ESSAYS ON SEMIFORMAL FINANCIAL INSTITUTIONS IN RURAL INDIA

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Chapter 1

Local Politics, Credit, and Credibility in Rural India

1.1 Introduction

The literature on political involvement in the credit market has so far concentrated on the division between three broad theories: the social view, the agency view, and the political view (Coleman 2011, Sapienza 2004). In the social view, governments can increase social welfare by forcing banks to make loans that are unprofitable but socially beneficial (Stiglitz 1993); the agency view complicates this by positing that government involvement produces weak managerial incentives that decrease the internal efficiency of banks (Tirole 1994). The political view, however, is that the government enables politicians to use their power over lending strategically, either to win reelection, increase campaign contributions, or otherwise reward favored individuals, creating inefficiencies in the credit market without any societal benefit (Shleifer and Vishny 1994). These views differ on the motivation for political involvement
in credit markets and on its social desirability, but all three share the common assumption that this involvement comes in the form of an implicit or explicit directive on lending issued by the politician, and therefore must have an adverse effect on the bank (as it would not choose to make the loan otherwise). There is a body of work that uses this assumption to test the political view by measuring how variations in political incentives affects credit outcomes; for instance, studies that show that lending increases in close elections (Coleman 2011, Cole 2009, Carvalho 2010). While that direct channel is present and relevant in many contexts, in this paper I show the existence of an alternate channel. Instead of forcing the banks to lend, the politician may increase lending by giving his constituents a way to credibly commit to repayment by using using the cooperative nature of the politician-constituent relationship as a kind of collateral. This could make bank, constituent, and politician better off by solving an underlying credit market failure while increasing the support received by the politician.

This idea is adapted from the literature on microcredit lending, and how it may exploit social capital to overcome credit market failures. Stiglitz and Weiss (1981) gives the canonical explanation of how credit market failure can affect poor borrowers: without collateral, there is no way to deter strategic default or to distinguish good credit risks from bad credit risks, potentially causing the entire market to unravel. Using this framework, Ghatak (1999) and Besley and Coate (1995) show that the joint-liability contract typically used by microlenders can overcome these issues by harnessing the ‘social capital’ of the borrowing group. In particular, Besley and Coate (1995) shows how group members may be deterred from strategic default by the threat of social sanctions from other group members; in essence, the group’s creditworthiness

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1In a standard joint-liability contract, members of a joint-liability group take out loans individually from a bank, but default by any member results in the entire group of borrowers being cut off from future loans.
increases because of the ability of the group to revert from a mutually-beneficial cooperative outcome to a suboptimal uncooperative outcome. The ‘social capital’ that is used as ‘collateral’ is the surplus value derived from cooperation.

Just as two members of the same group enjoy a cooperation surplus, so too can the politician and the constituent: the politician depends upon constituents for reelection, while constituents depend upon politicians for the provision of government-supplied public and private goods. Cooperation between the two results in the reelection of the politician and the provision of these government resources to the constituent. In the proper institutional context, there is no reason why the politician-constituent cooperation surplus could not be used as ‘collateral’ in the same manner as the intragroup cooperation surplus, under the condition that politician and constituent both enjoy a sufficient surplus from cooperation.

This formulation of the politician-constituent relationship builds on previous developments in political economy. There is a substantial literature on the problem of commitment that exists between the politician and the constituent, much of it set in the citizen-candidate framework of Besley and Coate (1997), in which politicians are incapable of commitment and thus candidates with preferences that match those of the median voter will be selected. One arm considers how the preferences of individual candidates affect policy decisions: Chattopadhyay and Duflo (2004) presents convincing evidence that female local politicians in India provide a mix of public goods preferred by women in their state, and Washington (2008) shows that United States congressmen vote differently on women’s issues depending on whether or not they have a daughter. Another arm of this literature shows how institutions can allow politicians to credibly commit to policies that do not match their personal preferences; Alesina and Spear (1988) and Harrington Jr. (1992) suggest that strong political parties can play this role, while Munshi and Rosenzweig (2010) give evidence
that, in contexts with weak political parties, extended kinship networks can be the vehicle for commitment.

This paper fits into a third arm of the literature, dealing with how politicians respond to incentives created by their repeated interaction with constituents. Besley and Case (2003) provide a thorough overview of the effects of term limits in the United States, with evidence that term limits affect the behavior of governors (Besley and Case 1995, List and Sturm 2006) and members of Congress (McArthur and Marks 1988). Two papers in the Brazilian context give particularly interesting evidence: Ferraz and Finan (2009a) show that mayors who are eligible for reelection (or who later run for higher office) are significantly less corrupt than those who are term-limited, and Ferraz and Finan (2009b) show that increasing the wages of municipal legislators leads to greater effort and greater provision of certain public goods; they also provide suggestive evidence that this is due to changes in the behavior of legislators in office as well as attracting more talented individuals to run for office.

I contribute to this literature by incorporating the incentives of constituents as well as those of politicians: just as the constituents can discipline the politician by controlling his ability to be reelected, so too can the politician discipline his constituents by controlling their access to government aid. This two-sided relationship potentially allows the politician to help his constituents both directly, by providing aid, and indirectly, by acting as a credible broker between constituents and third parties such as banks.

This paper was inspired by discussions with the leaders of an organization that sponsors and trains microcredit groups in Tamil Nadu, India. They expressed a desire to help their groups become involved with local electoral politics, despite the lack of formal connection between the powers and responsibilities of the local politicians and the interests of the microcredit borrowers. Results from preliminary data showed
that these politicians did somehow affect credit provision; this was puzzling since, again, these politicians do not seem to have any formal power in that regard. This suggested that politicians might be inducing lending in an indirect manner, which shaped my survey instrument and led to the development of my model.

I test my theory using novel data from a survey of microcredit groups in an administrative block of Tamil Nadu, India. Due to the government’s policy of reserving certain constituencies for members of historically “low” castes, local politicians face semi-random term limits. This creates an exogenous source of variation in the constituent’s ability to discipline the politician. The government anti-poverty programs examined provide money and materials for upgrading thatch-roof huts into cement houses in one case and guarantee employment for rural households in another case; these have greater value for certain constituents, based on the condition of their housing and the demographic make-up of their households respectively. Section 2 provides background on these institutions.

Section 3 presents a simple model of lending and patronage as an infinitely-repeated two-step game between constituent, bank, and politician. The constituent would benefit from a bank loan, and is capable of repaying it; however, she lacks collateral and therefore cannot credibly commit to repayment, and so the bank is unwilling to extend these otherwise-profitable loans. The local politician is vested with the power to choose the beneficiaries of government anti-poverty programs, and desires political support from his constituents; however, they too face a commitment problem, because both support and aid are costly. I show that if the politician sufficiently values the constituent’s support, there is a Pareto-optimal subgame perfect Nash equilibrium in which all three actors take a grim-trigger strategy in response to a defection in either game, and that this allows the actors to obtain the Pareto-optimal outcome under conditions in which bilateral grim triggers would not be equilibria. This predicts that
constituents with a higher valuation for the politician’s aid will receive more aid, give
more political support, and receive more loans under a president with high valuation
of support than under a president with a low valuation of support.

In Section 4, I test the key prediction of this model by regressing two forms of aid, the
microcredit’s political support for the president, and bank loans received on exogenous
variation in reelection eligibility caused by the reservation system, measures of the
microcredit group’s aid valuation, and their interaction. I find that, consistent with
my theory, an increase in the president’s eligibility for reelection causes large increases
in credit, both forms of aid, and political support in high-valuation groups relative
to low-valuation groups. I also consider two alternate hypotheses that could also
produce these results and show robustness checks that provide evidence against these
hypotheses. Section 5 concludes.

1.2 Institutional Background

In order to justify the model I present in the next section, in this section I detail
the structure of elected local government in Tamil Nadu and its relationship with
the “Self-Help Group” style of microcredit. A particular elected official, the gram
panchayat president, has authority over the provision of two important forms of aid
and the distribution of this aid comprises a large part of his responsibilities, but that
he\(^2\) has few other formal powers. I also show how the president faces uncertain term
limits as a result of the reservation system. Finally, I discuss the process by which
Self-Help Groups receive loans from branch offices of the traditional banking system,

\(^2\)For clarity, throughout this paper I refer to presidents and politicians as male, and borrowers
and constituents as female, despite the presence of female presidents and male borrowers.
and show that these groups are viewed as a potential source of political support by elected officials at the local and state level.

1.2.1 Gram Panchayats

In 1991, the central government of India passed the 73rd Amendment of the Constitution, which mandated the creation of a three-tier system of local elected government, with the most local tier being the gram panchayat. In Tamil Nadu, a single GP covers a village or a small group of villages with total population between 500 and 10,000. The GP council consists of a president, who is elected by popular vote\(^3\) of the entire GP, and between six and fifteen representatives elected by individual wards within the GP. Elections for all offices are held every five years, beginning in October 1996.

The GP government has few formal responsibilities and resources. Its primary roles are to provide public goods such as roads and sanitation and to select beneficiaries for certain government anti-poverty programs (Besley, Pande and Rao 2007). The majority of its revenue comes from block grants from the state and central governments (Munshi and Rosenzweig 2010), augmented by very limited taxation powers. It does not have any legislative duties or powers, and has no formal oversight powers over police, the local government bureaucracy, or the local branches of public banks. The ward representatives are not paid (although the president does receive a monthly travel stipend) and the GP government has very few employees. However, GP officials may have an indirect ability to influence outcomes outside of their direct control via their interactions with state and national officials. Evocatively, one GP president, when asked what made him an effective president, pointed to a picture on his desk of him shaking hands with the current MLA (Member of Legislative Assembly, the

\[^3\text{In West Bengal and Rajasthan, the states studied in Chattopadhyay and Duflo (2004) and Bardhan, Mookherjee and Torrado (2010), the president is instead indirectly elected in the manner of a parliamentary democracy, with different implications for effective term limits.}\]
This paper follows Besley et al. (2007) and Bardhan et al. (2010) in examining the GP government’s role in the selection of aid beneficiaries (as opposed to Chattopadhyay and Duflo (2004) and Munshi and Rosenzweig (2010), who consider its role in provision of public goods) through two forms of aid, house construction and guaranteed employment. The former is accomplished through both a long-running national program (IAY) and a recently-started state program (KVVT), which are both intended to replace mud and thatch huts with cement houses. The latter is provided through the National Rural Employment Guarantee Scheme (NREGS), a public works project started in 2008 which is intended to guarantee 100 days of annual employment to every household in rural India. The funding from these programs is quite large relative to the overall operating funds of the GP. In 2010, the three programs combined received Rs.48 billion (approximately $1.1 billion) in funding for operations in Tamil Nadu, while the State Grant to GPs totaled only Rs.14 billion (approximately $311 million) (Tamil Nadu Rural Development & Panchayat Raj Department 2010a). NREGS in particular has become a large component of rural life; an NGO in my study area that specialized in the export of handicrafts reported having difficulty recruiting local artisans since the introduction of NREGS, and my survey team frequently had to work around the respondents’ NREGS schedules.

The GP president plays a large role in the selection of aid beneficiaries, with both formal and de facto power to choose the level of aid received by each constituent. The official implementation procedures for NREGS and the national housing aid program in Tamil Nadu give the GP president specific powers: he has the “responsibility of allocating employment opportunities” (Tamil Nadu Rural Development Department 2006) and is the only fixed member of the committee responsible for the selection of housing aid beneficiaries. This is supported by evidence at the local level: a
2001 study of 20 GPs in Uttar Pradesh, India, found that in almost all cases “the names of the beneficiaries [for government housing aid] have been finalized by the pradhan [GP president], his henchmen, and ultimately by the village- and block-level functionaries” (Srivastava 2006), and in my survey I found that 70% of housing aid recipients reported that the GP president helped them get the aid and 12% reported that their ward representative helped them. Besley et al. (2007) also discuss the process of beneficiary selection for valuable ration cards intended for poor recipients, and report that GP politicians are more likely to possess these cards than others despite being wealthier on average, strongly suggesting that politicians have influence over aid distribution.

1.2.2 GP reservation policies

As part of the 73rd Amendment, GP president positions in each administrative block are set aside (“reserved”) for members of the historically “low” Scheduled Castes (SC) in proportion to their population in the block. In addition, one-third of positions are reserved for women. The implementation of this reservation system varies somewhat from state to state. In Tamil Nadu, the reservations were initially set before the first election in 1996, and rotate every other election (in 2006 and upcoming in 2016) to GPs that have not previously been reserved for that group: of the 27 GPs in my survey, 9 GPs were reserved for women from 1996-2006, 9 different GPs were reserved for women from 2006-2016, and in 2016 the final 9 GPs will be reserved for women from 2016-2026.

The reservation process is carried out by the District Rural Development Agency on a

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4 An administrative block, also called a tahsil or taluk, is an administrative unit roughly equivalent to a county. As of the 2001 census, there were 5564 administrative blocks in India, with average population of approximately 200,000.

5 Unreserved seats can be contested by any member of the GP, including women or SCs/STs, but are almost always occupied by non-SC/ST men.
block-by-block basis, using data from the most recent national census (the 1991 census for the 1996-2006 rotation period, and the 2001 census for the 2006-2016 period). First, the District Rural Development Agency uses the percent of the population which is SC to determine the number of SC-reserved GPs. Then they assign SC-reservations to the GPs in the block with the highest percent SC but which have not previously been SC-reserved. After this, they assign female reservations to the top third of GPs in each category (SC-reserved and non-SC-reserved) by percent female (again skipping those which have already been female-reserved). The reservation assignments are released publicly roughly 6 months before the election.

While the intent of this law is to increase the political participation of historically underprivileged groups, the rotation system also has the effect of creating pseudo-randomized term limits for presidents. Each male non-SC president faces the possibility that he will be ineligible to run in either the next election or the election after next (recall that reservations are only rotated every other election), and the probability that he will be ineligible due to his caste is based on two factors: the percent SC in his GP relative to the others in his administrative block, and the reservation history of the GPs in his block. For instance, a GP that was SC-reserved from 1996-2006 will not be SC-reserved in either 2006-2016 or 2016-2026, so that the GP president elected in 2006 knows that he or his wife will be eligible for election in 2016. Similarly, a GP with very few SC residents is unlikely to ever be assigned an SC-reservation, so the president of that GP in 2006 also knows that he or his wife will be eligible for election in 2016.

I focus on the term limits created by the rotation of SC reservations, rather than those created by female reservations, due to the possibility of a ‘dynastic’ situation in which both male and female members of the same household alternately run for office; the work of Dal Bó, Dal Bó and Snyder (2009) shows that this is a very salient
concern (albeit in the very different context of U.S. congressional races), and anecdotal evidence suggests that husband-and-wife presidential pairs are not uncommon\(^6\). Since castes are largely endogamous and caste status is inherited (Munshi and Rosenzweig 2009), a single household almost never contains both SC and non-SC members, which removes this complication.

1.2.3 Self-Help Groups

Self-Help Groups (SHGs) are an extremely widespread form of microfinance supported by the Indian government, particularly in South India. A SHG is a group of between 10 and 20 people, usually women, which combine aspects of an accumulating savings and credit association with no-collateral, joint liability microcredit. A SHG is typically formed by a ‘promoter’, which can be an NGO, government agency, bank, or private individual, who approaches women in a village and provides training and resources to set up the SHG. As part of the training, the SHGs learn to maintain records of their financial activities, which

Initially, an SHG functions as accumulating savings and credit associations; each member saves a small amount of money with the SHG every month, and the SHG lends that money back to individual members. After successfully functioning in this way for at least six months, the SHG may then apply to a bank for no-collateral, joint liability loans, which range in size from Rs.10,000 to Rs.500,000 (about US $200 - $1250) and have durations of 12 to 36 months. These loans are usually split up among the SHG members; they are also occasionally used for investments in a joint business venture. Estimates of the repayment rates for these bank loans range from 88% to

\(^6\)This does not contradict the evidence in Chattopadhyay and Duflo (2004) showing that male and female presidents provide more of the public goods favored by their own gender, because there is no reason to believe that providing public goods favored by one gender or another should affect reelection prospects.
95\% (Sinha, Tankha, Reddy and Harper 2010), which is not atypical for microcredit.

Unlike the state and central governments, which fund SHG promoters, subsidize certain types of lending, and provide refinancing for bank loans to SHGs, the GP government has no formal relationship with SHGs and has no power over banks or SHG promoters. However, in my discussions with GP presidents, they have described themselves as playing an important role in SHG lending in several ways, including informing their constituents of the availability and attractiveness of different loans; suggesting to bank officials which SHGs may be suitable for loans; and encouraging SHGs to repay their loans in a timely manner. This kind of informal engagement with SHGs is consistent with my theoretical model.

GP presidents have good reason to get involved: SHGs are widely recognized as being potential sources of political support. In Tamil Nadu, state-level elected officials take credit for the growth of SHGs, promise additional support for SHGs present themselves as being responsible for nurturing SHGs, and hold rallies in which they preside over the distribution of SHG loans (The Hindu 2008). Kalpana (2008) describes an instance in which SHGs discuss the possibility of promising a local politician votes if he helps them secure a loan, and my respondents reported that 75\% of their public political activities (such as attending rallies and canvassing for votes) were conducted through the SHG.

1.3 A Theory of Lending and Patronage

In this section, I present a simple model of no-collateral lending and patronage and show that a politician can facilitate lending between a bank and a constituent by making the constituent’s access to government aid contingent on repayment of her
loan. In return, the constituent provides the politician with political support, in the form of votes, donations, volunteering, or attending rallies.

I formulate this as an infinitely-repeated two-step stage game between constituent, bank, and politician and derive the conditions under which lending, aid, and support can obtain in equilibrium. In the first step, constituent and bank engage in a lending game, in which the bank chooses whether to make a no-collateral to the constituent and the constituent chooses whether to repay her loan. In the second step, constituent and politician engage in a patronage game, in which the politician chooses whether to give the constituent access to government aid and the constituent chooses whether to support the politician. I discuss a trilateral grim trigger strategy that can enable all three actors to reach the Pareto-efficient outcome under conditions where bilateral grim trigger strategies are not feasible, and derive testable predictions for how changes in the constituent’s valuation of aid and the politician’s valuation of support affect the incidence of aid, lending and support. My key prediction is that the interaction of the two valuations increases all three outcomes.

This set-up is similar to the ‘community enforcement’ games described in Kandori (1992). In that paper, he extends the result that any mutually-beneficial outcome of a stage game can be sustained as a subgame-perfect equilibrium in an infinitely-repeated game between the same players (Fudenberg and Maskin 1986) to stage games played repeatedly by different members of a population. In this case, the mutually-beneficial outcome of “lending, repayment, aid, support” can be sustained even though there are three players in the stage game rather than two. It is also similar in spirit to the joint-liability model of Besley and Coate (1995), in that the ability of two actors to discipline each other (“social capital”) can be used to overcome problems of strategic default, just as physical capital can be used as collateral.

In order to present the basic intuition of my model as cleanly as possible, I make three
important simplifying assumptions. First, I consider a politician’s interaction with one constituent in isolation from his interaction with other constituents and have the politician derive intrinsic value from the constituent’s support, rather than explicitly model the electoral process and make the politician value support as a means to re-election. Otherwise, the model would have to include a concept of the politician’s optimal electoral coalition, and the testable predictions generated by such a model go beyond my data. Second, I treat the ‘constituents’ of this model as unitary decision-makers with well-defined utility functions, but in context a constituent represents an entire microcredit group. This ‘unitary group’ assumption is analogous to the common ‘unitary household’ assumption. Finally, I assume that all actors have complete information about characteristics and actions. In the context of local politics, assuming perfect information between constituent and politician is not unreasonable, but in reality it may be very difficult for the bank to gather information about constituents (although this is not a concern if the politician and bank can communicate easily and are willing to share information). Models which weaken these assumptions and produce additional testable predictions are left for future work.

1.3.1 Set-up

There are three actors: a bank, a politician, and a constituent. The constituent is fully characterized by her valuation of aid $\nu_A \in [0, \infty)$, the value $\nu_L \in [1 + r, \infty)$ of her potential investment, and her discount factor $\delta^C \in [0, 1)$. In my empirical work, I use two measures of $\nu_A$ based on the two aid programs. For NREGS, households with unemployed or underemployed adults will have higher $\nu_A$ than households in which every adult member has a full-time job, and likewise for housing aid the households with thatch-roof huts will have higher $\nu_A$. 
The politician is described by his valuation of political support $\nu_S \in [0, \infty)$ and his discount factor $\delta^P \in [0, 1)$. I focus on the variation in $\nu_S$ caused by term limits: *ceteris paribus* a term-limited politician will have a lower $\nu_S$, since he does not need to win the next election for his office. However, a term limit may not push $\nu_S$ to 0, because the politician may have some other use for that political support. For instance, he may run for a different office, or use the constituent’s support on behalf of his party and be rewarded with an appointed position.

As noted above, I assume that all three actors have complete information about parameter values $\nu_A$, $\nu_L$, $\nu_S$, $\delta^C$, $\delta^P$, and $r$, and can observe all past actions.

### 1.3.2 Lending stage game

First, I consider the lending relationship in isolation from the patronage relationship. The bank, which faces no cost of capital, chooses whether to lend 1 unit of capital to the constituent at an exogenously set interest rate $r$. The constituent then invests in a project that returns $\nu_L \geq 1 + r$ with certainty and chooses whether or not to repay the borrowed principal. For simplicity, I collapse this process into a single-stage game, in which the bank chooses whether or not to lend at the same time as that the constituent chooses whether or not to repay conditional on receiving a loan. The payoff matrix for the lending stage game is shown in figure 1, panel A, denoting the bank’s choice to lend or not lend as $L$, $NL$ and the constituent’s choice to repay or not repay as $R$, $NR$. This stage game is then repeated infinitely, with the constituent discounting between each round at factor $\delta^C$.

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7Alternatively, I could model term limits as causing a decrease in $\delta^P$; as I show in section 3.5, the two are equivalent in my model.
8Supporting this idea, Ferraz and Finan (2009a) find that term-limited Brazilian mayors are more corrupt than those who do not face a term limit, but that this effect is lessened if the mayor then goes on to run for higher office.
Consider the following strategy profile:

**Definition 1** In the **lending grim trigger** strategy profile, the bank chooses $L$ if and only if the constituent has chosen $R$ in all previous rounds, and the constituent chooses $R$ if and only if the bank has chosen $L$ in all previous rounds.

The constituent’s IR constraint in this strategy profile is that $\nu_L$, the present-discounted value of defecting to $(L, NR)$ in the current round and then receiving $(NL, NR)$ in subsequent rounds, must be lower than $\frac{\nu_L - (1+r)}{1-\delta} \nu_L$, the present-discounted value of receiving $(L, R)$ outcome in this and all future rounds.

Since the lending grim trigger strategy profile results in $(L, R)$ and enacts the maximum possible punishment for deviation, if it is not a subgame perfect Nash equilibrium then $(L, R)$ cannot be the result of a subgame perfect Nash equilibrium. Thus $(L, R)$ can only occur in equilibrium when the parameters satisfy equation 1:

$$\delta^C \geq \frac{1+r}{\nu_L} \quad (1.3.1)$$

There is no IR constraint for the bank because, unlike the constituent, the bank receives a higher payoff from the cooperative outcome $(L, R)$ than it would by defecting $(NL, R)$ and thus has no incentive to deviate.

### 1.3.3 Patronage stage game

In the patronage game, the politician chooses whether or not to give aid to the constituent, who values that aid at $\nu_A \geq 0$. Simultaneously, the constituent chooses whether or not to give political support to the politician, who values support at
I set both\(^9\) the politician’s cost of providing aid and the constituent’s cost of providing support to 1. The cost to the politician could either reflect the opportunity cost of giving aid to this constituent rather than another or simply the foregone value of not embezzling the aid, while the cost to the constituent could either be the actual time cost of attending rallies or the opportunity cost of supporting the politician instead of a competitor. The payoff matrix for the political stage game is shown in figure 1, panel B, denoting the politician’s choice to aid or not aid as \(A, NA\) and the constituent’s choice to support or not support as \(S, NS\). Note that \((A, S)\) will only be the Pareto-efficient outcome if \(\nu_S \geq 0\) and \(\nu_A \geq 0\). As in the lending game, this stage game is repeatedly infinitely, with discount factors \(\delta^C\) and \(\delta^P\) for the constituent and politician respectively.

The grim-trigger strategy profile for this game parallels the lending grim trigger strategy profile:

**Definition 2** In the **patronage grim trigger** strategy profile, the politician chooses \(A\) if and only if the constituent has chosen \(S\) in all previous rounds, and the constituent chooses \(S\) if and only if the politician has chosen \(A\) in all previous rounds.

Again, if this is not a subgame perfect Nash equilibrium then \((A, S)\) cannot be the result of a subgame perfect Nash equilibrium. And just as in the lending game, the IR constraint for the constituent is that the value of a one-round defection \(\nu_A\) must be lower than the value of continued cooperation \(\frac{\nu_A - 1}{1 - \delta^C}\). However, in this case the politician faces a symmetric IR constraint, that \(\nu_S < \frac{\nu_S - 1}{1 - \delta^P}\). Thus, \((A, S)\) can only be sustained only if the parameters satisfy equation 2 and 3:

\[
\delta^C \geq \frac{1}{\nu_A} \tag{1.3.2}
\]

\(^9\)Because these two costs are measured in different units (politician utility as opposed to constituent utility), I may normalize both without loss of generality.
\[
\delta^P \geq \frac{1}{\nu_S}
\] (1.3.3)

Note that equation 2 cannot be satisfied for any \( \delta^C \in [0, 1) \) when \( \nu_A < 1 \), meaning the constituent values aid less than she values the opportunity cost of supporting the president. Similarly, equation 3 cannot be satisfied for any \( \delta^P \in [0, 1) \) when \( \nu_S < 1 \).

### 1.3.4 Trilateral game

In the trilateral game, in each round the actors first play the lending stage game, followed by the political stage game. Clearly, the lending and patronage bilateral grim-trigger strategy profiles will continue to be subgame perfect Nash equilibrium under the same conditions, so that when equation 1 is satisfied, the \((L, R)\) outcome can be sustained, and when equations 2 and 3 are satisfied the \((A, S)\) outcome can be sustained. However, it is possible to use a community enforcement mechanism to sustain cooperation in the trilateral game. I consider a strategy profile in which the politician and bank both punish the constituent if she defects in either game, and the constituent punishes both the politician and bank if either one defects.

**Definition 3** In the trilateral grim trigger strategy profile, the bank chooses \( L \) if and only if the constituent has chosen \( R \) and \( S \) in all previous rounds and the politician has chosen \( A \) in all previous rounds. The constituent chooses \( R \) if and only if the bank has chosen \( L \) and the politician has chosen \( A \) in all previous rounds, and chooses \( S \) if and only if the bank has chosen \( L \) in this round and all previous rounds and the politician has chosen \( A \) in all previous rounds. The politician chooses \( A \) if and only if the bank has chosen \( L \) in this round and all previous rounds and the constituent has chosen \( R \) in this round and all previous rounds and \( S \) in all previous rounds.
It is evident that the trilateral grim trigger strategy profile results in the cooperative outcome \((L, R, A, S)\). However, in order for the trilateral grim trigger to be a sub-game perfect Nash equilibrium, it must satisfy the IR constraints for constituent and politician. Since the politician suffers the same consequences from defecting in the trilateral game as he does in the patronage game, his constraint remains the same.

The constituent’s IR constraint changes in two ways. First, she must now satisfy both a lending IR constraint and a patronage IR constraint, because she now has two opportunities to defect in each round. Second, each of these IR constraint become less binding than in the lending and patronage games. This is because the benefits of a single-round defection remain the same for each game but the cost of defecting increases, as a defection in either game means that constituent must forgo the future benefits of cooperation in both.

The first constraint, that she not defect in the lending game, is:

\[
\nu_L \leq \frac{\nu_L - [1 + r] + \nu_A - 1}{1 - \delta^C} \quad \text{rearrange} \quad \delta^C \geq \frac{[1 + r] - [\nu_A - 1]}{\nu_L} \tag{1.3.4}
\]

When \(\nu_A > 1\), this will be a weaker condition than equation 1, and when \(\nu_A < 1\) it will be a stronger condition.

The second constraint, that constituents not defect in the patronage game, is

\[
\nu_A \leq \frac{\nu_A - 1 + \delta^C(\nu_L - [1 + r])}{1 - \delta^C} \quad \text{rearrange} \quad \delta^C \geq \frac{1}{\nu_A + \nu_L - [1 + r]} \tag{1.3.5}
\]

Since \(\nu_L > 1 + r\), this will always be a strictly weaker condition than equation 2. The combined constraint is

\[
\delta^C \geq \max\left(\frac{1}{\nu_A + \nu_L - [1 + r]}, \frac{[1 + r] - [\nu_A - 1]}{\nu_L}\right) \tag{1.3.6}
\]
1.3.5 Comparative statics

Consider a term-limited politician who has a low $\nu_S = \bar{\nu}_S < \frac{1}{\delta^P}$, with constituents who vary in $\nu_A$ and $\delta^C$ but who have fixed $\nu_L$ and $r$. This politician can not credibly commit to either the patronage grim trigger strategy or the trilateral grim trigger strategy since he does not fulfill his IR constraint (equation 3). This means that his constituents can only receive lending in equilibrium if they have $\delta^C \geq 1 + \frac{r}{\nu_L}$ (equation 1) and are therefore capable of committing to the lending grim trigger strategy, and since they only aid and give support in equilibrium under the patronage grim trigger or trilateral grim trigger strategies, aid and support do not occur in equilibrium under this politician.

Now consider a politician who is likely to be able to run for reelection and who therefore has a high $\nu_S = \bar{\nu}_S > \frac{1}{\delta^P}$, satisfying equation 3. The bank can lend to his constituents in equilibrium so long as they fulfill equation 1 (so that the lending grim trigger strategy is an SPNE) and/or equation 6 (so that the trilateral grim trigger strategy is an SPNE). This means that any constituent who could receive a loan in equilibrium under the term-limited president can also receive a loan under the reelectable politician, and that there may be additional constituents who can receive loans under the reelectable politician but not under the term-limited politician. In other words, the constituents who can receive loans in equilibrium under the term-limited politician are a subset of the constituents who can receive loans in equilibrium under the reelectable president. This is also (trivially) true for aid and support, since no constituents give support or receive aid under the term-limited president$^{10}$.

Figure 2 shows the possible lending regions for the term-limited and reelectable politi-

---

$^{10}$Note that while I model the term-limited politician as having a low $\nu_S$ and the reelectable politician as having a high $\nu_S$, it would be equally accurate to say that the term-limited politician has a low $\delta^P$ and the reelectable politician has a high $\delta^P$. 

cians for parameter values $r = 0.7$ and $\nu_L = 2$, with $\nu_A$ along the horizontal axis and $C$ along the vertical. Notice that all along the $\nu_A$ axis, lending occurs for a weakly broader range of $\delta_C$ under $\bar{\nu}_S$ than under $\nu_S$. And as $\nu_A$ increases, so does the increase in potential lending associated with the change in $\nu_S$, because the loss from defection under the trilateral grim trigger strategy (available only under the reelectable politician) increases with $\nu_A$ while the loss from defection under the lending grim trigger strategy (available under both politicians) does not. The same will be true for aid and support, since the loss from defection increases with $\nu_A$ under both patronage and trilateral grim trigger strategies, which are both available only under the reelectable president. This intuitively leads to my key theoretical prediction:

**Prediction 1** The effect of an increase in the politician’s valuation of support $\nu_S$ on the constituent’s aid received $A$, support provided $S$, and lending received $L$ increases as the constituent’s valuation of aid $\nu_A$ increases.

I show this prediction formally by defining the function $\Delta_Y(\nu_A)$ to be the effect of a change in $\nu_S$ on outcome $Y \in \{L, A, S\}$ as a function of $\nu_A$, and then taking the partial derivative of this function with respect to $\nu_A$. Let $\Delta_Y(\nu_A)$ be the difference between the lowest $\delta_C$ for which outcome $Y$ is in equilibrium under the term-limited politician and the lowest $\delta_C$ for which outcome $Y$ is in equilibrium under the reelectable politician. As discussed above, lending under the term-limited politician can occur when equation 1 is fulfilled, while lending under the reelectable politician can occur when either equations 1 or 6 are fulfilled. Therefore

$$
\Delta_L(\nu_A) = \frac{1 + r}{\nu_L} - \min(\frac{1 + r}{\nu_L}, \max(\frac{1}{\nu_A + \nu_L - [1 + r]}, \frac{[1 + r] - [\nu_A - 1]}{\nu_L}))
$$

since $\frac{1+r}{\nu_L}$ is the threshold value for $\delta_C$ for term-limited politicians and the right-hand term is the threshold value for reelectable politicians. Aid and support can only occur
in equilibrium under the reelectable politician, and only with constituents who can credibly commit to either the patronage or trilateral grim trigger strategies (equation 2 or equation 6). Therefore the increase in aid and support associated with a change in $\nu_S$ will be

$$\Delta_S(\nu_A) = \Delta_A(\nu_A) = 1 - \min(1, \frac{1}{\nu_A}, \max(\frac{1}{\nu_A + \nu_L - [1 + r]}, \frac{[1 + r] - [\nu_A - 1]}{\nu_L}))$$

by the same reasoning as above.

If I take the derivatives of $\Delta_Y$ with respect to $\nu_A$, I find that $\frac{\partial \Delta_A}{\partial \nu_A} = \frac{\partial \Delta_S}{\partial \nu_A} \geq 0$ and $\frac{\partial \Delta_L}{\partial \nu_A} \geq 0 \ \forall \ \nu_A \geq 0$. To see this simply, note that the right-hand term is non-increasing in $\nu_A$, and since that term is subtractive $\Delta_Y$ is therefore non-decreasing in $\nu_A$.

1.4 Empirical Analysis

1.4.1 The Data

The analysis uses novel data from a survey of SHG members in 27 rural GPs in an administrative block of Vellore district, in northern Tamil Nadu, India, as well as census data from the 1991 and 2001 Indian censuses. The survey took place in three stages, beginning in June 2010. First, my survey team contacted local informants, SHG-promoting NGOs, and the Block Development Office and compiled a complete list of all 985 existing and defunct SHGs in the administrative block. Then, between November 2010 and January 2011, we attempted to interview one current or former leader from every group, conducting a total of 926 leader interviews (a 95% response rate). These leader interviews included questions about the SHG’s saving and borrowing practices each year from 1997 to 2010. The respondents usually had access to
the SHG record books, which aided in recall of this information. The interview also involved compiling a roster of current and former SHG members, which we used as a sample frame for the member interview.

For the member interview, we sampled 5 current or former members from each SHG, excluding members who were reported to be dead or who had moved out of the survey area. Between January and April 2011, we interviewed 4101 of the 4630 members sampled (an 89% response rate). These member interviews included questions on household demographics, household living standards, and aid received from the government for each year from 1997 to 2010.

Table 1 contains group-level summary statistics. The rate of loan delinquency is only 4%, which is quite low even by the standards of microcredit. I suspect that this is an underestimate for two reasons: the SHGs who refused to participate in the leader survey probably had a higher rate of loan delinquency than participants, and the participants may have thought they were being evaluated for inclusion in a program of some kind and underreported their delinquency rates (despite being told otherwise in the consent statement). Figure 3 shows the total number of active SHGs each year, which increases dramatically over the survey period.

In the empirical analysis, I combine the responses from the leader and member surveys and form a pseudo-panel dataset. The dataset overlaps with two “reservation periods”: 1997-2006 and 2007-2016. The analysis is conducted at the SHG-year level, clustering at the GP-rotation period level, for a total of 54 clusters. However, as I discuss in the next section, in my analysis I exclude the 9 clusters which are reserved for SC presidents, leaving 45 usable clusters.
1.4.2 Variables of interest

Valuation of support $E_{pt}$

My empirical strategy relies on having a plausibly exogenous source of variation in $\nu_S$, the GP president’s valuation of political support. Because much of the value of political support is tied to reelection, a non-SC president who thinks his GP will be reserved next rotation period will *ceteris paribus* have a lower $\nu_S$. I use simulation methods to construct reelection eligibility $E_{pt}$, which is an approximation of the probability that GP $p$ will not be SC-reserved in the next rotation period.

As discussed in Section 2.2, the determinants of SC-reservation for the 2006-2016 rotation period are the %SC as of the 2001 census and the SC-reservation status of each GP in the 1996-2006 rotation period. Likewise, SC-reservations for 2016-2026 rotation period depend on the %SC in the 2011 census and the SC-reservation status for the 1996-2006 and 2006-2016 rotation periods. If a president had perfect information about these values for all 27 GPs, he could determine with certainty whether or not his GP would be reserved, and $E_{pt}$ would either equal 0 or 1. While it is reasonable to assume that a president is aware of the relevant reservation histories, it is unlikely that he knows the exact %SC for each GP from the relevant census. Therefore, from the perspective of the president, the %SC in each GP is a random variable, and his probability of being eligible for reelection will be determined by the distribution of these variables for each GP.

In order to approximate the perceived distribution of 2001 %SC, I assume that the president has accurate information about the 1991 %SC in each GP, and that he believes that the 2001 %SC of each GP will be equal to the sum of 1991 %SC and an independent identically distributed error term. I further assume that he has an
accurate perception of the distribution of this error term, so that I randomly draw from the actual change in %SC between 1991 and 2001 when I conduct my simulations.

Based on these assumptions, I use a simple simulation method to construct reelection eligibility $E_{pt}$. I describe this process in detail in Appendix A, but in brief, I create simulated data for %SC in 2001 in each GP by taking the true 1991 census data on %SC for each GP and adding a random error term. The error term is drawn from the 27 actual changes in GP %SC between the 1991 and 2001 census. Using the simulated %SC data, I assign simulated reservations according to the rules discussed in Section 2.2. After performing 10,000 of these simulations, I set $E_{pt}$ for the first rotation period to be the fraction of simulations in which GP $p$ was not reserved. I use a similar method for the second rotation period, again drawing error terms from the pool of changes between 1991 and 2001 (since data from the 2011 census was not available at the time of writing).

My approximation of how the GP president determines his probability of reelection eligibility is clearly very simplistic, and the values of $E_{pt}$ are subject to considerable error. However, my empirical results are qualitatively unchanged if I use a binary variable $E_{pt}^{high}$ in place of $E_{pt}$, where $E_{pt}^{high} = 1$ if $E_{pt} \geq 0.5$. My results are therefore driven by broad differences in eligibility rather than small differences, and my simplistic simulation method is likely to be broadly accurate.

I exclude SC-reserved GP-rotation periods from my analysis due to the difficulty of coding $E_{pt}$ for those clusters. Technically, SC presidents may be elected in unreserved GPs, so that an SC president (or a member of his household) will always be eligible for reelection, and thus $E_{pt} = 1$; however, this rarely happens in practice. Including these clusters with $E_{pt} = 1$ strengthens my results.

Table 1 supports the exogeneity of $E_{pt}$ by showing that there are no significant differ-
ences between the characteristics of SHGs in GPs with $E_{pt} > 0.5$ and the characteristics of those in GPs with $E_{pt} < 0.5$. The only exception is that the average fraction of SC members in each SHG in 2005 and 2010 is higher when $E_{pt}$ is low, because having a low $E_{pt}$ is correlated with having a high %SC in the GP. I will include a specification to control for this possible confounding variable.

Valuation of aid $V_{gpt}$

In order to test my predictions empirically, I construct measures of SHG-level valuation of two different forms of government aid: housing assistance and guaranteed employment. I will use these as my measures of $\nu_A$, the valuation of aid.

I use the demographic characteristics of the sampled households to measure the SHG valuation of guaranteed employment aid. As demonstrated in figure 4, the most common users of NREGS are women between 18 and 70 years old with 8 or fewer years of education. This makes intuitive sense: these individuals are likely to be healthy enough to perform manual labor and relatively unlikely to have better employment opportunities. I choose 8 years of education as my cutoff because it is the threshold between elementary and secondary education, as defined by the 2009 Right to Education Act (Government of India 2009), as well as the median level of education for 18-70 year old women in my data in 2010. My results are sensitive in magnitude and significance to using alternate cutoffs, such as 5 years or 10 years (the 25th percentile and 75th percentile, respectively), but the signs remain the same.

I use two measures of valuation: the fraction of individuals sampled in the SHG who live in households with 1 or more such women, and the fraction who live in households with 2 or more such women. The first serves as a proxy for how much the SHG values the first 100 days of NREGS provided per household, while the second measures how
much the SHG values values provision of NREGS beyond 100 days. Because the GP president is charged with ensuring that households do not exceed the 100 day limit on NREGS, he can very easily allow households to “double-dip” by having two members each work 100 days by simply turning a blind eye; however, it may be more difficult for him to deny households use of NREGS up to 100 days. In terms of my model, it may be that the president’s action of “giving aid” actually corresponds to “allowing the household a 100 day per member cap instead of a 100 day total cap”, so that the proper measure of aid valuation is the value of more than 100 days of NREGS, not the value of up to 100 days of NREGS. I will therefore use the 2+ measure for most of the empirical work, and only use the 1+ measure as a robustness test (as described in section 4.5).

As a measure of how the much the SHG collectively values housing aid, I use the fraction of individuals sampled in the SHG who live in a thatch roof dwelling. Individuals reported that government housing aid came partially in the form of materials in 63% of instances; certainly in these cases, the aid will be more valuable to those with low-quality houses than those with higher-quality houses. I use thatch roof as an indicator of low housing quality, as the Tamil Nadu state government housing program KVVT specifically notes that “all huts with thatched roof irrespective of the type of wall of the huts, will be taken up for conversion into permanent houses” (Tamil Nadu Rural Development & Panchayat Raj Department 2010b).

Figure 5 shows the average fraction of thatch roof dwellings per SHG over time and the average fraction of households with 1+ and 2+ low education women per SHG. As should be expected, the fraction of thatch roof dwellings is decreasing over time (due to government intervention and general economic growth), while the fraction of low education women remains more or less constant.
**Outcome variables**

The four outcomes under consideration are housing aid given to SHG members, NREGS aid given to SHG members, political support given to the president by SHG members, and lending by banks to SHG members. For housing aid, I use the value of housing aid received by each sampled household in each year, averaged across all sampled households in the SHG. For NREGS aid, I use the total number of person-days of NREGS attended by members of each sampled household in each year, again averaged across sampled households in the SHG. For political support, I use the average hours spent by SHG members in political activities (such as attending rallies or speeches, or canvassing) that were planned by the GP president, supported the GP president, or which the GP president asked them to attend, in each year. For bank lending, I use annual bank lending (in thousands of Rs.) to each SHG in each year.

All values are self-reported. While the respondents typically had access to SHG record books, which helped them recall details of loans, the respondents undoubtedly made mistakes in giving the details of housing aid received and political support given over the past 14 years. For this reason, the analysis of NREGS should be given more weight, because the data comes from a more recent time period, and it should also be easier to respondents to recall the days of NREGS she and her family attended than to estimate the value of housing aid her household received.

Figure 6 shows the change in housing aid and NREGS use over time. Housing aid is low and roughly constant from 1997-2009, except for a spike in 1998 that is likely due to the small sample size (as shown in figure 3), then experiences a jump in 2010 with the introduction of KVVT. NREGS usage increases steadily from 2008-2010 as the program expands. Figure 7 shows the change in political support and credit. Political support increases in election years (2006) and in the year before the election.
year (2005, 2010), while credit is expanding rapidly over the survey period. Note that this is average credit per SHG, and that the number of SHGs also increased rapidly over this period, so that the total credit is expanding even faster.

1.4.3 Empirical strategy

Using the valuation variables described above, I test the key prediction of my model: the effect of an increase in president’s support valuation on the outcome variables will increase as the SHG’s valuation for aid increases.

Using $E_{pt}$ as my measure of the president’s support valuation and $V_{gpt}$ as my measures of the SHG’s aid valuation, and assuming that $E_{pt}$ is exogenous, I can test these predictions by estimating a simple interacted OLS regression:

$$Y_{gpt} = \beta_0 + \beta_1 V_{gpt} + \beta_2 E_{pt} + \beta_3 E_{pt} \ast V_{gpt} + \mu_t + \epsilon_{gpt} \quad (1.4.1)$$

where the outcome $Y_{gpt}$ is either housing aid received, NREGS used, political support given, or bank lending to group $g$ of GP $p$ in year $t$, $V_{gpt}$ is a measure of the group’s valuation of aid as described above, and $E_{pt}$ is the probability that the GP president will be eligible for reelection in the next rotation period.

The key empirical test is to show that the coefficient on the interaction term $E_{pt} \ast V_{gpt}$ is positive. Due to the inclusion of this interaction term, the coefficient on eligibility $E_{pt}$ should be interpreted as the effect on the outcome of an increase in eligibility when the valuation of aid is 0. However, because the measures of aid exposure I use (low education adult women and thatch roof huts) are very likely to be correlated with unobservable drivers of the outcomes, such as poverty, the coefficients on aid exposure $V_{gpt}$ will be biased and do not have a causal interpretation.
Since all variables change substantially over time, I include year fixed effects in all specifications. I also include specifications with GP fixed effects to increase power and to allow for the possibility that GPs may have different aid budgets:

\[ Y_{gpt} = \beta_0 + \beta_1 V_{gpt} + \beta_2 E_{pt} + \beta_3 E_{pt} \ast V_{gpt} + \mu_t + \chi_p + \epsilon_{gpt} \quad (1.4.2) \]

In specifications where \( V_{gpt} \) is the valuation of NREGS, and I must thus restrict my sample to 2008-2010, there will only be one value of eligibility for each GP. For these specifications, eligibility will be collinear with the GP fixed effects and thus I do not report it in the results table. I also use GP-year fixed effects, which fully control for differential changes over time between GPs:

\[ Y_{gpt} = \beta_0 + \beta_1 V_{gpt} + \beta_2 E_{pt} \ast V_{gpt} + \theta_{pt} + \epsilon_{gpt} \quad (1.4.3) \]

Note that, in this case, eligibility will always be collinear with the GP-year fixed effects and so eligibility will always be excluded from the results table.

I include two more specifications to deal with concerns that eligibility may be endogenous. Since eligibility is determined by factors including the \( \%SC \) in GP \( p \) as of the last census, one legitimate concern is that the coefficients on eligibility and the interaction in equations 14-16 will actually be picking up some effect of \( \%SC_{pt} \) and its interaction with aid valuation \( \%SC_{pt} \ast V_{gpt} \). I therefore include a specification that controls for those variables:

\[ Y_{gpt} = \beta_0 + \beta_1 V_{gpt} + \beta_2 E_{pt} + \beta_3 \%SC_{pt} + \beta_4 \%SC_{pt} \ast V_{gpt} + \mu_t + \chi_p + \epsilon_{gpt} \quad (1.4.4) \]

Another concern is that the SHGs in high eligibility clusters differ systematically from SHGs in low eligibility clusters; for instance, SHGs in low eligibility clusters are more likely to be SC. I therefore include a specification with a vector of SHG-level controls.
$X_{gpt}$:

$$Y_{gpt} = \beta_0 + \beta_1 V_{gpt} + \beta_2 E_{pt} + \beta_3 E_{pt} \times V_{gpt} + \gamma X_{gpt} + \mu_t + \chi_p + \epsilon_{gpt} \quad (1.4.5)$$

where $X_{gpt}$ includes SHG size, fraction of members in fieldworker households, fraction of members who are SC, and fraction of members in households with a member that has 12 or more years of education.

### 1.4.4 Results

The results from equations 7-9 for NREGS valuation and housing aid valuation are presented in tables 2 and 3. The results for NREGS valuation are very consistent with my key theoretical prediction: for all three outcomes, the interaction coefficient is large, positive, and significant. In the regressions using housing aid valuation, the interaction coefficient is large and positive for housing aid and credit, but there is no effect on support and the effect on credit is only 95% significant when I include year and GP fixed effects. This may be because housing aid is given much less frequently than NREGS, lowering the power of the statistical tests, and in addition problems of recall may be exacerbated for housing aid and for the more distant past as discussed above. These results are also visualized in figures 8-10 (for NREGS) and 11-13 (for housing aid).

The results from equations 10-11 are presented in tables 4 and 5. For the NREGS specifications, including the $\%SC$ and its interaction or the SHG controls has only a negligible effect on the magnitude or significance of the interaction coefficient for any outcome. The housing aid specifications are also mostly robust to these inclusions, however the interaction coefficient halves in magnitude and becomes insignificant in the specification including $\%SC$, as shown in column 5 of table 5. However, it remains
positive and is still quite large relative to average credit.

The effect of the interaction on credit is extremely large. In an SHG where all members live in households with two or more low-educated women, going from an ineligible president to a fully eligible one increases the bank credit received by the SHG by Rs.57,690 per year in my specification with year and GP fixed effects. This is roughly equal to the overall average annual bank credit received by SHGs over the period. Another way to look at it is that, with an average SHG size of 15.2 members, each affected SHG household receives Rs.3,795 more credit on average each year. This increase is equal to roughly 8% of the average rural household income in India in 2005 of Rs.48,097 (Shukla 2010). The differential increase in credit caused by the same change in presidential eligibility for an SHG where all members live in huts as compared to an SHG where no members live in huts is estimated to be Rs.20,920 in my preferred specification, corresponding to Rs.1,376 more credit per household, or about 3% of income.

If the aid is being used to induce the SHGs to repay (as is the case in my model), the increase in aid should be comparable in magnitude to the increase in credit; if the effect on aid were much smaller than the effect on credit, it would be implausible that the aid promised would be sufficient to induce the SHG to repay the loan. The average annual increase in NREGS usage per household that results from a president going from completely ineligible to completely eligible for an SHG where all members live in households with two or more low-educated women is 22.2 days. Multiplied by the NREGS daily wage of Rs.80 in 2008 and 2009, the average increase in income per household is Rs.1,776, a significant fraction of the Rs.3,795 increase in SHG credit. Given that the increased access to NREGS may be sustained over several years, this effect could easily be of similar magnitude to the effect on lending. Similarly, the differential increase in housing aid for an all-hut SHG versus a no-hut SHG from
switching from an ineligible president to an eligible one is Rs.1,250 per household, roughly equal to the increase in credit of Rs.1,376. It makes sense that the ratio of aid to credit is higher for housing aid than for NREGS, since housing aid is a one-time transfer rather than a flow of income (as is NREGS). The magnitude of my results is thus quite consistent with the assumptions of my model.

My weakest results appear to come when I use political support as the outcome variable. For the housing aid valuation specifications, I find that the interaction coefficient is completely insignificant in table 3, and it actually becomes negative (although still insignificant) in the specifications of table 5. Even in the NREGS valuation specifications, the increase in political support that results from a president going from completely ineligible to completely eligible for an SHG where all members live in households with two or more low-educated women is only 14.4 minutes per member per year. This would appear to be a very small price to pay, given the large payoff in aid and credit discussed above. However, what is important in my model is not how much it costs the SHG to give support, but rather how much the president values that support. Public support could not only be directly valuable to the president, but also a sign that SHG members (and their families) are more likely to vote for the president. It is then more relevant to consider the increase in political support relative to average levels of support, and in that light the effect is quite large, as SHG members on average spent only 6.6 minutes per year supporting the president politically between 2008 and 2010.

The most interesting and best-identified results come from the interaction coefficient, but the coefficients on eligibility and valuation deserve mention as well. The coefficient on eligibility, which can be interpreted as the effect of eligibility when the SHG has the minimum possible valuation for aid, is never statistically significant at the 95% level. This is roughly consistent with my model, because if the president truly had nothing
to offer the SHG, then he would have no way of motivating the SHG to support him or to repay their loans. While the coefficient on valuation cannot be causally interpreted, the fact that higher valuation is associated with a significant decrease in credit suggests these characteristics are indeed picking up the effect of poverty as I suggested above. One surprising result is that there is a robust negative correlation between higher housing aid valuation and lower levels of housing aid. While this does not contradict my model, intuitively one would expect that a program intended to upgrade huts would succeed at distributing more aid to households living in huts than to households living in houses, even under an indifferent president. The fact that it does not may reflect just how much personal discretion the president has over the allocation of this aid.

1.4.5 Robustness tests

There are two other competing theories that could explain the pattern of results showed above. The first competing theory is that the presidents that are likely to face reelection will do a better job of distributing aid to the households who can benefit most from it, and that, as a consequence of receiving aid, household income increases and this directly increases creditworthiness. I can test this theory by using “fraction of members in households with one or more low education adult women” as my measure of NREGS valuation $V^{N'}_{gpt}$:

$$
Y_{gpt} = \beta_0 + \beta_1 V^{N'}_{gpt} + \beta_2 E_{pt} + \beta_3 E_{pt} \ast V^{N'}_{gpt} + \mu_t + \epsilon_{gpt}
$$

(1.4.6)

Having one potential NREGS user in the household should increase the household’s income upon the introduction of NREGS, while having two potential NREGS users will increase the household’s income further only if the president allows the household
to exceed the legal limit of 100 days per household. This allows me to distinguish the straight effect of an increase in income from the effect of increase in income subject to the president’s discretion. While I do not have a similar test for housing aid, it is a one-time transfer that is likely to result in decreased eligibility (if, as intended, the household uses the aid to upgrade their dwelling) rather than a continual stream of benefits for which the household will remain eligible. This makes it unlikely that an increase in housing aid will substantially raise the SHG’s ability to repay loans.

The results of equation 12 are reported in table 6, and are not consistent at all with the “increased income” theory. There is a large increase in NREGS usage among SHGs that have many households with one or more likely NREGS user, and this does not change with the president’s eligibility; however, there is no corresponding increase in credit, but rather an (insignificant) decrease. This makes it highly unlikely that my previous results have been caused by a mechanical relationship between NREGS aid and creditworthiness.

Another possibility is that the presidents have the ability to force the banks to lend, and that the president believes that constituents with high valuations of aid are marginal voters who can be convinced to vote for him if he forces the bank to give them additional credit. I conduct two tests to distinguish this theory from my theory. The first test is to use loan delinquency $D_{gpt}$ as my outcome:

$$D_{gpt} = \beta_0 + \beta_1 V_{gpt} + \beta_2 E_{pt} + \beta_3 E_{pt} * V_{gpt} + \mu_t + \epsilon_{gpt} \quad (1.4.7)$$

While default does not occur in the equilibrium of my theoretical model, obviously in reality some borrowers default on their loans or have other difficulty repaying; in my data, about 4% of completed reported late payments, low payments, or default. In my model, the loans given out to constituents with high valuations of aid under
presidents with high eligibility for reelection cannot have higher levels of delinquency, since these groups have an additional incentive to repay. However, if the presidents are pressuring the banks to increase lending, the marginal borrowers must be the worst credit risks with high delinquency rates, and I should observe that the interaction coefficient will be positive.

The results of equation 13 are reported in table 7: the interacted effect is consistently large and negative but insignificant. This is consistent with my model but not the alternative.

I also test the assumption that constituents with high valuations of aid are marginal voters. If the identity of the marginal voters is not changed by the introduction of NREGS, then a president with high eligibility should be increasing credit to individuals with high valuations of NREGS aid even before the introduction of NREGS. I then simply rerun equations 7 and 8 for the pre-NREGS period. Under my model, I would expect to see that the interaction of president’s eligibility and SHG’s NREGS valuation has no effect on support or credit, and under this alternate model I would expect to see that the interaction increases credit and support.

These results are reported in table 8. The interaction coefficient is insignificant and does not follow the same pattern as the results of equations 7-8 (shown in table 3), which again is consistent with my model but not with the alternative.

1.5 Conclusion

This paper has proposed a new channel by which a politician may intervene in the credit market without pressuring banks to increase or redirect lending. Instead, the politician can make a constituent into a more attractive credit risk by making her
receipt of private government aid conditional on her loan repayment; this allows the constituent to credibly commit to repaying her loan in much the same manner as collateral. However, the politician’s offer to deliver benefits is itself only credible if the politician values the constituent’s support. I have shown evidence of this dynamic with novel data from a survey of microcredit groups in South India: a constituent with high aid valuation receives more aid, spends more time supporting the politician and his political allies, and receives more credit than a constituent with low valuation, but only when the politician is likely to be eligible for reelection. With additional robustness checks, I have ruled out the possibility that the politician is applying pressure to the banks to increase lending or that receiving aid directly increases the income of the constituent and thus her capacity to receive credit.

These findings show that political involvement in the credit market could be beneficial not only for the borrower and the politician, but for the bank as well; this parallels Maurer and Haber (2007), which showed that loans to firms with close associations to the lending bank (so-called ‘related lending’) performed as well as other loans in late 19th century Mexico, and runs contrary to the three prevailing views of government lending. And while my results do not permit me to perform welfare calculations or make claims regarding the efficiency of this brokered lending, it is notable that the households which received additional credit were those with low-quality housing and with multiple women with low levels of education, characteristics which may be associated with poverty and inability to access alternate forms of credit.

Finally, my model of the politician as broker could have applications beyond the context of low-collateral credit markets. The interdependence of politician and constituent could allow the politician to play an informal role in any relationship that requires the constituent or politician to make a credible commitment. This is especially true at the local level, where the politicians have more direct contact with
constituents and the party apparatus may be weaker, and in developing countries, where contract enforcement is more difficult and costly. Shedding light on the hidden role of local politicians could provide social scientists and policymakers with novel insights into these vital but opaque areas of the economy.
Figure 1.1: Stage games

Panel A: Lending Game

<table>
<thead>
<tr>
<th>R</th>
<th>L</th>
<th>Bank</th>
<th>NL</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>$\nu_L(1+r), r$</td>
<td>0,0</td>
<td></td>
</tr>
<tr>
<td>NR</td>
<td>L</td>
<td>$\nu_L-1$</td>
<td>0,0</td>
</tr>
</tbody>
</table>

Panel B: Patronage Game

<table>
<thead>
<tr>
<th>A</th>
<th>Politician</th>
<th>NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>$\nu_A-1, \nu_S-1$</td>
<td>-1, $\nu_S$</td>
</tr>
<tr>
<td>NS</td>
<td>$\nu_A-1$</td>
<td>0,0</td>
</tr>
</tbody>
</table>

Figure 1.2: Lending region

Lending under term-limited politician or reelectable politician

$\frac{1 + r}{\nu_L}$

Additional lending under reelectable politician

$\frac{1}{\nu_A + \nu_L - [1 + r]}$

$\frac{[1 + r] - [\nu_A - 1]}{\nu_L}$
Figure 1.3: Number of SHGs over time

Figure 1.4: Probability of NREGS use by age, sex, and education
Figure 1.5: SHG valuation of aid over time

![Graph showing the average fraction of SHG members over time for different categories of women and Thatch Roof.](image)

Figure 1.6: SHG aid received over time

![Graph showing the average housing aid and NREGS use over time.](image)
Figure 1.7: SHG political support and borrowing over time

Figure 1.8: SHG NREGS use by electability and NREGS valuation
Figure 1.9: SHG support to president by electability and NREGS valuation

Figure 1.10: SHG bank lending by electability and NREGS valuation
Figure 1.11: SHG housing aid by electability and housing aid valuation

Figure 1.12: SHG support to president by electability and housing aid valuation
Table 1.1: Summary statistics

<table>
<thead>
<tr>
<th>SHG characteristic</th>
<th>All GPs</th>
<th>GPs with E&lt;0.5</th>
<th>GPs with E&gt;0.5</th>
<th>t-stat of difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHG size</td>
<td>15.08</td>
<td>15.30</td>
<td>15.01</td>
<td>1.18</td>
</tr>
<tr>
<td>SHG age</td>
<td>3.86</td>
<td>3.99</td>
<td>3.83</td>
<td>0.57</td>
</tr>
<tr>
<td>SC members</td>
<td>0.21</td>
<td>0.32</td>
<td>0.18</td>
<td>4.00</td>
</tr>
<tr>
<td>Female members</td>
<td>0.93</td>
<td>0.93</td>
<td>0.93</td>
<td>-0.19</td>
</tr>
<tr>
<td>Fieldworker HH members</td>
<td>0.42</td>
<td>0.44</td>
<td>0.41</td>
<td>1.20</td>
</tr>
<tr>
<td>Average member age</td>
<td>38.51</td>
<td>38.72</td>
<td>38.45</td>
<td>0.46</td>
</tr>
<tr>
<td>Average member years of schooling</td>
<td>6.18</td>
<td>6.25</td>
<td>6.16</td>
<td>0.38</td>
</tr>
<tr>
<td>Members in thatch roof</td>
<td>0.35</td>
<td>0.37</td>
<td>0.35</td>
<td>0.94</td>
</tr>
<tr>
<td>Members with 2+ low ed. women</td>
<td>0.18</td>
<td>0.19</td>
<td>0.18</td>
<td>0.46</td>
</tr>
</tbody>
</table>

SHG member data from 2010.

"Fieldworker HH" indicates that the primary earner of the member's household is an unlanded agricultural worker.

Size is number of members in 2010.
Table 1.2: Regression results for NREGS valuation

<table>
<thead>
<tr>
<th>Subset:</th>
<th>NREGS Usage</th>
<th>Support to President</th>
<th>Annual SHG Credit</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2008-2010</td>
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<td>(1)</td>
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<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>President Eligibility</td>
<td>19.90</td>
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<td>0.22</td>
</tr>
<tr>
<td>X NREGS Valuation (2+)</td>
<td>(8.93)</td>
<td>(6.70)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>NREGS Valuation (2+)</td>
<td>-4.49</td>
<td>-2.70</td>
<td>-0.05</td>
</tr>
<tr>
<td>President Eligibility</td>
<td>(4.48)</td>
<td>(3.66)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>(5)</td>
<td>(6)</td>
<td></td>
<td></td>
</tr>
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<td>YES</td>
<td>YES</td>
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<td>YES</td>
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<tr>
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<td>YES</td>
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<td>YES</td>
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<tr>
<td>(7.33)</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>(0.30)</td>
<td>(0.40)</td>
<td>(0.05)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>(11.08)</td>
<td>(12.97)</td>
<td>(0.05)</td>
<td>(0.11)</td>
</tr>
<tr>
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<td>1889</td>
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<tr>
<td>Number of clusters</td>
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<td>22</td>
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</tbody>
</table>

Standard errors are robust to heteroscedasticity and clustered residuals within each GP-rotation period.

Table 1.3: Regression results for housing aid valuation

<table>
<thead>
<tr>
<th>Subset:</th>
<th>Housing Aid</th>
<th>Support to President</th>
<th>Annual SHG Credit</th>
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</thead>
<tbody>
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<td></td>
<td>1997-2010</td>
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<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>President Eligibility</td>
<td>1.40</td>
<td>1.23</td>
<td>0.05</td>
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<tr>
<td>X Housing Aid Valuation</td>
<td>(0.48)</td>
<td>(0.44)</td>
<td>(0.11)</td>
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<td>Housing Aid Valuation</td>
<td>-0.87</td>
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<td>0.01</td>
</tr>
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<td>President Eligibility</td>
<td>(0.36)</td>
<td>(0.34)</td>
<td>(0.07)</td>
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<tr>
<td>(5)</td>
<td>(6)</td>
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<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
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<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>(0.30)</td>
<td>(0.40)</td>
<td>(0.05)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>(11.08)</td>
<td>(12.97)</td>
<td>(0.05)</td>
<td>(0.11)</td>
</tr>
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</table>

Standard errors are robust to heteroscedasticity and clustered residuals within each GP-rotation period.
### Table 1.4: Robustness checks for NREGS valuation

<table>
<thead>
<tr>
<th>Subset:</th>
<th>President Eligibility</th>
<th>X NREGS Valuation (2+)</th>
<th>%SC in GP</th>
<th>NREGS Valuation (2+)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30.36</td>
<td>21.40</td>
<td>0.25</td>
<td>51.85</td>
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<tr>
<td></td>
<td>(7.36)</td>
<td>(7.45)</td>
<td>(0.15)</td>
<td>(15.63)</td>
</tr>
<tr>
<td></td>
<td>70.52</td>
<td>-</td>
<td>0.02</td>
<td>-55.81</td>
</tr>
<tr>
<td></td>
<td>(41.63)</td>
<td>-</td>
<td>(0.63)</td>
<td>(70.60)</td>
</tr>
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<td></td>
<td>-21.31</td>
<td>-6.57</td>
<td>-0.08</td>
<td>-15.76</td>
</tr>
<tr>
<td></td>
<td>(11.39)</td>
<td>(4.62)</td>
<td>(0.18)</td>
<td>(20.76)</td>
</tr>
<tr>
<td>Year Fixed Effects</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>GP Fixed Effects</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Additional Controls</td>
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<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Adjusted R²</td>
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<td>0.58</td>
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<td>0.30</td>
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<td>Number of clusters</td>
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<td>22</td>
<td>22</td>
<td>22</td>
</tr>
</tbody>
</table>

Standard errors are robust to heteroscedasticity and clustered residuals within each GP-rotation period. Controls include SHG size, fraction of members in fieldworker HHs, fraction of SC members, and fraction of members in HHs where earner has 12+ years of education.

### Table 1.5: Robustness checks for housing aid valuation

<table>
<thead>
<tr>
<th>Subset:</th>
<th>President Eligibility</th>
<th>X Housing Aid Valuation</th>
<th>%SC in GP</th>
<th>Housing Aid Valuation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.67</td>
<td>1.23</td>
<td>-0.09</td>
<td>-0.09</td>
</tr>
<tr>
<td></td>
<td>(0.51)</td>
<td>(0.43)</td>
<td>(0.12)</td>
<td>(0.15)</td>
</tr>
<tr>
<td></td>
<td>2.62</td>
<td>-</td>
<td>-0.56</td>
<td>-67.13</td>
</tr>
<tr>
<td></td>
<td>(1.72)</td>
<td>-</td>
<td>(0.51)</td>
<td>(37.17)</td>
</tr>
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<td></td>
<td>-1.54</td>
<td>-0.88</td>
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<td>3.16</td>
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<td>(0.60)</td>
<td>(0.35)</td>
<td>(0.15)</td>
<td>(12.41)</td>
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<td></td>
<td>-0.67</td>
<td>-0.55</td>
<td>-0.15</td>
<td>25.07</td>
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<td>(0.42)</td>
<td>(0.36)</td>
<td>(0.12)</td>
<td>(14.91)</td>
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<td></td>
<td>-1.46</td>
<td>-</td>
<td>0.63</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>(2.26)</td>
<td>-</td>
<td>(1.35)</td>
<td>(230.40)</td>
</tr>
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<td>Year Fixed Effects</td>
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<td>YES</td>
<td>YES</td>
<td>YES</td>
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<tr>
<td>GP Fixed Effects</td>
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<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Additional Controls</td>
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<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Adjusted R²</td>
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<td>0.09</td>
<td>0.02</td>
<td>0.27</td>
</tr>
<tr>
<td>Number of observations</td>
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<td>3714</td>
<td>3718</td>
<td>3714</td>
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<tr>
<td>Number of clusters</td>
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<td>45</td>
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</tbody>
</table>

Standard errors are robust to heteroscedasticity and clustered residuals within each GP-rotation period. Controls include SHG size, fraction of members in fieldworker HHs, fraction of SC members, and fraction of members in HHs where earner has 12+ years of education.
Table 1.6: Falsifiability test using alternate measure for NREGS

<table>
<thead>
<tr>
<th>Subset:</th>
<th>NREGS Usage</th>
<th>Support to President</th>
<th>Annual SHG Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Days/Member HH</td>
<td>Hrs./Member</td>
<td>Rs. Thousands</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>President Eligibility</td>
<td>3.96</td>
<td>1.14</td>
<td>0.07</td>
</tr>
<tr>
<td>X NREGS Valuation (1+)</td>
<td>(9.27)</td>
<td>(9.33)</td>
<td>(0.1)</td>
</tr>
<tr>
<td>NREGS Valuation (1+)</td>
<td>18.34</td>
<td>18.47</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>(6.86)</td>
<td>(5.89)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>President Eligibility</td>
<td>5.81</td>
<td>-</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>(8.07)</td>
<td>-</td>
<td>(0.05)</td>
</tr>
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</table>

Year Fixed Effects: YES YES YES YES YES YES
GP Fixed Effects: NO YES NO YES NO YES
Adjusted R^2: 0.43 0.57 0.05 0.06 0.23 0.30
Number of observations: 1885 1885 1885 1885 1885 1885
Number of clusters: 22 22 22 22 22 22

Standard errors are robust to heteroscedasticity and clustered residuals within each GP-rotation period.

---

Table 1.7: Delinquency regression results

<table>
<thead>
<tr>
<th>Subset:</th>
<th>Late Repayment, Low Repayment, or Default Rate per SHG-year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008-2010 with lending</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>President Eligibility</td>
<td>-0.07</td>
</tr>
<tr>
<td>X NREGS Valuation (2+)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>President Eligibility</td>
<td>-</td>
</tr>
<tr>
<td>X Housing Aid Valuation</td>
<td>-</td>
</tr>
<tr>
<td>NREGS Valuation (2+)</td>
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</tr>
<tr>
<td>Housing Aid Valuation</td>
<td>(0.07)</td>
</tr>
<tr>
<td>President Eligibility</td>
<td>-</td>
</tr>
<tr>
<td>Year Fixed Effects</td>
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</tr>
<tr>
<td>GP Fixed Effects</td>
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<tr>
<td>Adjusted R^2</td>
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<td>Number of clusters</td>
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Standard errors are robust to heteroscedasticity and clustered residuals within each GP-rotation block.
Table 1.8: Pre-2008 regression results

<table>
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<tr>
<th>Subset:</th>
<th>President Eligibility</th>
<th>X NREGS Valuation (2+)</th>
<th>NREGS Valuation (2+)</th>
<th>President Eligibility</th>
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</thead>
<tbody>
<tr>
<td>(1)</td>
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<td>(0.18)</td>
<td>-0.11</td>
<td>0.18</td>
</tr>
<tr>
<td>(2)</td>
<td>0.20</td>
<td>(0.26)</td>
<td>-0.20</td>
<td>-</td>
</tr>
<tr>
<td>(3)</td>
<td>-1.06</td>
<td>(9.89)</td>
<td>11.36</td>
<td>6.18</td>
</tr>
<tr>
<td>(4)</td>
<td>-9.32</td>
<td>(7.59)</td>
<td>7.26</td>
<td>-</td>
</tr>
</tbody>
</table>

Adjusted R²: 0.01
Number of observations: 1328
Number of clusters: 23

Support to President
Hrs./Member
Annual SHG Credit
Rs. Thousands
1997-2006

Standard errors are robust to heteroscedasticity and clustered residuals within each GP-rotation block.

1.6 Appendix: Simulation method for generating $E_{pt}$

I use data on GP populations in 1991 and 2001 perform a simple simulation of GP-level population dynamics and use the result to construct a variable $E_{pt}$, the probability that the current president of GP $p$, or his or her spouse, will be eligible for reelection in the next rotation period.

In the first step, I used census data on the %SC members in each GP $p$ for 1991 (labelled $S_{p,1991}$) and 2001 ($S_{p,2001}$) and found the difference between them ($\Delta_{1991,p} = S_{p,2001} - S_{p,1991}$). I also used a binary variable indicating SC reservation status for the first reservation period, $R_{p,1997}$. In each simulation $i$, I constructed a counterfactual 2001 %SC for each GP, $\hat{S}_{p,2001}^i = S_{p,1991} + \hat{\Delta}_{1991,p}^i$, where $\hat{\Delta}_{1991,p}^i = \Delta_{1991,r}$ for a randomly selected $r$. Since there were 5 GPs that were SC-reserved for the second
reservation period, I constructed a counterfactual reservation variable \( \hat{R}_{p,2007} \), which took value 1 if \( \hat{S}_{p,2001} \) was among the top 5 \( \hat{S}_{p,2001} \) that were not SC-reserved in 1997, and 0 otherwise. In other words, I created a counterfactual for 2001 by taking the value for 1991 and then adding a random error term, which was distributed the same as were the GP population changes between 1991 and 2001. I then assigned simulated reservation status on the basis of those population changes.

I performed this simulation 10,000 times, and use the results to set \( E_{pt} \) for the first reservation period:

\[
E_{pt} = \sum_i \frac{1 - \hat{R}_{p,2007}}{10000} \text{ if } t < 2006 \text{ and } R_{p,1997} = 0
\]

(1.6.1)

In the second step, I used a similar procedure again to find \( E_{pt} \) for the second reservation period. Since the 2011 census data was not yet available at the time this was written, I assumed that the dynamics between 2001 and 2011 were the same as the dynamics between 1991 and 2001, and set \( \hat{\Delta}_{2001,p} = \Delta_{1991,r} \) for a randomly selected \( r \). I then generated \( \hat{S}_{p,2011} = S_{p,2001} + \hat{\Delta}_{2001,p} \), and constructed the counterfactual reservation variables \( \hat{R}_{p,2017} \) to take value 1 if \( \hat{S}_{p,2011} \) was among the top 5 \( \hat{S}_{p,2011} \) that were not SC-reserved in 1997 or 2007, and 0 otherwise. I then used those results to set \( E_{pt} \) for the second reservation period:

\[
E_{pt} = \sum_i \frac{1 - \hat{R}_{p,2017}}{10000} \text{ if } t >= 2007 \text{ and } R_{p,1997} = R_{p,2007} = 0
\]

(1.6.2)
Chapter 2

The Perverse Effects of External Aid on Accumulating Saving and Credit Associations

2.1 Introduction

Accumulating Savings and Credit Associations (ASCAs, sometimes also referred to as Village Savings and Loan Associations or VSLAs) are a widespread and growing semiformal financial institution in developing countries. In an ASCA, members gather each week or month and save money in a collective fund. That money is then used to make short term loans back to the members at prespecified interest rates. As members continue to save and borrowing members make repayments, the fund continues to accumulate and lend back to the members. The ASCA is thus, in essence, a miniature credit union. After some time, the ASCA winds down its operations and distributes the accumulated funds back to its members, paying dividends in proportion to each member’s savings.

ASCAs are extremely common in India in the form of government-supported Self-
Help Groups (SHGs). As of 2012, there were more than 55 million SHG members across India (NABARD 2012) and participation continues to expand. Independently, several large international NGOs (including CARE and Oxfam) have begun programs to train and support ASCAs in Africa. These ASCAs had nearly 4 million members as of 2011, and CARE is engaged in a 10-year plan to dramatically expand its program (CARE 2011). However, despite the prevalence of ASCAs across two continents and the official enthusiasm behind them, there have been as yet no attempts by economists to understand the purpose and value of these institutions on a theoretical level. This paper fills that gap by presenting the first formal economic model of ASCAs, focussing on their role as a method of providing members with insurance against negative shocks.

My model builds upon the robust literature on a related institution, the Rotating Savings and Credit Association or ROSCA. ROSCA members contribute to a common pot each meeting and each member receives the entirety of the pot once each cycle; which member receives the pot at each meeting is either determined randomly or by bidding. This simpler and more limited format has been linked with a number of possible purposes and justifications, falling mainly into four categories. First, the ROSCA might facilitate the purchase of indivisible durable goods, as suggested in the initial study of Besley, Loury and Coate (1993). Second, the ROSCA might be a method of dealing with control issues, either self-control issues as in Ambec and Treich (2007) or issues arising from intra-household bargaining as in Anderson and Baland (2002). Third, the bidding ROSCA might serve as a financial intermediary, matching the members with good investment opportunities to other members with excess funds (Eeckhout and Munshi 2010).

Finally, and most relevantly for this paper, studies by Klonner (2003) and Calomiris and Rajaraman (1998) have considered the potential for bidding ROSCAs to provide
“event insurance”. In the formal model of Klonner (2003), ROSCA members are identical \textit{ex ante} but are risk-averse, live multiple periods, and face stochastic income shocks. The bidding ROSCA helps these members smooth risk, since the ROSCA member with the lowest realized income in a period can make an aggressive bid for the pot. In effect, the bidding mechanism allows the member to receive a smaller pot when she has a high marginal utility for consumption rather than a larger pot when she has low marginal utility.

However, while the ROSCA may be helpful in smoothing risk, there are a number of clear flaws with it. First, since the pot is only given to one member each meeting, if there are two members suffering from low income in the same period only one of them will be able to insure herself using the ROSCA. Klonner (2003) discuss how participating in multiple ROSCAs might mitigate this problem, but the solution might require a very large number of concurrent ROSCAs. Second, there are utility losses associated with using the bidding mechanism. The value of bidding is that it allows the ROSCA to identify the member with the highest marginal utility for consumption in the presence of information asymmetries. But since the member who submits the highest bid has the highest marginal utility, \textit{ex ante} the ROSCA members would prefer a system that gives that member a larger rather than smaller pot. Therefore, in the absence of information asymmetries present bidding is a very counterproductive method of allocating the pot, and in small, rural groups with longstanding ties information asymmetries may pose much less of a problem. Despite these shortcomings, Calomiris and Rajaraman (1998) does show some evidence from field studies of ROSCAs suggesting an insurance motive.

One reason to consider the ASCA as a risk-sharing arrangement is that the ASCA format allow members to overcome both of these problems. The additional flexibility of the ASCA means that if there are multiple members who need to borrow at the
same time, lending may be divided between them instead of allocated entirely to one or the other. In addition, the ASCA may deliberately prefix a low interest rate in order to increase the consumption of the (poor, high marginal utility) net borrowers at the expense of the (rich, low marginal utility) net savers.

Of course, the concern with setting a low interest rate is that the credit market within the ASCA will fail to clear, as the demand for loans will outstrip the supply of savings. However, if individuals are identical *ex ante* and the credit market is used solely for risk-smoothing, the optimal interest rate for the ASCA to set will still end up being below the market-clearing interest rate. Glaeser and Scheinkman (1998) derive this theoretical result as a method of understanding and justifying historical usury laws. They consider an environment with incomplete markets in contingent contracts and show that a community of *ex ante* identical members will want to set a usury law that caps interest rates below the market-clearing level as a “primitive” ¹ means of social insurance. The function of the ASCA could be understood as a method for a small group of people to enact a similar “usury law” among themselves.

By putting the ASCA in the context of missing markets in contingent contracts, I place myself in some contradiction with the broad literature and evidence in support of informal insurance stemming from the work of Townsend (1994). These studies assume that members of informal insurance arrangements are capable of engaging in complex, state-contingent transfer contracts, which are a superior method of smoothing against idiosyncratic shocks. However, tests of risk-sharing in developing countries have rejected the hypothesis of full risk-sharing (Townsend 1994, Munshi and Rosenzweig 2009), leading to a literature on constrained optimal informal insurance arrangements (Coate and Ravallion 1993, Ligon, Thomas and Worall 2002). The work of Ligon et al. (2002) suggests that these constrained optimal arrangements do

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¹In the sense of Posner (1980).
involve an element of “quasicredit”, and evidence from Udry (1994) indicates that a flexible lending format can be an important component of risk-sharing.

My model of ASCAs as a method of risk-smoothing insurance highlights three key issues in ASCAs. The first is that due to the low interest rate, there will be an unpriced positive externality from saving. This means that ASCA members will always save less than is socially-optimal. The second is that there is a positive complementarity between a member’s savings rate and the ASCA’s average savings rate. This is because one of the costs of setting a high savings rate in an ASCA is the risk that the member may face a situation where she would like to spend down her ASCA savings, but is unable to because other members have higher priority access to loans. This situation is less likely to occur when total ASCA funds are higher, which creates the complementarity. The combination of these effects can lead to a situation where the members of an ASCA are stuck in an inefficient, low-savings equilibrium.

The third issue builds on this problem of undersaving by examining the effect of external aid from the government or an NGO on the ASCA. Since the cost of defaulting on a loan is confiscation of savings and exclusion from the ASCA, these benefits play a role in determining how much the ASCA is willing to lend to its members. An increase in benefits will allow the ASCA to allocate more credit to the members with the greatest need without risk of default. But this increased “depth” of lending causes a decline in the “breadth” of lending. This causes a decline in the average savings rate, and the ASCA adjusts to the new, inferior equilibrium. And if the increase in benefits is too large, it could cause the equilibrium to disappear entirely. Understanding the potential adverse effects of these external benefits has important policy implications for governments and NGOs, which often view ASCAs as a convenient vehicle for social programs or other forms of aid.

In the next section, I discuss the institution of ASCAs in more detail, including
differences between African ASCAs and the Self-Help Groups prevalent in India. Compared to Self-Help Groups, African ASCAs feature higher interest rates, higher savings rates, and confer lower external benefits. These factors lead me to conclude that my model of ASCAs as a risk-sharing institution is more applicable to the Self-Help Groups, and I focus with an additional focus on the “Self-Help Group” (SHG) version of ASCAs prevalent in India. SHGs are of particular importance because they are by far the most common form of ASCA in the world, and due to the government’s support membership in an SHG may confer many additional benefits. These include access to microcredit loans from banks, invitations to participate in educational and empowerment activities organized by local NGOs, access to government aid programs, and the ability to engage in patron-client relationships with local politicians. This “piling-on” of benefits make it very plausible that SHGs may be suffering from low savings rates for the reasons discussed above.

In section 3, I construct a parsimonious model of the ASCA as a method of risk-sharing. This model uses a number of simplifying assumptions in order to analytically derive the savings complementarity effect and the external aid effect. Section 4 concludes.

2.2 Institutional Background

2.2.1 General Features of ASCAs and SHGs

ASCAs function much like a very small-scale credit union. An ASCA is composed of 10-30 members who live close to each other and who meet regularly (either weekly or monthly) and contribute money to a collective fund. Members of the ASCA then take out short-term uncollateralized loans from the fund and repay them at a fixed
interest rate. In India, loans are typically repaid in 5 or 10 monthly installments at an interest rate of 1 – 3% per month (Sinha et al. 2010, Gadenne and Vasudevan 2007). In Africa, interest rates tend to be higher, up to 5% per month (Maliti 2012) and loan terms tend to be shorter, commonly 3 months or less according to Allen and Panetta (2010). When not lent out, the money is kept in a secure location; in Africa, this is commonly a simple locked box, while the Indian ASCAs typically deposit their excess savings in a joint bank account. In both cases, the demand for loans is high enough that ASCAs typically do not have much excess money.

Interest paid on the loans accumulates in the ASCA’s fund, and when the ASCA breaks up members receive dividends based on their individual contributions. In this way, the “savings” aspect of the ASCA is more like the purchase of an equity stake in the organization. In some African ASCAs, members explicitly purchase shares in the ASCA at each meeting (Maliti 2012, Allen and Panetta 2010). African ASCAs typically operate over a prespecified time-frame of 6 to 18 months (Allen and Panetta 2010), then shut down operations and pay out dividends (although they may then start up again for another cycle). Indian ASCAs, however, do not generally have a fixed end-date, and may operate over the course of many years, either continually accumulating funds or occasionally distributing a portion of the fund to members as dividends. Some of these ASCAs have been in continuous existence since 1992, when the government first began officially supporting the SHG model (Gadenne and Vasudevan 2007).

A common feature of ASCAs is that members are required to save consistently, but ASCAs enforce this with varying degrees of rigidity. Some ASCAs only require that each member save something each week or each month, while others require members to set a fixed quantity of savings each month and adhere to it. Savings rates are generally quite low, around $2 per month in India and $5 per month in Africa. This
means that a five person household living at the poverty line of $1.25 per person per day that contains one ASCA member is saving less than 3% of its income with the ASCA. These low savings rates are consistent with my theory’s predictions of inefficiency. Since savings are treated as shares in the ASCA, it is uncommon for members to withdraw money from their savings unless the ASCA is breaking up or the member is leaving.

Given that the demand for loans among ASCA members frequently outstrips the supply, a natural question is how the ASCA rations credit. According to Bouman (1995):

Loan requests are granted to a prearranged order of priorities that seems almost universal. Emergencies and cases of misfortune ... always range first. Consumption loans have priority over production loans, because the latter are for profit-making and thus considered less urgent.

More recent studies in both Africa (Innovations for Poverty Action 2010) and India (Gadenne and Vasudevan 2007) have confirmed that this loan prioritization continues to hold. It is also consistent with the overwhelming use of ASCA loans for household expenses and health care reported in Premchander, Prameela, Chidambaranathan and Jeyaseelan (2009), as well as my own discussions with ASCA members in India. This motivates my theoretical focus on the ASCA as primarily a method of community-based risk management (Bhattamishra and Barrett 2010) rather than as a source of funds for investment or the purchase of durable goods (unlike the ROSCAs studied by Besley et al. (1993) and Eeckhout and Munshi (2010), respectively). This need-based rationing creates one cap on the amount a member can borrow, since when some members have suffered “misfortunes”, the remaining members will be unable to borrow.
In addition to need-based rationing, another cap on borrowing there is also the practical issue of ensuring that borrowers have sufficient incentive to repay. Since being removed from the ASCA and thus forfeiting her share in the ASCA is the only cost of default for a member, the incentive to repay will naturally be linked to the amount she has saved with the ASCA. The African ASCAs studied by Maliti (2012) put a borrowing limit at two or three times the member’s stake in the ASCA, while Sinha et al. (2010) puts this multiplier at three to four times the borrower’s total savings. This in turn gives ASCA members an additional incentive to save with the ASCA beyond the interest rate offered. The interaction of this incentive with the prioritization of lending plays an important role in my model.

Exclusion from the ASCA may also carry costs beyond the forfeiture of savings. Because ASCAs are relatively complex organizations that require sophisticated bookkeeping (Bhattamishra and Barrett 2010), they are unlikely to emerge without external support and training. This is usually conducted by NGOs, which have recently been very active in organizing ASCAs, as discussed in the African context by Allen and Panetta (2010). These NGOs increasingly use the ASCA as a tool for advancing other development objectives, such as health eduction, business training, and social empowerment. Since losing these benefits is another result of being excluded from the ASCA, a member’s valuation of benefits also plays a role in determining her willingness to If ASCA members value these extra benefits from membership, the threat of losing them creates another incentive for a borrower to repay her loan.
2.2.2 Special Features of the Indian Self-Help Group (SHG)

The Self-Help Group, or SHG\(^2\) is a particular form of ASCA prevalent in India. As I have already discussed, the Indian SHGs exhibit substantially lower interest rates and savings rates as compared to African ASCAs, and also accumulate funds indefinitely instead of paying dividends on a yearly cycle. This may be partially due to several distinctive features of the SHG form stemming from government support and regulation.

Since 1992, the Indian government has supported the SHG as a combination of ASCA and microcredit group. After six months of functioning purely as an ASCA, the SHG as an entity becomes eligible to receive uncollateralized external loans from the traditional banking sector, acting much like the standard joint-liability groups of microcredit. These loans, some of which are heavily subsidized, represent one substantial external benefit for SHG members. This features may also account for the longevity of the SHGs relative to African ASCAs, since banks usually increase the loan sizes offered to repeat borrowers.

Another benefit stems from the SHG’s relationship with NGOs. Since ASCAs are generally too complicated to arise spontaneously, the government provides financial incentives for NGOs to recruit and train SHG members. This has drawn many NGOs which were not initially focussed on financial services into the business of SHG “promotion”, making it more likely that SHGs will receive additional, unrelated benefits through the NGO, such as invitations to attend programs centered around (among other things) health and nutritional education, women’s empowerment, livelihood or business training. These programs usually involve free lunches, and sometimes include payments to participants to compensate them for their time.

\(^2\)These Self-Help Groups should not be confused with the unrelated Self-Help Groups studied by Fafchamps and Ferrara (2012) and Kast, Meier and Pomeranz (2012).
The last source of external benefits comes from the SHGs involvement with the government. As shown in Goldston (2012), SHG members are drawn into patron-client relationships with local politicians, exchanging political support for preferential access to government programs. According to Sinha et al. (2010), “SHG members are brought in in large numbers to political meetings and to meetings organized by the government. During any election, different parties distribute money to SHGs, and SHGs have in turn begun to demand funds and benefits.” In some states, the connection between SHGs and government aid programs is explicit:

Non-members’ perception of benefits from SHG membership included the largely expected ones relating to the benefits of credit for emergencies, bank loans and savings for contingencies. In AP [the Indian state of Andhra Pradesh], an additional element is the access provided by SHG membership to government programmes ... the series of cash grants, subsidies, facilities and services made available to SHG members has resulted in SHG membership being turned into a ticket to the benefits of government schemes. (Sinha et al. 2010), p.35

2.3 Theory

The environment of the model is most similar to that of Glaeser and Scheinkman (1998), a three period model with a continuum of ex ante identical individuals who experience stochastic income shocks and make saving and borrowing decisions. However, in my model the agents (“members”) choose their savings rates in advance, and credit is allocated unevenly among members in order to maximize ex post utility. This causes my model to incorporate a game-theoretic component.
2.3.1 Individual environment

A member lives for three periods. In the initial period 0, she chooses the savings rate $s \geq 0$ that she will save with her ASCA in period 1. In the first consumption period 1, she receives a stochastic income $y \sim f_y$, saves $s$, and then makes a decision to borrow $b \geq 0$ from the ASCA. Her period-1 consumption is her income plus her net borrowing $c_1 = y + [b - s]$. In period 2, she receives non-stochastic income $\mu = E(y)$ and decides whether or not to repay her loan $R \in \{0, 1\}$ at exogenously-determined interest rate $\rho$. If she repays ($R = 1$), she makes her payment of $\rho b$ and receives dividends on her savings $\rho s$. In this case, her period 2 consumption is income minus the interest rate time net borrowing, $c_2 = \mu - \rho [b - s]$. Since period 1 consumption $c_1 = y + [b - s]$, I can express period 2 consumption as a function of period 1 consumption: $c_2 = \mu - \rho [c_1 - y]$. If she chooses to default ($R = 0$), she does not have to repay her loan, but must leave the ASCA and does not receive a dividend on her savings, so period 2 consumption simply $\mu$. Overall, period 2 consumption will be $c_2 = \mu - R [\rho (c_1 - y)]$.

This model embeds a number of non-trivial assumptions. First, members are not able to save or borrow money from sources other than the ASCA; this assumption is consistent with the literature on informal insurance arrangements (Ligon et al. 2002, Munshi and Rosenzweig 2009) and some of the literature on ROSCAs (Klonner 2003). This assumption makes the most sense if ASCA usage is partially motivated by concerns about intrahousehold allocation of resources, as in (Anderson and Baland 2002); in that case, the ASCA may very well be providing a unique opportunity for a (female) member to save and borrow under her own initiative. Second, members choose their savings rate $s$ before the realization of their period 1 income. As discussed above, empirically ASCA members usually pick a fixed amount to save every month, only rarely updating or deviating from that. For members who suffer from problems of self-control, making a public commitment to inflexible savings may itself be valuable.
In the particular case of the Indian SHGs, the government stresses the importance of regular, consistent savings and make it an explicit prerequisite for SHGs that wish to access certain subsidized loans. For these reasons, it makes sense that members fix their savings rate before they know what income shocks will occur in the future.

In each period, the member derives her utility from two sources: consumption \( c \) and "benefits" \( k \). These benefits are conferred by an external source, such as the government or an NGO, and might take the form of preferential treatment by politicians, enhanced access to external loans, or invitations to attend training programs or women’s empowerment seminars as discussed above. Since many of these benefits do not take the form of purchaseable goods, I assume that the value of these benefits are orthogonal to the value of cash, so the member’s preferences can be expressed as a quasilinear utility function \( v(c, k) = u(c) + k \) with \( u' > 0, u'' < 0 \).

A member receives a benefit \( k = \kappa \) at the end of each period that she remains in the ASCA and benefit \( k = 0 \) otherwise. Practically speaking, this means that a member who choose not to repay her debt in period 2 will not receive benefits in that period. This provides net borrowers with some incentive not to default.

Since I will be examining symmetric equilibria with no default, it is worthwhile here to derive the “no-default” borrowing constraint \( \bar{b} \), defined as the largest \( b \) for which the value of repaying the loan \( u(\mu + \rho[s - b]) + \kappa \) is higher than the value of defaulting on the loan \( u(\mu) \). This constraint will be \( \bar{b} = s + \frac{h(\kappa)}{\rho} \), where \( h(k) = \mu - u^{-1}(u(\mu) - k) \).

Combining this with \( c_1 = y + [b - s] \) gives the period 1 no-default constraint on consumption:

\[
c_1 \leq y + \frac{h(\kappa)}{\rho} \tag{2.3.1}
\]

Before proceeding to the group environment, it is useful to construct the “unconstrained optimum” function \( c^*(y) \). This is the level of period-1 consumption that a
member with period 1 income $y$ would choose if she could borrow or lend freely at interest rate $\rho$. Formally, $c^u(y)$ is the solution to:

$$\max_c u(c) + \delta u(\mu + \rho[y - c]) + \kappa + \delta \kappa$$  \hspace{1cm} (2.3.2)

**Definition 1.** $c^u(y)$ is implicitly defined as

$$u'(c^u(y)) = \delta \rho u'(\mu + \rho[y - c^u(y)])$$  \hspace{1cm} (2.3.3)

**Claim 1.** $c^u(y)$ is upward-sloping with a slope less than unity: $0 < c^u'(y) < 1$

**Proof.** See appendix A. \qed

In order to increase the tractability of my theory, I would like it to be the case that, at some level $y \in [y_{\min}, y_{\max}]$, the member’s optimal level of consumption $c^u(y) < y$, which is to say that there will be some states of the world in which the member would like to transfer money from period 1 to period 2 at interest rate $\rho$. Since the slope of $c^u(y) < 1$, the necessary and sufficient condition is that $c^u(y_{\max}) < y_{\max}$, and a sufficient condition for that is $u'(y_{\max}) < \delta \rho u'(\mu)$. I therefore make the following assumption regarding $\rho$:

**Assumption 1.** $\rho \geq \frac{u'(y_{\max})}{\delta u'(\mu)}$.

Since $\frac{u'(y_{\max})}{u'(\mu)} \leq 1$, this lower bound on $\rho$ is lower than the actuarially fair rate of interest. That the lower bound is low is consistent with the idea that the purpose of an ASCA is to pool risk, since low interest rates facilitate risk-sharing, as shown in Glaeser and Scheinkman (1998). Those who are net borrowers in period 1 will be poorer in period 2 than those who are net savers and so have higher marginal utility of consumption. Lowering the interest rate transfers money from the (rich)
net savers to the (poor) net borrowers, which increases the \textit{ex ante} expected utility of the representative member.

I also make several simplifying assumptions regarding the distribution of period 1 income, again to increase tractability:

\textbf{Assumption 2.} $f_y$ is symmetric, continuous, differentiable, unimodal, and bounded in $(y_{min}, y_{max})$ with $f_y(y_{min}) = f_y(y_{max}) = 0$.

Symmetry and bounds $y_{min}$ and $y_{max}$ imply that mean $\mu = \frac{y_{min} + y_{max}}{2}$.

\section*{2.3.2 Group environment}

The ASCA is characterized by the exogenously-determined lending rate $\rho$ and external benefits $\kappa$. In order to parsimoniously derive analytic results about individual savings choices, I make several simplifying assumptions about the ASCA membership. These assumptions are the same as those in the model of Glaeser and Scheinkman (1998). First, I assume that members are \textit{ex ante} identical. SHG promoters in India do try to recruit a homogenous membership, so this assumption is not unreasonable, and I will maintain it throughout the paper. Second, I assume that member’s incomes are independent of each other. Third, rather than give a specific size for the ASCA, I assume that it has a unit-mass of membership indexed by $i$; this allows me to shut down any direct effect of an individual member’s savings rate on the total ASCA savings rate and so isolate the “public goods” aspect of effect. For this purpose, the assumption is relatively innocuous, as ASCAs typically have 10-20 members, enough that members are unlikely to consider the effect of their own savings on the total savings available.

However, by combining assumptions 2 and 3, I (and, more importantly, the mem-
bers) can treat demand for credit in period 1 as deterministic rather than stochastic, which plays a key role in allowing me to derive my analytic results. This use of the assumptions may cause more concern, as realistically the aggregate demand for credit is uncertain and awareness of that uncertainty could certainly play a role in member’s savings decisions. I address this in my simulated model.

After all members have made their savings decisions \( \{s^i\} \), that money becomes the assets that the ASCA lends back to its members \( A = \int_0^1 s^i di \), so total borrowing by ASCA members cannot exceed total savings: \( \int_0^1 b^i di \leq \int_0^1 s^i di \). Since \( c - y = b - s \), I can restate this ASCA budget constraint as

\[
\int_0^1 c^i di \leq \int_0^1 y^i di \quad (2.3.4)
\]

If this budget constraint does not bind, that means that the ASCA is not utilizing all of its funds internally. In order for the ASCA to provide dividends \( \rho s \) to each member, I assume that the money which the ASCA does not lend internally will be lent externally at an equal interest rate \( \rho \). This could be thought of as either lending to non-members, or as internal lending done for (unmodelled) investment purposes. This assumption both simplifies the model and reflects reality. Money rarely lies “fallow” in ASCA accounts, and Sinha et al. (2010) notes that it is not uncommon for ASCAs with excess funds to lend to outsiders.

If the ASCA budget constraint does bind, that means that the total desired borrowing (taking into account the individual credit limits \( \bar{b} \) from the previous section) exceeds total available funds. Credit will then need to be rationed. I assume that the ASCA makes a collective decision on who to lend to, based on a desire to maximize average
member utility \textit{ex post}. This means that the ASCA’s objective function is:

\[ U = \int_0^1 u(c) + \delta u(\mu + \rho[y - c]) \, di + k + \delta k \]  \hspace{1cm} (2.3.5)

In this case, it will allocate lending in order to maximize the minimum marginal value of borrowing among its members. If the ASCA observes individual’s consumptions but not their incomes, the best way to accomplish this is to set a consumption threshold \( m \) and only allow members to borrow until their period 1 consumption reaches \( m \). In terms of borrowing, this means that \( b \leq \max(0, m - [y - s]) \): members with low liquid wealth \( y - s < m \) may only borrow up to the amount necessary to achieve period 1 consumption \( m \), while members with high liquid wealth \( y - s > m \) are not allowed to borrow at all. If the ASCA can observe both consumption and income, it will be able to implement a more efficient but more complicated allocation method that explicitly targets the marginal value of borrowing \( u'(c) - \delta \rho u'\mu + \rho y - c]) \). The results of using this other method are qualitatively identical to the ones I derive below.

\subsubsection{2.3.3 The consumption decision}

The intuition behind the consumption decision in period 1 is very simple. A member with income \( y \) is simply trying to get as close as possible to the unconstrained optimum \( c^*(y) \), given her constraints. When \( y \leq m + s \), the inequality constraints are

\[ c \leq y + \rho h(k) \]  \hspace{1cm} (2.3.6)

\[ c \leq m \]  \hspace{1cm} (2.3.7)

\[ c \geq y - s \]  \hspace{1cm} (2.3.8)
And when \( y > m + s \), there is the equality constraint \( c = y - s \). Consumption therefore follows the general pattern shown in figure 1. When income is low, the no-default constraint binds, so \( c^* = y + h(k) \). At some point as income rises, it may become possible to attain the unconstrained optimal consumption \( c^* = c^u(y) \). As income rises further, the consumption threshold begins to bind, so \( c^* = m \). Finally, when income rises above \( m + s \), consumption is set to \( c^* = y - s \). Note that the member may never be able to attain \( c^u \) if \( m \) or \( h(k) \) are low enough, and that when \( s \) is low and \( m \) is high it is possible for \( c \geq y - s \) to become the binding constraint. As I will show later on, the second condition will never hold in equilibrium.

In period 1, the member chooses consumption based on realized income \( y \), savings rate \( s \), and the consumption threshold \( m \). There are two possible cases: when \( y - s \geq m \), the member’s income net of benefits and savings is greater than the consumption threshold and so the member is forced to consume \( c = y - s \). And when \( y - s < m \), the member chooses the \( c^* \) that solves

\[
\max_c u(c) + k + \delta u(\mu + \rho[y - c]) + \delta k
\]

subject to

\[
c \leq y + \rho h(k) \quad (2.3.10)
\]

\[
c \leq m \quad (2.3.11)
\]

\[
c \geq y - s \quad (2.3.12)
\]

The Lagrangian is

\[
\mathcal{L}_c = u(c) + \delta u(\mu + \rho[y - c]) - \gamma_1[c - \rho h(k) - y] - \gamma_2[c - m] - \gamma_3[y_1 - s - c] \quad (2.3.13)
\]
with FOC
\[
\frac{du^*}{c^*} - \delta \rho u' (\mu + \rho [y - c^*]) = \gamma_1 + \gamma_2 - \gamma_3
\] (2.3.14)

This defines \( c^*(y, s, m) \) when \( y < m + s \). When \( y > m + s \), \( c^*(y, s, m) = y - s \). \( c^* \) can therefore be expressed as

\[
c^*(y, s, m) = \max(y - s, \min(c^u(y), y + h(k), m))
\] (2.3.15)

### 2.3.4 The threshold decision and positive externalities

Since there is no aggregate uncertainty regarding the distribution of \( y \) in a symmetric outcome where all members save the same amount \( s \) and consume \( c^*(y, s, m) \) in period 1, I can reframe the ASCA objective function and budget constraint in terms of \( f_y \).

Defining \( C(s, m) = \int_{y_{\min}}^{y_{\max}} c^*(y, s, m) \, dF_y(y) \) to be the total period 1 consumption of ASCA members, the budget constraint will be

\[
C(s, m) = \int_{y_{\min}}^{y_{\max}} c^*(y, s, m) \, dF_y(y) \leq \int_{y_{\min}}^{y_{\max}} y \, dF_y(y) = \mu
\] (2.3.16)

The very last leap, from \( \int_{y_{\min}}^{y_{\max}} y \, dF_y(y) \) to \( \mu \), is precisely where my assumptions of i.i.d. income and the unit mass of members kick in, because together they mean that total period 1 income is the deterministic \( \mu \) rather than a random variable centered on \( \mu \).

The objective function is also re-expressed as

\[
U(m) = \int_{y_{\min}}^{y_{\max}} u(c^*(y, s, m)) + \delta u(\mu + \rho [y - c^*(y, s, m)]) \, dF_y(y) + k + \delta k
\] (2.3.17)

Since \( m \) only enters the representative ASCA member’s consumption function as a constraint, clearly \( U \) is monotonically increasing in \( m \). Therefore, the ASCA’s
problem of maximizing $\mathcal{U}$ subject to the budget constraint is just the problem of finding the (usually unique) $m$ that fulfills $C(s, m) = \mu$.

Figure 2 provides the intuition for this relationship when the ASCA budget constraint binds. Members with income realizations $y < m$ are net borrowers, who each borrow $c^* - y$. Therefore, the area of region A (bounded by $c = y$ below, $c = c^*$ above, $y = y_{\text{min}}$ to the left and $y = m$ to the right) represents “net borrowing by net borrowers”. Members with income realization $y > m$ are net savers, who each save $y - c^*$, so the area of region B represents “net saving by net savers”. Since overall net borrowing must be less than or equal to 0, the area of region B must be at least as large as the area of region A (with the area of both regions weighed by the pdf $f_y(y)$). For a fixed savings level $s$, adjusting $m$ upwards continuously increases area A and decreases area B, and $m$ can then (generally) be adjusted until the areas are equal.

The following lemma establishes the conditions under which I can find a unique $m$ that satisfies $C(s, m)$

**Lemma 1.** There is a $\bar{s} \geq 0$ such that there exists a unique $m'$ that fulfills $C(s', m') = \mu$ and $\frac{\partial C(s', m')}{\partial m} > 0$ whenever $s' < \bar{s}$.

**Proof.** See appendix A. \hfill \qedsymbol

This lemma allows me to define a mostly-well-behaved relation $m(s)$ that gives the ASCA’s optimal choice of $m$ given average savings rate $s$.

**Definition 2.** Let the function $m : [0, y_{\text{max}} - c^*(y_{\text{max}})] \rightarrow \mathbb{R}$ be piecewise defined as:

1) when $s' \leq \bar{s}$, $m(s') = m'$ where $C(s', m') = \mu$ and $\frac{\partial C(s', m')}{\partial m} > 0$.

2) when $s' > \bar{s}$, $m(s') = y^s - s$, where $y^s$ is implicitly defined by $c^*(y^s) = y^s - s$. 

The first piece of $m$ deals with situations in which the budget constraint is binding, and is of primary interest. The second piece deals with situations in which the budget constraint is not binding; in these cases, there is no unique threshold that optimizes $\mathcal{U}$, so I pick a $m$ in order to maintain continuity and monotonicity.

Claim 2. The function $m(s)$ has the following properties:

1) $m(0) = y_{\text{min}}$.

2) $m(s)$ exists and is continuous over the domain $s \in [0, c^u(y_{\text{max}})]$.

3) $m(s) \leq m(s')$ for all $s < s'$.

4) $m(y_{\text{max}} - c^u(y_{\text{max}})) \leq c^u(y_{\text{max}})$.

5) $m(s)$ is a global maximizer of $\mathcal{U}(m)$ subject to $C(s, m) \leq \mu$.

Proof. See appendix A.

Property 4 establishes that $m(s)$ is non-decreasing. Since $\mathcal{U}$ is increasing in $m$, this suggests that there are positive externalities to each member’s individual choice of savings. Higher average savings result in higher $m$, which has a positive effect on a broad group of members. It is clear that this general result would be preserved in a model with aggregate uncertainty as even if total income were not deterministically equal to $\mu$, since the objective function $\mathcal{U}$ and optimal consumption functions $c^*$ would remain the same.

2.3.5 The savings decision and complementarity

I begin analysis of the savings decision by considering the \textit{ex ante} expected utility of a member $i$ who knows with certainty that the ASCA will impose a consumption
threshold of $m$: 

$$
EU^i = EU(s^i, m) = \int_{y_{\min}}^{y_{\max}} u(c^*(y, s^i, m)) + \delta u(\mu + \rho[y - c^*(y, s^i, m)]) \, dF_y(y) + k + \delta k
$$

(2.3.18)

Since there are a unit mass of identical members with i.i.d income, there is no aggregate uncertainty in this model, and so the equation for ex ante expected utility is identical to the equation for ex post average utility. This is why $EU = U$. In a model with aggregate uncertainty, instead of a fixed $m$ and a stochastic $y$ the member would have to consider some joint distribution $f_{m,y}$, and expected utility would be taken across the joint distribution.

The member’s savings decision here is somewhat less intuitive than previous decisions. Since she sets her savings level before she knows $y$, her savings decision will be based on the marginal value of saving in three different kinds of outcomes. First, when $y < m + s$, her savings decision does not matter, because she will either attain her preferred level of consumption $c^u(y)$ or be constrained by $c < m$ or $c < y + \rho h(\kappa)$, and the choice of $s$ has no effect on any of these. Second, when $y > m + s$ and $y - s < c^u(y)$, the member is forced to be a net saver and consume $c = y - s$, but would prefer to have been a net borrower. In these outcomes, she wishes she had set a lower savings rate for herself. Finally, when $y > m + s$ and $y - s > c^u(y)$ the member would prefer to be more of a net saver than she is, and so she wishes she had set a higher savings rate for herself.

Roughly speaking, since the cost of ‘missing’ $c^u(y)$ increases with the magnitude of the miss, the member chooses $s$ to position the $y - s$ line so that it harpoons the $c^u(y)$ curve midway between $m + s$ and $y_{\max}$ (with appropriate weights for $f_y$ and increasing or decreasing risk aversion). An increase in $m$ moves that midway point closer to $y_{\max}$ and so induces an increase in $s$. 
Another way of looking at this is that the member is facing a reversed precautionary savings problem: she is choosing how much to transfer from the “lottery” period 1 to the “safe” period 2. But since the member can borrow back her savings whenever $y < m + s$, when $m$ increases the member faces a new lottery in period 1 that first-order stochastically dominates the old lottery.

The following lemma helps me to establish a basis for my piecewise function $s(m)$:

**Lemma 2.** For all $m < c^u(y_{\text{max}})$, there exists a unique solution to $\max_{0 \leq s} EU(s, m)$, and this unique solution $s^* \leq c^u(y_{\text{max}}) - m$. And $\max_{0 \leq s} EU(s, c^u(y_{\text{max}})) = EU(c^u(y_{\text{max}}) - m, c^u(y_{\text{max}}))$.

**Proof.** See appendix A. □

**Definition 3.** Let the function $s : [0, y_{\text{max}}] \to \mathbb{R}^+$ be piecewise defined as:

1) $s(m) = \max_{0 \leq s} EU(s, m)$ when $m < c^u(y_{\text{max}})$

2) $s(m) = y_{\text{max}} - c^u(y_{\text{max}})$ when $m \geq c^u(y_{\text{max}})$

**Claim 3.** The function $s(m)$ has the following properties:

1) $s(m)$ exists and is continuous over the domain.

2) $s(m') \geq s(m)$ for all $m < m'$.

3) $s(m) \in [0, y_{\text{max}} - c^u(y_{\text{max}})]$.

4) $s(m)$ is a constrained global maximizer of $EU(s, m)$ subject to $s \geq 0$.

**Proof.** See appendix A. □

The fact that $m(s)$ and $s(m)$ are both upward-sloping reflects the complementarity of savings. When average savings $S$ increases, the ASCA has more funding and the
threshold $m$ increases. When the threshold $m$ increases, the optimal savings increases for the reasons just explained. This means that a member of a group that has average savings $S$ will face a consumption threshold $m(S)$, and her best response will be to pick a savings rate $s(m(S))$. When $S$ increases, $m(S)$ increases, and when $m$ increases, $s(m)$ increases. So the individually-optimal level of savings increases with the average savings rate; hence, complementarity.

### 2.3.6 Equilibrium and inefficiency

I define a symmetric equilibrium as follows:

**Definition 4.** A symmetric equilibrium consists of a pair $e = (s^e, m^e)$ such that

1) $EU(s^e, m^e) \geq EU(s, m^e)$ for all $s \geq 0$.

2) $U(m^e) \geq U(m)$ for all $m$ such that $C(s^e, m) \leq \mu$.

To find these symmetric equilibria, I would like to construct two “best response” functions, one that fulfills condition 1 and the other that fulfills condition 2. Because there are a unit mass of members, the savings decision of any one member cannot affect the average savings rate of the ASCA, so if $s^j = s \forall j \neq i$, member $i$ knows for certain that she will face a consumption threshold of $m(s)$. This means that I can use the $m(s)$ and $s(m)$ functions already constructed as my best response functions.

**Claim 4.** Any $(s^e, m^e)$ such that $m(s^e) = m^e$ and $s(m^e) = s^e$ is a symmetric equilibrium.

**Proof.** See appendix A. 

Figure 3 shows possible $m(s)$ and $s(m)$ curves. Where they cross, there is a symmetric
equilibrium. For any other symmetric equilibrium where \( s(m) \) and \( m(s) \) do not cross, \( m + s > y_{max} \), and that equilibrium \((s, m)\) is weakly dominated by an equilibrium where \( m(s) \) and \( s(m) \) do cross.

Suppose \( s(y_{min}) = 0 \). Then since \( m(0) = y_{min} \), there must be an equilibrium at \((m, s) = (y_{min}, 0)\); there may be other equilibria as well.

Now suppose \( s(y_{min}) > 0 \). From the properties of \( s(m) \), I know that \( s(c^u(y_{max})) = y_{max} - c^u(y_{max}) \). Since \( m(s) \) is a continuous curve defined for all \( s \) that is bounded from above by \( c^u(y_{max}) \), it follows that the two curves must cross. This leads me to make the following claim:

**Claim 5.** There is always at least one symmetric equilibrium \((s^e, m^e)\).

**Proof.** See appendix A.

Having established the existence of symmetric equilibria, I now wish to determine which outcomes will be socially-optimal. First, I define my concept of social optimality:

**Definition 5.** A socially-optimal outcome consists of a pair \((\hat{s}, \hat{m})\) such that \( U(\hat{m}) \geq U(m) \) for all \( C(s,m) \leq \mu \).

Since the \( m(s) \) and \( c^*(y, m, s) \) function are socially-optimal ex post, the problem of finding the socially-optimal outcome reduces to finding the socially-optimal level of savings \( \hat{s} \). All the money a member saves will either be lent back to her or lent to a member with a higher marginal value of borrowing. Therefore \( \frac{dEU(s,m(s))}{ds} \geq 0 \), with a strict inequality \( \frac{dEU(s,m(s))}{ds} > 0 \) when an increase in \( s \) causes an increase in \( m(s) \).

Given the properties of \( m(s) \) established in claim 2, I make the following claims:

**Claim 6.** A socially-efficient outcome \((\hat{s}, \hat{m})\) always fulfills \( \hat{s} + m(\hat{s}) = y_{max} \).
Proof. See appendix A.

Claim 7. When \( m(y_{\text{max}} - c^u(y_{\text{max}})) < c^u(y_{\text{max}}) \), the socially-efficient outcome \((\hat{s}, \hat{m})\) will not be an equilibrium, and there will exist a best possible equilibrium \((s^o, m^o)\) such that:

1) \( EU(s^o, m^o) < EU(\hat{s}, \hat{m}) \) (inefficiency)

2) \( EU(s^o, m^o) > EU(s^e, m^e) \) for all other equilibrium \((s^e, m^e)\) (uniquely optimal)

Proof. See appendix A.

Simply put, \((s^o, m^o)\) will be the highest intersection of \(s(m)\) and \(m(s)\). And since \((\hat{m}, \hat{s})\) is the intersection of \(m(s)\) and \(m + s = y_{\text{max}}\), the best possible equilibrium will only result in the socially-optimal outcome when the three curves \(m(s)\), \(s(m)\), and \(m + s = y_{\text{max}}\) all intersect.

2.3.7 The perverse effect of government aid

The most interesting theoretical result is that an increase in the external benefits \(k\) directed at an ASCA can undermine its value as a risk-sharing organization. Since an increase in \(k\) allows members with low levels of income to borrow more, this means that there is a higher demand for credit and there must be a correspondingly lower consumption threshold. Since members are less willing to save when there is a lower consumption threshold, this causes a decrease in member's individual savings and a lower supply of credit. The lower supply of credit means that the consumption threshold must lower again in order to maintain equilibrium, causing another decrease in savings. This process could either converge at a lower savings rate and a lower
consumption threshold ("minor" perversity), or could accelerate, causing the entire group to unravel ("major" perversity).

This is illustrated in figures 4 and 5. In figure 4, with benefit level $k_0$, when the savings rate is $s$, net savings and net borrowing will balance when $m = m_0$. However, if $k$ is increased to $k_1$ while the savings rate is kept constant as shown in figure 5, the increase in savings at threshold must drop to $m_1 < m_0$ in order to compensate for the increased borrowing at low income levels that the increase in $k$ allows.

As shown in figure 5, this causes the $m(s)$ curve to shift (weakly) downwards, with a strict decrease once $m(s)$ is above a certain threshold. It is a “weak” shift at the low levels curve because when $m < y_{min} + h(k)$ there is no region of $y$ in which the no-default constraint binds, and so loosening that constraint has no effect. For the same reason, a change in $k$ also has no effect when $k$ is already very high, $h(k) > c^u(y_{max}) - y_{min}$.

Since there is no corresponding change in the $s(m)$ curve, and the $s(m)$ is bounded from the right and the $m(s)$ is bounded from above, I can derive my first result, the “minor” perversity of government aid:

Claim 8. If $(s^o, m^o) \neq (\hat{s}, \hat{m})$ and $(s^o, m^o) \neq (0, y_{min})$, then $\frac{\partial s^o}{\partial k} < 0$ for all $k < k'$, where $h(k') = c^u(y_{max}) - y_{min}$.

Proof. See appendix A. □

As already described, $s(m)$ shifts down. Because $s(m)$ and $m(s)$ are both monotonically increasing and bounded, at the last intersection of the two curves they will both be “concave down” (roughly speaking). This means that the last intersection of the $s(m)$ and $m(s)$ occurs when both are concave down (in terms of $m$ and $s$ respectively), so a downward shift in $m(s)$ moves the highest intersection point $(s^o, m^o)$ down as
well.

This is “minor” perversity, because while the increase in benefits is bringing down savings, it is also shifting resources towards those whose current period 1 consumption level is the furthest from \(c(y)\), and they are the one who are most likely to have the highest marginal value for additional period 1 consumption (again, ignoring considerations of increasing or decreasing risk aversion). This means that the net welfare effect of an increase in \(k\) could still be positive.

Of much greater concern is the potential for “major” perversity, where an increase in \(k\) could actually remove the possibility for a positive-savings equilibrium. This would happen when an increase in \(k\) shifts the \(m(s)\) curve down so much that it “misses” the \(s(m)\) curve entirely. The best possible equilibrium in this case is then \((0, y_{\text{min}})\).

Claim 9. Under some conditions, there exists a \(\bar{k}\) such that when \(k < \bar{k}\), \((s^o, m^o) \gg (0, y_{\text{min}})\), and when \(k > \bar{k}\) \((s^o, m^o) = (0, y_{\text{min}})\).

Proof. See appendix A.

The necessary conditions for this to occur are difficult to characterize, because they involve assumptions on the interaction of the \(u\) and \(f_y\) functions.

If the change in \(k\) moves it from below \(\bar{k}\) to above \(\bar{k}\), the perversity effect dominates. But how likely is it that the ASCA fulfills these conditions? As discussed above, it is most effective to pool risk via loan contracts when interest rates are low. When interest rates get low enough \(\rho < \frac{\int_{y_{\text{min}}}^{\text{max}} u'(y) \, dF_y(y)}{\delta u'(\mu)}\), members will be unwilling to save at all unless the threshold rises above some level \(m > y_{\text{min}}\), which creates the possibility that the \(s(m)\) and \(m(s)\) curves could miss each other entirely. This would cause the best possible equilibrium to revert to \((0, y_{\text{min}})\). This could either be interpreted as the ASCA falling apart, or as the ASCA never getting together in the first place.
2.4 Conclusion

The Accumulating Savings in Credit Association, or ASCA, is a popular and fast-growing semiformal financial institution in India and Africa. With over 60 million members, this is an institution that affects more people than Medicare. Despite this, economists have thus far ignored ASCAs entirely, and while there are empirical studies underway none of them incorporate a strong theoretic element. This paper is the first formal theoretical treatment of the ASCA. Based on my experiences with the Self-Help Group model of ASCA popular in India, I have constructed a model of ASCAs in which they serve primarily as devices for risk-sharing. Because using credit as a form of risk-sharing works best when interest rates are low, I show that ASCAs will generally suffer from inefficient undersaving. I also show a disturbing result, that government agencies and NGOs which provide additional benefits to ASCAs could unintentionally worsen this problem, with potentially catastrophic results.
Figure 2.1: Period 1 Consumption as a function of income

\[ c = y + h(k) \]
\[ c = y \]
\[ c = y - s \]
\[ c = u(y) \]
\[ c = y \]

Figure 2.2: Net borrowing and net saving

\[ c = y + h(k) \]
\[ c = y \]
\[ c = y - s \]
\[ c = m \]
Figure 2.3: ASCA budget constraint \( s(m) \) and member optimal saving \( s(m) \)

\[ s(m) = y_{\text{max}} - c_u(y_{\text{max}}) \]

\[ m = c_u(y_{\text{max}}) \]

\[ s + m = y_{\text{max}} \]

\[ m(s) \]

\[ (s^*, m^*) \]

Figure 2.4: Initial benefits \( k_0 \) and threshold \( m_0 \)

\[ c = y + h(k_0) \]

\[ c = y - s \]

\[ c = m_0 \]
Figure 2.5: When benefits increase to $k_1$, the threshold must decrease to $m_1$ to keep the budget constraint satisfied.

\[ c = y + h(k_1) \]
\[ c = y - s \]
\[ c = m_1 \]

Figure 2.6: The increase in $k$ causes a downward shift in $m(s)$.
2.5 Appendix: Proofs

Proof of claim 1. \( c^u(y) \) is defined as 
\[ u'(c^u(y)) = \delta \rho u'(\mu + \rho[y - c^u(y)]) \]
Taking the derivative of each side with respect to \( y \) and rearranging, I find that 
\[ c^u'(y) = \frac{\delta \rho^2 u''(\mu + \rho[y - c^u(y)])}{u''(c^u(y)) + \delta \rho^2 u''(\mu + \rho[y - c^u(y)])} \]
Since \( u'' < 0 \) by assumption, both top and bottom of the right-hand side must be negative for all \( y \) and so \( c^u'(y) > 0 \). And since the numerator \( u''(c^u(y)) + \delta \rho^2 u''(\mu + \rho[y - c^u(y)]) \) has a higher magnitude than the denominator \( \delta \rho^2 u''(\mu + \rho[y - c^u(y)]) \), \( c^u'(y) < 1 \).

Proof of lemma 1. For each \( s' \geq 0 \), there are two possibilities: either \( C(s', m) \leq \mu \forall m \) or there exists a unique \( m' \) that fulfills \( C(s', m') = \mu \) and \( \frac{\partial C(s', m')}{\partial m} > 0 \). If \( C(s', m) \leq \mu \forall m \), then for all \( s'' > s' \) it is also the case that \( C(s'', m) \leq \mu \forall m \), since \( \frac{\partial C}{\partial s} \leq 0 \). And since \( C(0, m) > \mu \forall m > y_{\text{min}} \), it cannot be the case that \( C(0, m) \leq \mu \forall m \). Therefore, the lowest \( s \) where uniqueness is violated must be greater than 0.

Proof of claim 2. 1) When \( m \leq y_{\text{min}} \), \( C(0, m) = \mu \), and when \( m > y_{\text{min}} \), \( C(0, m) > \mu \). Therefore \( C(0, y_{\text{min}}) = \mu \) and \( \frac{\partial C(0, y_{\text{min}})}{\partial m} > 0 \).

2) Existence is clear for \( s \leq \bar{s} \). When \( s > \bar{s} \), existence depends on whether \( c^u(y) \) intersects \( y - s \), and since \( c^u(y_{\text{min}}) > y_{\text{min}} \geq y_{\text{min}} - s \) and \( c^u(y_{\text{min}}) \) has a shallower slope than \( y - s \), the two lines must intersect.

Continuity for \( s \leq \bar{s} \) is inherited from \( C \) since \( \frac{\partial C(s, m(s))}{\partial m} > 0 \), any discontinuous leap in \( m(s) \) would translate into a discontinuous leap in \( C(s, m) \). Continuity for \( s > \bar{s} \) is inherited from \( c^u(y) \).
3) Monotonicity for \( s \leq \bar{s} \) comes from \( \frac{\partial C}{\partial s} \leq 0 \) and \( \frac{\partial C}{\partial m} \geq 0 \). Monotonicity for \( s > \bar{s} \) is inherited from \( c^u(y) \).

4) If \( \bar{s} < y_{\text{max}} - c^u(y_{\text{max}}) \), then \( m(y_{\text{max}} - c^u(y_{\text{max}})) = y^s - [y_{\text{max}} - c^u(y_{\text{max}})] \). And since \( c^u(y^s) = y^s - [y_{\text{max}} - c^u(y_{\text{max}})] \), it must be that \( c^u(y^s) = y^s = c^u(y_{\text{max}}) - y_{\text{max}} \), so that \( y^s = y_{\text{max}} \). Therefore \( m(y_{\text{max}} - c^u(y_{\text{max}})) = c^u(y_{\text{max}}) \).

Since the highest possible desired consumption is \( c^u(y_{\text{max}}) \), \( \frac{\partial C(s,m')}{\partial m} = 0 \) for all \( m' > c^u(y_{\text{max}}) \). Therefore the highest possible value that \( m \) can attain when \( s \leq \bar{s} \) is lower than \( c^u(y_{\text{max}}) \). So property 4 is fulfilled when \( \bar{s} = y_{\text{max}} - c^u(y_{\text{max}}) \) as well.

5) Since \( U(m) \) and \( C(s, m) \) are both non-decreasing in \( m \), if \( m' \) fulfills \( C(s, m') = \mu \) and \( \frac{\partial C(s,m')}{\partial m} > 0 \), \( m' \) must be a constrained optimizer of \( U(m') \). And since \( m \) only affects \( U \) through its effect on \( C \), if \( \frac{\partial C}{\partial m} = 0 \) then \( \frac{\partial U}{\partial m} = 0 \).

\[
\text{Proof of lemma 2. See the companion paper (Goldston 2013).}
\]

\[
\text{Proof of claim 3. See the companion paper (Goldston 2013).}
\]

\[
\text{Proof of claim 4. See the companion paper (Goldston 2013).}
\]

\[
\text{Proof of claim 5. See the companion paper (Goldston 2013).}
\]
Proof of claim 6. See the companion paper (Goldston 2013).

Proof of claim 7. See the companion paper (Goldston 2013).

Proof of claim 8. See the companion paper (Goldston 2013).
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