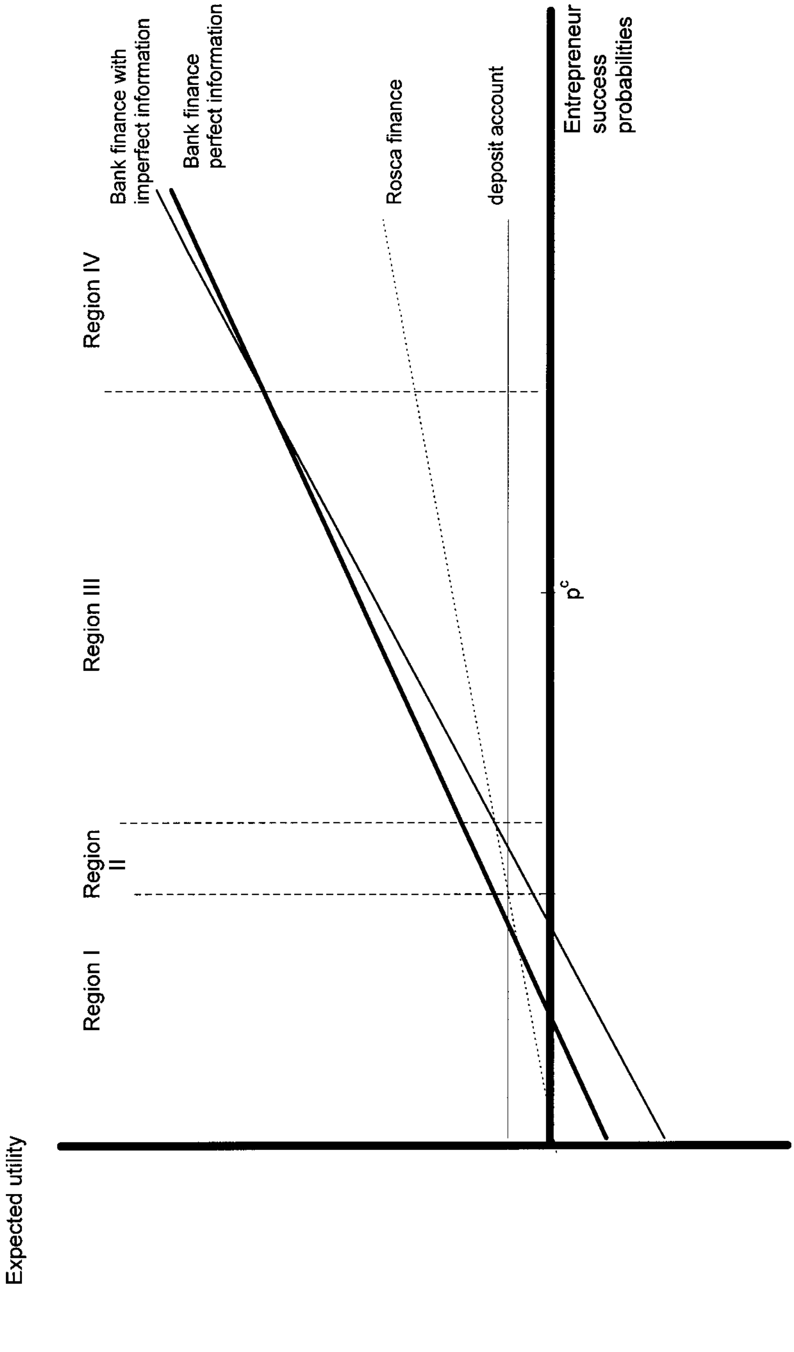

Figure 3. Comparison of entrepreneurs' expected utility under different financing options

Under bank finance, entrepreneur total expected utility depends on the expected outcome of the project, the obligation to the bank, and the retained earnings that accrue after the project start date. This results in the following expression:[19]

$$(Bw + \gamma)p_i + \left[J - (Jr^d + \gamma)\right] \tag{10}$$

It is apparent in Figure 3 that in the absence of monitoring costs banks are poised to serve all entrepreneurs. This is seen by noting that when $\gamma = 0$, the bank-financed total expected utility function lies everywhere above the line depicting total entrepreneur expected utility with rosca participation for all entrepreneurs. Furthermore, when $\gamma = 0$, the repayment requirement in (7) can be satisfied by all projects so that no project is excluded. In the presence of imperfect information, however, the bank sector is neither prepared to serve all entrepreneurs nor the preferred financing device for all entrepreneurs. This is because the function representing entrepreneur's total expected utility from bank finance under imperfect information crosses the function representing expected utility from rosca participation at a low p_i, creating a region (region II) in which the expected utility from rosca participation lies above the function representing entrepreneur's expected utility from bank finance. Furthermore, when monitoring costs are positive, the cutoff probability is greater than the lowest probability of success that exists in the economy: $p^c > p^L$. With some projects excluded from bank financing and a range of entrepreneurs for whom roscas are the second most preferred financing device, one expects the excluded entrepreneurs to form roscas. This corresponds to a situation in which p^c lies in region III in Figure 3.

The role that enforcement costs play in creating a role for roscas in an economy with banks is now apparent. If enforcement costs are positive, the function representing the total entrepreneur expected utility under rosca finance in Figure 3 shifts downward, as equation (9) now will have an additional, negative component ($-EC/N$). This causes the size of region II to contract (and that of region III too if the shift is severe). It therefore is clear that low enforcement costs support the existence of roscas in an economy with banks while large enforcement costs depress the prospects for rosca formation.

Implications of the analysis

It is clear that the monitoring costs experienced in the bank sector contribute to the existence of roscas. The greater a bank sector's monitoring costs, the more entrepreneurs there are who are excluded and left to seek out rosca financing. If the bank sector's monitoring costs can be reduced therefore, one would expect rosca activity to decline as a result. (In Figure 3 this would be represented by a rotation in the expected utility under bank finance with imperfect information schedule toward that for the perfect information case.) However, there is nothing in the literature on information imperfections to suggest that monitoring costs can be eliminated entirely. Instead, they appear to be an inevitable feature of banking. Accordingly, the analysis suggests that there always will be some clientele whose needs can be met by non-bank sources such as roscas. This would be true even if banks are widespread throughout the economy, and even if there are no government imposed credit controls in the bank sector.[20] In fact, even if one looks to the case of the

[19] Derivations are contained in the Appendix.

[20] This offers a possible explanation for the findings of scholars who have documented the presence of roscas in communities in which banks are present: Aredo (1993) for urban areas already populated by banks and Van den Brink and Chavas (1997), for example.

United States, there are studies that indicate that there are a number of households and entrepreneurs that rely on sources other than the banks, bond markets, and stock markets typically classified as representing formal financial institutions in order to meet their need for financial services (Caskey, 1994; for example). This literature on 'alternative' forms of finance in the United States also presents evidence of rosca activity in recent US history. Roscas have been documented in Korean–American communities during the 1990s (Szymanski and Song, 1996; for example), in Mexican–American communities of the 1970s and early 1980 (Velez-Ibanez, 1983), and among West Indians in New York City during the 1970s (Bonnett, 1981), this last observation being particularly noteworthy because the latter presumably would not face language barriers in the use of formal bank sector credit devices because the analysis is restricted to descendants of Commonwealth Caribbean countries. This provides a clear suggestion that 'financial dualism'—the term given to the coexistence of an informal and formal financial sector in developing countries—may be more widespread than previously acknowledge in the literature. Our model suggests that this possibility would exist because the credit rationing that it discusses is attributable to inherent market imperfections that would not be specific to developing countries.

Alternatively, these results may prompt one to ask whether the phenomenon that economists presently term 'financial dualism' really is more akin to financial market diversification—a situation in which an economy is characterized by different institutions offering different financial contracts suited to the needs of different borrowers, but where the distinctions between the different financing devices are not deemed to be significant enough to prompt any concern about the structure of the financial system. In analyses of dualism in the real sector, there are important differences between the way that the informal and formal sectors operate—differences in how production decisions are made, or in pricing mechanisms (see Meier 1995; for example). As Kanbur and Mclntosh (1989) note, in the models of the real sector, dualism generates inefficiencies. In our model, banks and roscas operate according to similar principles, however. Each seeks to devise a financial contract that maximizes entrepreneur expected utility. It is therefore unclear whether the existence of roscas alongside banks is any more peculiar than the existence of other forms of finance, such as equity markets, alongside banks. Accordingly, it may be appropriate to reconsider the use of the word 'dualism' in conjunction with the coexistence of banks and 'informal' financial institutions in an economy because its usage suggests that there is a structural flaw in the financial system, given the standard connotation of the term 'dualism' in the development literature. Our model suggests that the existence of roscas alongside banks does not signify a problem with the financial system. Rather, it suggests that roscas represent a solution to a problem.

4 CONCLUDING REMARKS

That the rosca has a distinctive ability to force its members to make all promised contributions to the association has been mentioned repeatedly in the literature, although the rosca's ability to enforce its contract has not been analysed closely in previous studies. This paper has discussed the nature of the rosca's ability to enforce contracts and the implications that this has for the existence of roscas. It suggests that enforcement can be viewed along a continuum of membership sizes, rather than as an all or nothing proposition about whether a rosca can or cannot enforce the terms of membership.

Additionally, it reveals that enforcement costs play a central role in determining whether rosca participation is desirable. By establishing this connection between the magnitude of enforcement costs and the desirability of rosca participation, the analysis elucidates the factors that lead roscas to flourish in developing countries. Enforcement costs affect the desirability of rosca participation, which works in conjunction with the need for financing to lay the foundation for the presence of this financial institution in the economy—whether banks are absent or present.

Our framework differs from existing models in several respects. Rather than treating roscas as funding the acquisition of consumer durables, it considers roscas used to finance project investment, thereby allowing roscas to be embedded in a standard model of an economy with banks where the presence of endogenous credit rationing creates a void that roscas can fill if enforcement costs are sufficiently low. Existing models of roscas implicitly treat banks as capable of financing all would-be borrowers in the economy when making comparisons between banks and roscas. Our framework demonstrates the consequences of relaxing such an assumption, and it also reveals that bank–rosca comparisons are most helpful when they serve as a basis for analysing the relationship between the sector in which rosca activity occurs and the sector of the economy offering bank finance. Despite the stylized framework, this modeling of the relationship between the 'informal' and the 'formal' financial sectors allows one to show how the two sectors interact, following the tradition of models of dualism in the real sector, such as the Lewis (1954) and Ranis–Fei (1961) models. The model also allows one to show why informal arrangements like roscas do not become functionally obsolete in the presence of banking, thereby suggesting that financial 'dualism' may not simply be a transitory feature of a developing economy. Leonard (2000) recently has argued that informal activity in labour markets may not be destined to disappear with development. Our analysis suggests that this also may be true for informal activity in financial markets. Accordingly, policymakers always must be prepared to grapple with the challenge of handling an 'unbanked' population.

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APPENDIX: EQUATIONS UNDERLYING THE GRAPHS IN FIGURE 3

With rosca finance, the total amount that an entrepreneur expects to have available at the end of the first period is equivalent to the proceeds expected from the project. From equation (9), this amount is represented by

$$\tau^e Bw p_i.$$

This expression is graphed as the ‘total expected utility under rosca finance’ schedule.

An entrepreneur who relies on bank finance expects that at the end of the investment period he will have proceeds from the project, an obligation to repay his bank loan, and retained earnings that have accrued over the course of the investment period. From equation (1), the expected project proceeds are represented by Bwp_i. As in equation (7), the value of the expected repayment to the bank is, $Jg_i p_i$. Finally, the sum of accrued retained earnings is given by J. Together, these produce the following expression for entrepreneur total expected utility in the wake of bank finance:

$$Bw p_i - J g_i p_i + J.$$

Substituting the optimal loan rate g_i^* (taken from equation (4)) and combining like terms produces

$$(Bw + \gamma) p_i + [J - (Jr^d + \gamma)].$$

This is the expression graphed for the case of bank finance under imperfect information. With perfect information, $\gamma = 0$, and the expression for total entrepreneur expected utility under bank finance is given by,

$$Bwp_i + J - Jr^d.$$

(This obtains because under perfect information, the constraint in equation (7) becomes $Jg_ip_i = Jr^d$ so that the optimal loan rate does not include a term for expected monitoring costs.)

If an entrepreneur were to open a deposit account with the funds that he has at the beginning of the investment period, the total expected utility for the end of the investment period would be given by,

$$y^e r^d + J.^{21}$$

In this stylized model, regions II and III present a range of entrepreneurship in which banks and roscas can coexist when the line representing the *ex ante* expected utility from deposit accounts lies below the schedules depicting expected utility when projects are undertaken. Mathematically, this obtains provided that,

$$Bw\left(1 - \frac{r^d}{2}\right) < \left(\frac{\gamma}{J}\right)\left[B\left(\frac{w}{2} - 1\right) + y^e\left(\frac{w}{2} + 1 - r^d\right)\right]$$

This expression establishes that parameter values are such that the line representing the utility associated with entrepreneur deposit-taking intersects the graph representing the expected utility associated with rosca participation before it crosses the function representing the utility associated with bank finance under conditions of imperfect information. It is clear that with a well behaved deposit rate (taking on values that lie between one and two) and a high level of monitoring costs, this condition will be satisfied. A well-behaved deposit rate guarantees that the left-hand side of the expression is positive. The expression on the right-hand side also takes on positive values. Accordingly, the equation establishes a positive lower bound for γ/J.

The cutoff entrepreneur necessarily lies to the right of the entrepreneur who is indifferent between bank financing and rosca finance. This can be seen most clearly by noting that the expression for the indifferent entrepreneur is

$$p = (Jr^d + \gamma - J)/(Bw + \gamma - \tau^e Bw)$$

and then rewriting the denominator as $[Jw + \gamma - (\tau^e Bw - y^e w)]$. This allows comparison with the bank sector's cutoff point p^c, where as noted in equation (8),

$$p^c = (Jr^d + \gamma)/(Jw + \gamma).$$

This comparison is made most easily by J and $(\tau^e Bw - y^e w)$. Substitution of the value of τ^e that prevails given the rosca's choice of membership size reveals that $J < (\tau^e Bw - y^e w)$.

[21]In this simple two-period model the bank deposit window is open only at the start of the first period (banks only fund projects in the first period). Relaxing this assumption would raise the gross return to demand deposits, thereby shifting the total end of period expected utility associated with deposits upward. However, it would not alter the spirit of this analysis. The interpretation of our financial sector model would remain the same.

