

# DEPARTMENT OF ECONOMICS

## Working Paper

MICRO-CREDIT AND GROUP LENDING:  
THE COLLATERAL EFFECT

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# Micro-Credit and Group Lending: The Collateral Effect

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## ABSTRACT

Conventional banking practices do not easily accommodate the financial needs of poor persons. Group-lending, on the other hand, has found several advantages in the context of poor borrowers with no collateral to offer. An important advantage is that the bank's losses due to unsuccessful projects are dramatically reduced, because group members cover at least part of those losses. In effect, a kind of collateral has been created in the group even though each individual had no collateral to offer.

This paper will analyze the collateral-effect in a model with two types of entrepreneurs (high-risk and low-risk) and a competitive banking system. We show that with individual lending, the typical situation for poor entrepreneurs in developing countries is likely to lead to a separating equilibrium where only high-risk borrowers are served (at a high interest rate). Allowing for group-lending, however, is likely to result in a pooling equilibrium, where all entrepreneurs are served at a considerably lower interest rate.

We complement the theoretical analysis by a comparison of the performance of Bolivia's BancoSol, which practices group-lending, with the other private Bolivian banks, which lend on an individual basis.

**KEYWORDS:** Micro credit, group-lending, collateral, Bolivia, BancoSol.

**JEL classification:** G20

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## 1. INTRODUCTION

Considerable resources have been devoted to supplying cheap credit to small farmers in developing countries during the last four decades. It was believed that these farmers had credit needs that commercial banks for some reason were not willing to meet and that this left local money lenders in a monopoly position where they could charge abusively high interest rates. Government sponsored rural credit institutions were consequently set up to provide credit for the rural poor at reasonable terms. It is widely agreed, however, that the performance of these institutions have been disappointing (e.g. Hoff & Stiglitz 1990; Adams & Pischke 1992). Most of the programs were unsustainable because they were expensive, collected too little revenue, depended too heavily on outside funding, and often suffered serious default problems. Even worse, a substantial portion of the subsidies was captured by people who were not poor and who could have obtained loans in the commercial market (Adams & Pischke, 1992).

There is now a second wave of enthusiasm for micro-credit—this time targeted at both rural and urban micro-entrepreneurs. The new micro-credit programs attempt to avoid the problems of the first wave by delivering credit and related services at commercial rates of interest in a convenient and user friendly way, maintaining high repayment rates through adequate incentives, and encouraging savings in concert with lending programmes (Micro Credit Summit 1997, Draft Declaration).

This paper analyses the incentive system used by some of the most successful micro-credit institutions of the second wave (e.g. BancoSol in Bolivia and Grameen Bank in Bangladesh). All loans are given to groups (typically composed of four to seven individuals), and the individual borrowers act as co-guarantors of each other's loans.

There are several advantages with the group-lending setup. First, the task of credit-evaluation is done by the borrowers, rather than the bank, since members choose to be in a group with others whom they believe to be credit-worthy and whom they can rely on to make timely payments. This is called the peer screening effect, and it reduces transaction costs because community members have much better information about each other than the bank has. Varian (1990) has analyzed this effect in a model where banks can obtain perfect knowledge of borrower types by incurring some screening costs. Screening costs

are lower in the group-lending setup, because they only have to interview one of the group members, as groups tend to form with individuals of similar types (assortative matching).

Second, there is a peer monitoring effect that induces each group member to apply the loans in a productive way, so that the probability of success increases. Stiglitz (1990), Varian (1990), and Banerjee *et al* (1994) have already developed models that illustrate the working of the peer monitoring effect.

Third, the desire to preserve valuable social ties may induce borrowers to spend extra effort if necessary to secure timely payment. Social ties are valuable, because they will allow you to borrow in the future, because they may help you with advice on your business, and because they may provide connections (customers, suppliers, etc.) useful for your business. We can call this the social relations effect.

Fourth, and very important, there is a collateral effect. The banks' losses due to unsuccessful projects are greatly reduced because successful entrepreneurs within each group will cover part of these losses. In effect, a kind of collateral is created in the groups, even when none of the individuals had any collateral to offer. The reduction in losses allows banks to reduce interest rates, thus attracting applicants with lower risk projects. This improvement of the pool of applicants will reduce average risk and thus allow a further reduction in interest rates.

The model proposed in this paper will ignore the first three effects and focus on the fourth. We will show how the collateral effect in group-lending can move the market from a bad, high-interest rate separating equilibrium, where only high-risk entrepreneurs can afford to borrow, to a good, low-interest, pooling equilibrium, where both high-risk and low-risk entrepreneurs are served.

The paper is organized as follows. Section 2 describes the model and shows how the collateral-effect of group lending can improve welfare in a situation with poor borrowers without individual collateral. Section 3 provides a practical example of group lending by comparing the performance of BancoSol with the more conventional banks of Bolivia. Section 4 concludes.

## 2. THE MODEL

The basic model is set up along the lines of Akerlof's (1970) model of lemons. Instead of good used cars and bad used cars, we here have high-risk and low-risk entrepreneurs. Each entrepreneur has an indivisible investment project that requires an initial investment of 1 unit of capital and yields a return  $R_i^s$  if successful and 0 if it fails. The two types of entrepreneurs are assumed to exist in the proportions  $\theta$  and  $(1-\theta)$  in a large population normalized to one. Type 1 (low-risk) entrepreneurs have a high probability of success,  $p_1$ , while Type 2 (high-risk) entrepreneurs have a low probability of success,  $p_2$ . As a compensation for the higher risk, type 2 entrepreneurs receive higher returns in case they succeed. For analytical convenience, we model the correlation between risk and return in the following way:

$$E(R_i) = p_1 R_1^s = p_2 R_2^s = \bar{R} \quad (1)$$

The outcomes of projects are assumed to be independent both within types and across types.

The alternative to starting a micro-enterprise is to earn a safe wage,  $W$ , which is assumed to be lower than  $\bar{R}$ . As entrepreneurs are assumed to be risk-neutral, they would always want to start the enterprise if they had the money. They are, however, assumed to have no endowment, so they will have to borrow from the bank at the going rate  $r$ .

Entrepreneurs will apply for a loan as long as the expected profit is higher than the safe wage. Loans are assumed to be of a standard debt type, which allows for bankruptcy if the project fails. The main information asymmetry arises because banks do not know the type of the applicants, while the applicants themselves do.

Expected profits for an entrepreneur of type  $i$  is:

$$E(\pi_i) = p_i [R_i^s - (1+r)] = \bar{R} - p_i(1+r) \quad (2)$$

For the marginal loan applicant expected profits will be equal to the safe wage. Rearranging (2) we see that the probability of success for the marginal applicant will depend negatively on the interest rate charged by the bank:

$$p_i = \frac{(\bar{R} - W)}{(1 + r)} \quad (3)$$

Thus, if the interest rate is too high, the banks will get only high-risk applicants. But at a lower interest rate a pooling equilibrium may be possible, where both low-risk and high-risk entrepreneurs will apply for loans. Consider the banks' expected profits in the two above mentioned cases (they will never be able to attract only low-risk applicants in this setup):

$$\begin{aligned} E(\pi_b^{All}) &= (1 + r)[\theta p_1 + (1 - \theta)p_2] - (1 + \rho) \\ E(\pi_b^{High-risk}) &= (1 + r)(1 - \theta)p_2 - (1 - \theta)(1 + \rho) \end{aligned}$$

If we assume banks' profits will be driven down to zero in a competitive equilibrium, and that the banks' opportunity cost of capital is  $\rho$ , then, in the first case, they should charge an interest rate  $r$  satisfying  $(1 + r) = (1 + \rho) / \Pi$ , where  $\Pi = \theta \cdot p_1 + (1 - \theta)p_2$ . The payoff to entrepreneurs of type  $i$  is then

$$E(\pi_i^{All}) = \bar{R} - p_i(1 + \rho) / \Pi.$$

Notice that the expected profits for high-risk entrepreneurs are higher than those for low-risk entrepreneurs because high-risk entrepreneurs default more often. Low-risk entrepreneurs in effect subsidize high-risk borrowers as the bank makes profits on the first to cover the losses incurred on the latter. This equilibrium is only possible if the low-risk entrepreneurs are willing to subsidize high-risk entrepreneurs. They will do this as long as their expected profits are higher than the reservation wage. This requires that

$$\bar{R} - W \geq \frac{(1 + \rho)p_1}{\Pi} \quad (4)$$

Thus, low-risk applicants will stay out of the market if a) the difference between the safe wage and the expected risky return is small, if b) the cost of capital is high, if c) the probability of their own success is not high enough, and d) if the proportion of high-risk entrepreneurs is high. These conditions are likely in a developing country with a) a large informal sector with free entry, which drives profits among micro-entrepreneurs down, with b) imperfect capital markets, and with c) poorly educated micro-entrepreneurs.

It is therefore quite likely that the pooling equilibrium is not feasible (i.e. (4) does not hold). In that case we will end up in the separating equilibrium where only high-risk entrepreneurs want to borrow. The bank then needs to charge an interest rate  $r$  satisfying  $(1+r) = (1+\rho) / p_2$ , which is higher than in the previous case. High-risk entrepreneurs now get a lower expected profit,  $E(\pi_2^{High-risk}) = \bar{R} - (1+\rho)$ , because they are not subsidized by low-risk borrowers. Low-risk entrepreneurs do not get any surplus at all, so this is a classical example of a “bad equilibrium” in markets with adverse selection. High-risk types drive all the low-risk types out of the market to the detriment of themselves and others.

The use of collateral would solve this problem, but that is ruled out by the assumption of no endowment. There is, however, another option, as some successful micro-credit institutions have discovered.

### *Group lending*

Under a group-lending scheme, banks ask borrowers to form joint-limited-liability groups. If one borrower’s project is successful, she has to pay her own debt,  $(1+r)$ , *plus* a share of the debt of unsuccessful borrowers in the group. This is subject to the limited liability constraint: Her total dues to the bank cannot exceed the total revenues from her project and if her project fails she doesn’t owe the bank anything.

Borrowers can choose their own group members, and we assume that borrowers know each other’s types, while the bank does not. In that case it is in the interest of borrowers to find group members with a high probability of success, since every default will increase their effective cost of borrowing. Ghatak (1995) and others have shown that this results in assortative matching, so that group members always are of the same type. Low-risk



entrepreneurs cannot even be bribed to include high-risk entrepreneurs in their group, since that would require a bribe higher than the expected gain for the high-risk individual.

The expected cost of borrowing (or, equivalently, the expected pay-off from lending) is positively correlated with the size of the group (at a given interest rate). With group size one (individual loans) expected cost of borrowing one unit of capital is  $E(C_i^1) = p_i(1+r)$  for an individual of type  $i$ , since he must pay  $(1+r)$  if he succeeds (with probability  $p_i$ ) and zero if he fails. For a group with two members, it has increased to  $E(C_i^2) = p_i^2(1+r) + p_i(1-p_i) \cdot \min\{R_i^S, 2(1+r)\}$ , because an individual in such a group has to pay zero if he fails;  $(1+r)$  if both he and the other member succeeds; or  $2(1+r)$  if he succeeds while the other fails. The latter is subject to the limited liability constraint: he should never pay more than his return from the successful project,  $R_i^S$ .

For members in a group with  $n$  members, the expected costs of borrowing one unit of capital is:

$$E(C_i^n) = \sum_{x=0}^{n-1} p_i^{n-x} (1-p_i)^x \cdot \binom{n}{x} \cdot \min\left\{R_i^S, (1+r) \cdot \left(1 + \frac{x}{n-x}\right)\right\}$$

This rather complicated expression does not lend itself easily to analytical analysis. But a numerical example will illustrate its features well. Assume that  $\theta = 0.5$ ,  $p_1 = 0.8$ ,  $p_2 = 0.4$ ,  $\bar{R} = 1.4$ ,  $W = 1.3$ , and  $\rho = 0.1$ . Equation (1) then implies that  $R_1^S = 1.75$  and  $R_2^S = 3.5$ .

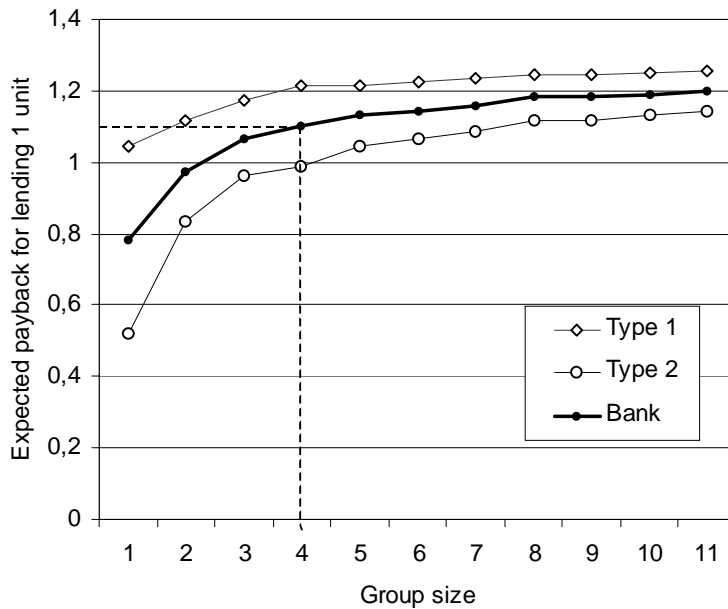
If entrepreneurs should borrow on an individual basis, the bank would have to charge an interest rate of 83.5% to cover its costs on average. However, at that interest rate, the expected costs of borrowing for type 1 individuals would be 1.468 which is higher than their expected return (1.4), so they would pull out of the market. When low-risk borrowers pull out, the banks overall risk increase dramatically and they would therefore have to increase interest rates to 175% to cover their costs. At that rate the expected costs for the remaining type 2 borrowers would be 1.1 (equal to the banks opportunity costs,  $1+\rho$ ) which is lower than their expected returns, so they would remain in the market. This

is therefore a typical example of a separating equilibrium where the low-risk individuals have been driven out of the market while high-risk individuals stay, but are worse off.

However, if borrowers are asked to form joint-limited-liability groups of size  $n = 4$ , the bank could reduce the interest rate to 30,4% without losing money. Both high and low risk entrepreneurs would be interested in borrowing at that rate since their expected costs would be 1.21 and 0.99, respectively. Notice that low-risk borrowers are still subsidizing high-risk borrowers, but not as much as with individual loans.

Figure 1 shows the expected cost of borrowing one unit of capital for different group sizes. At a given interest rate, the bank expects to get more back from low-risk borrowers than from high-risk borrowers, because of the lower default rate. It also expects to get more back from borrowers in groups than from individual borrowers, because group members pay part of the losses from failing projects in their own group. The interest rate assumed in the figure is  $r = 0.304$ , which is the one where banks break even with group sizes of four. If groups are smaller, the bank has to increase the interest rate to break even, while they can decrease the interest rate further if the groups are bigger. The marginal gain from group sizes larger than 7 or 8 is not big, though, and such big groups sizes would be inconvenient for many borrowers.

Figure 1: Expected payback for different group sizes



Group lending thus increases overall welfare in a setting where individuals cannot offer collateral. The mechanism of welfare enhancement is as follows: The bank has lower risk when lending to joint-limited-liability groups because it receives money in more states of the world than with individual loans. The lower risk allows the bank to reduce the interest rate. The lower interest rate then attracts less risky loan applicants, which further reduces the banks overall risk and allows an additional reduction in interest rates. In the end, more customers are served, which means that more entrepreneurs can carry out their projects (job creation), and the bank breaks even as with individual lending. Some risk is transferred from the bank to the entrepreneurs, but that doesn't matter here, since we have assumed that entrepreneurs are risk neutral.

The biggest welfare gain accrues to high-risk entrepreneurs who can borrow at very favorable interest rates. Low-risk entrepreneurs also receive a welfare gain, since they now can carry out their projects with positive expected profits.

The bank gets zero profit in any case because of competition, but it has a lot more customers in the group lending setup. In the following section we will look at a real life example of a Bolivian bank practicing group lending to poor micro-entrepreneurs with no

collateral, and compare its performance with conventional banks practicing individual lending with collateral.

### 3. BOLIVIA'S BANCOSOL

This section will discuss the experiences of BancoSol, which services poor micro-entrepreneurs without demanding physical collateral, but instead demands that customers create groups that are jointly liable. We will show that the customers that were attracted to BancoSol are different from those catered to by more conventional banks<sup>2</sup>. This implies that the interest rates charged by BancoSol should be compared to the interest rates charged in the informal money market, rather than those charged by other banks, because the latter only apply to big borrowers with collateral. We will also see that BancoSol's mode of operation implies very high administrative costs, which are covered by a combination of low default rates and a high interest rate spread. Finally, we will show that BancoSol has succeeded in attracting small savers, which is necessary for the bank to become sustainable and function without donor funds.

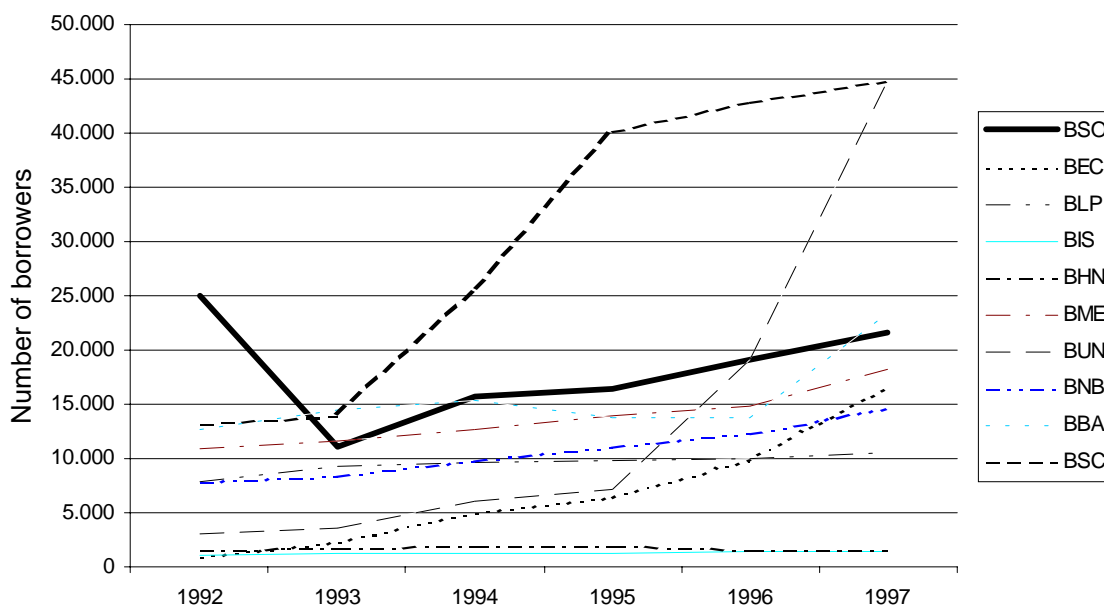
BancoSol started out in 1986 as a nonprofit micro-lending organization called PRODEM (Foundation for the Promotion and Development of Microenterprise) but decided to turn into a commercial bank in order to be able to offer much needed small-scale savings facilities for its clients and thereby raise more funds for lending.

The new bank opened its doors in February 1992. Inheriting the customers of the PRODEM foundation it immediately became the biggest bank in Bolivia in terms of number of borrowers. Since then, however, it has been overtaken by both Banco Santa Cruz (BSC), Banco de la Unión (BUN), and lately also Banco Boliviano Americano (BBA). See Figure 2.

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<sup>2</sup> We compare BancoSol with the 9 other private Bolivian banks that existed throughout the period 1992-1997. For a list of these, please see the Appendix.

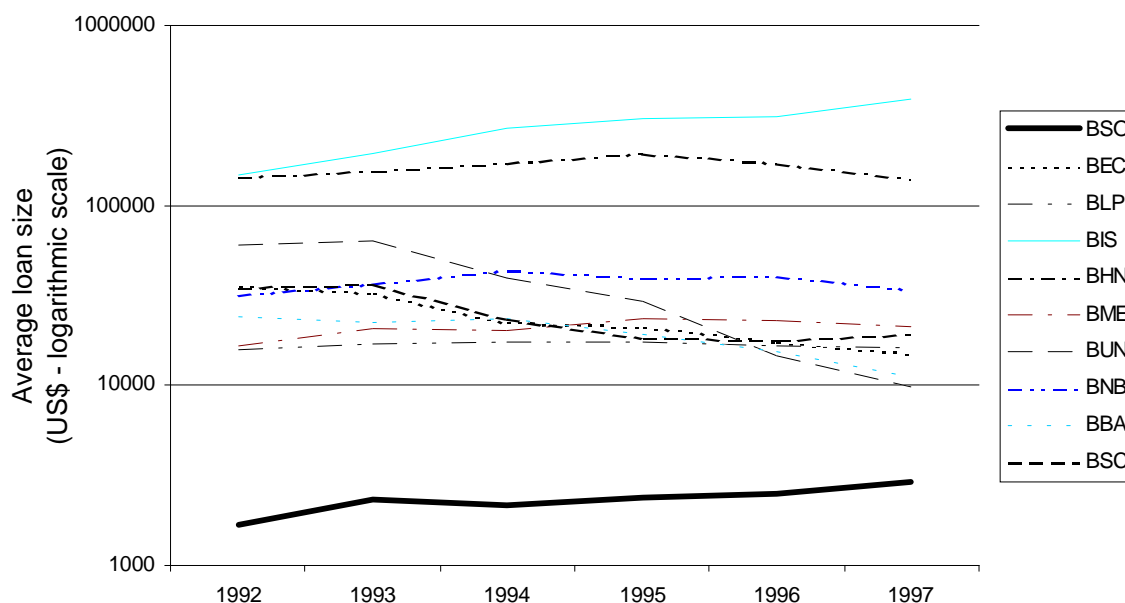
Figure 2: Number of borrowers in Bolivian Banks



Source : Superintendencia de Bancos, Boletín Informativo, various issues

The borrowers in BancoSol are very different from those in the other banks, though. By the end of the first year of operations, BancoSol served 24,952 borrowers and 34,475 depositors with average loan size (US\$1,704) and average deposit size (US\$57) both below the minimum limits for other banks (US\$3,000 for loans and US\$100 for deposits). By the end of 1997, the average size of BancoSol loans had increased to US\$ 2,936 – corresponding to a used car or just 4% of the average loan size for the other 9 banks (average loan size US\$ 72,780). See also Figure 3.

Figure 3: Average loan size in Bolivian Banks

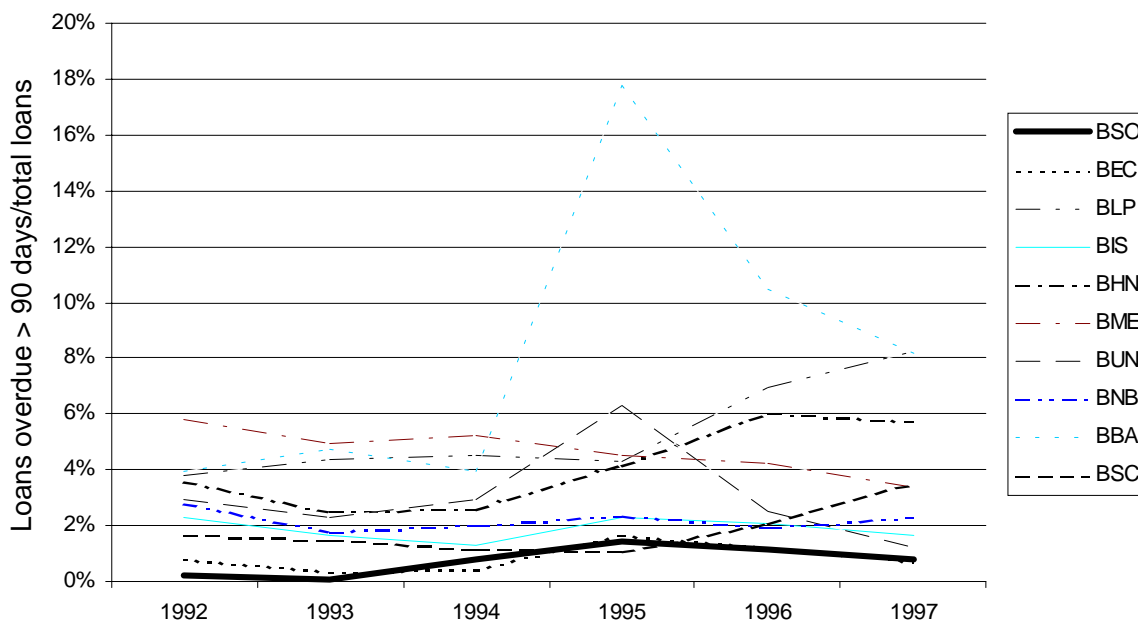


Source: Superintendencia de Bancos, Boletín Informativo, various issues

BancoSol generally doesn't demand collateral. The share of loans without collateral was 100% in the beginning but has decreased to 95% in 1997. This compares to shares between 8% and 25% for the other 9 banks (Superintendencia de Bancos, Boletín Informativo, various issues).

Instead all BancoSol loans are given to solidarity groups—usually consisting of 4-7 members. The first loans are small (US\$100), but subsequent loans can be increased as long as the payment record of the borrower is impeccable. This includes paying for unsuccessful group-members. The group-lending practice has kept the share of non-performing loans at very low levels. Throughout the period 1992-1997 the share of loans overdue by 90 days or more was always below 1.5%. This compares to average shares oscillating between 2.7% and 4.9% for the other nine banks during the same period. See Figure 4.

Figure 4: Share of loans overdue > 90 days

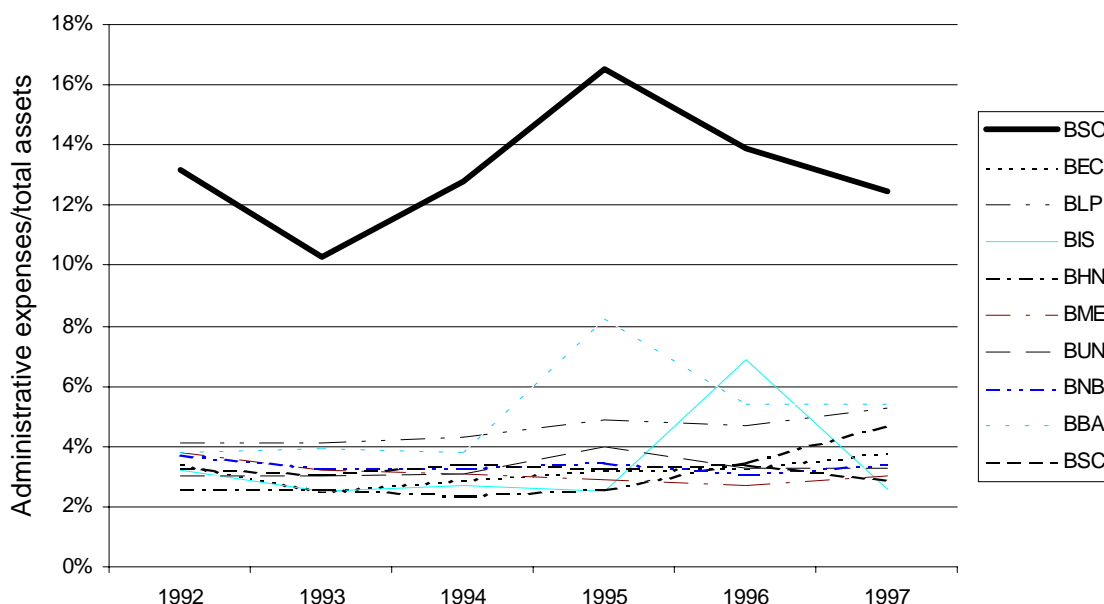


Source: Superintendencia de Bancos, Boletín Informativo, various issues

Extensive interaction between staff and clients also helps to minimize default rates. Loan officers in the 37 branches are recruited from their local communities, and they undertake extensive fieldwork to survey local needs and concerns, as well as to acquaint themselves with potential clients and the purposes for which loans may be needed. They also work closely with solidarity groups, meeting with each group on a weekly basis<sup>3</sup>. All this is bound to lead to high administrative costs compared to the size of the assets they administrate. Indeed Figure 5 shows that administrative costs as a percentage of total assets are about three times higher than those for the other Bolivian banks.

<sup>3</sup> For a more thorough discussion of BancoSol and its banking methods, see Glosser (1994) or Smith (1998).

Figure 5: Administrative expenses of Bolivian Banks



Source: Superintendencia de Bancos, Boletín Informativo, various issues

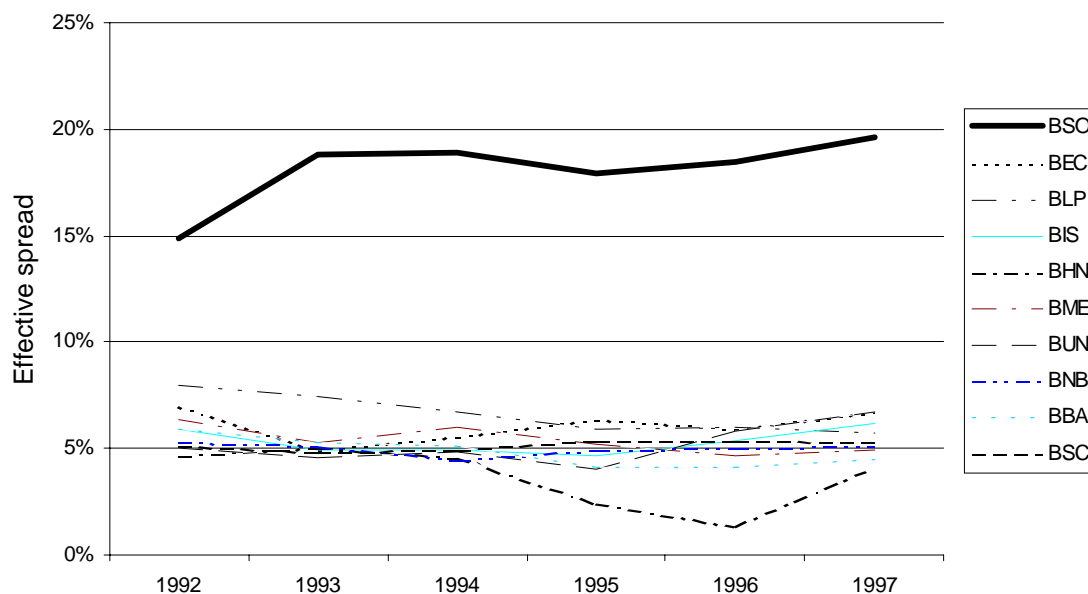
If BancoSol is to be self-sustaining, these relatively high administrative costs need to be covered either by exceptionally low default rates, or by maintaining a high interest rate spread. We have already seen that default rates are very low. Figure 6 shows that the effective interest rate spread<sup>4</sup> of BancoSol is large - about 3 times bigger than for the other Bolivian banks.

This might seem at odds with the theory, which predicted that group-lending should make it possible to lower the interest rate. But the above analysis has shown that BancoSol is clearly not serving the same type of customers as the other banks. The comparison should therefore be with the informal money-lenders who provide small, short-term loans to the poor. There is not any systematic information about these, but they are reported to charge as much as 1-10% per day which imply implicit interest rates of several thousand percent per year (World Bank, 1996).

<sup>4</sup> (Financial income + other operating income - financial expenses)/Average assets



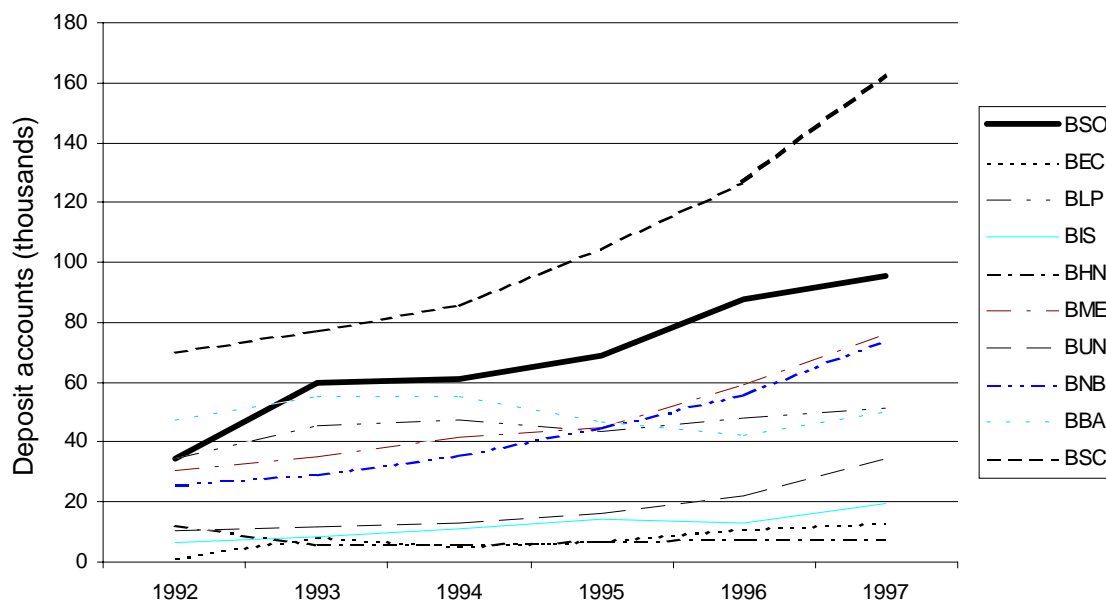
Figure 6: Effective interest rate spreads in Bolivian Banks



Source : Superintendencia de Bancos, Boletín Informativo, various issues

The fact that both borrowers and depositors have flocked to BancoSol despite the high interest rate spread is also evidence that BancoSol is serving a different segment of

Figure 7: Number of deposit accounts in Bolivian Banks

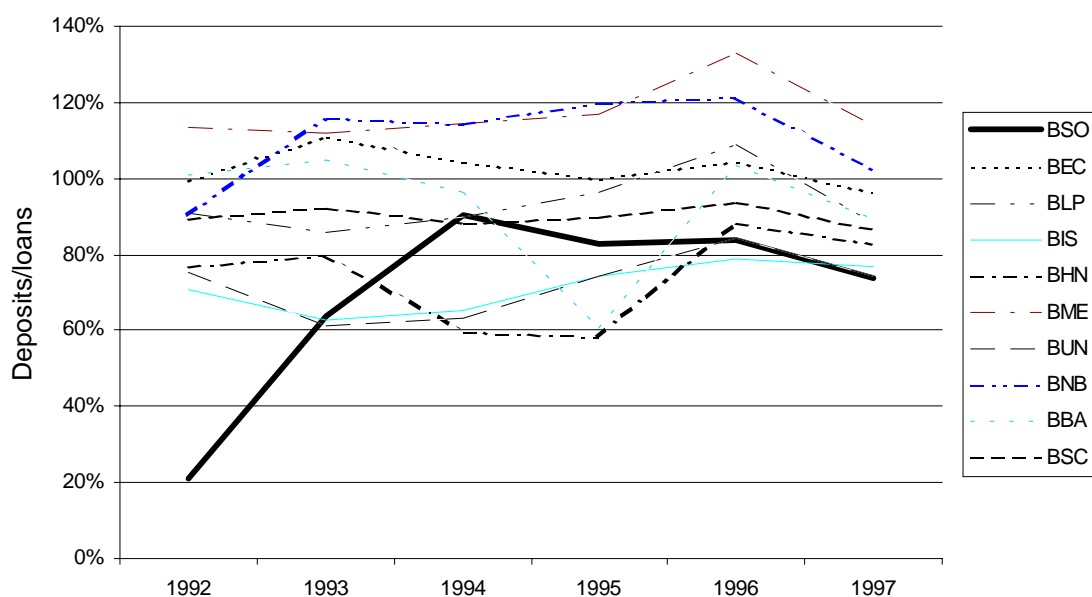


Source : Superintendencia de Bancos, Boletín Informativo, various issues

the market than the conventional banks. Figure 7 shows the rapid increase in the number of depositors. After only 10 months of operation, it already had 34,475 depositors. This number had increased to 95,825 by the end of 1997 making BancoSol the second most popular bank among depositors.

They still don't have enough deposits to be self-sufficient, though. While the ratio of deposits to loans increased impressively from 21% in 1992 to 90% in 1994, the ratio has lately dropped to 74%. See Figure 8. This ratio has to increase again, if BancoSol is to become self-sustainable without having to rely on donor funds like the first wave of micro-credit institutions. It has been more difficult for BancoSol to attract deposits, however, after they made the other banks realize that they were neglecting a lucrative market. Competition in the small customer market is now much higher than it was in 1992.

Figure 8: Self-sufficiency: Deposits/loans



Source : Superintendencia de Bancos, Boletín Informativo, various issues

## 5. CONCLUSIONS

This paper has demonstrated theoretically how limited joint liability group lending reduces interest rates and improves welfare in a setting with poor borrowers who are unable to offer collateral for bank loans.

The mechanism of welfare enhancement is as follows: The lender has lower risk when lending to joint-limited-liability groups because he receives money in more states of the world than with individual loans. The lower risk allows the lender to reduce the interest rate. The lower interest rate then attracts less risky loan applicants, which further reduces the lender's overall risk and allows an additional reduction in interest rates. In the end, more customers are served, which means that more entrepreneurs can carry out their projects (job creation). The lender breaks even as with individual lending, but has a lot more customers.

Several micro-credit institutions around the world have found the group-lending strategy effective. In this paper we have shown that BancoSol, using this strategy, quickly captured a large number of small customers in Bolivia. By the end of the first year of operations, it had almost 25% of all loan accounts, while the loan amount accounted for less than 2% of all credit extended by private national banks. These customers were not drawn away from the existing banks, but rather from the informal money-market.

Lately many of the conventional banks have been extending their business towards small customers, and BancoSol has lost market share in the small customer market. While BancoSol was close to self-sufficient in 1994, it now has to rely on outside funding for 25% of its loans.

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#### APPENDIX A: LIST OF BOLIVIAN BANKS AND THEIR ACRONYMS

BSO	Banco Solidario S.A.
BEC	Banco Económico S.A.
BLP	Banco de La Paz S.A.
BIS	Banco Industrial S.A.
BHN	BHN' Multibanco S.A.
BME	Banco Mercantil S.A.
BUN	Banco de la Unión S.A.
BNB	Banco Nacional de Bolivia S.A.
BBA	Banco Boliviano Americano S.A.
BSC	Banco Santa Cruz S.A.

Note: The banks included in this list comprise all the private national banks in Bolivia which have existed throughout the period 1992 – 1997.

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