

# Peer group micro-lending programs in Canada and the United States

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## Abstract

There are numerous theoretical models that consider peer group micro-lending programs. These models use monitoring, peer pressure, mutual insurance, information transfer and the costs of entering new relationships to explain the success of peer group micro-lending programs outside Canada and the United States (such as the Grameen Bank in Bangladesh). While these explanations may be applicable to programs abroad, they do not adequately describe the dynamics of many programs in Canada and the United States due to the vast difference in economic environment. I present a model that relies on screening and the reduction of overhead costs to explain the existence of peer group micro-lending programs in Canada and the United States. Evidence from these programs is presented to support the model. © 1999 Elsevier Science B.V. All rights reserved.

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## 1. Introduction

The 1992 Los Angeles riots underscore the importance of economic growth in impoverished communities in the United States. A major hindrance to economic growth in many of these areas is the lack of capital available to local entrepreneurs interested in starting or expanding a business. These individuals are traditionally

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unable to obtain capital through banks and other conventional lending institutions because they have insufficient collateral to qualify for a loan or they seek a loan amount smaller than conventional lending institutions provide.

Substantial time, energy and resources have been spent on an array of programs to encourage economic activity in low-income communities throughout North America. One effort to spur economic growth in these areas is through over 250 micro-lending programs operated by primarily non-profit organizations. These programs provide local entrepreneurs with capital to facilitate the growth of their businesses until they are capable of qualifying for loans from conventional lending institutions. A number of these over 250 micro-lending programs either had, have or plan to establish micro-lending programs that employ a peer group concept.<sup>1</sup> The focus of this paper is on peer group micro-lending programs in Canada and the United States.

The concept of peer group micro-lending began in underdeveloped countries such as at the Grameen Bank in Bangladesh. Many of these programs have experienced substantial success and growth. The existing theoretical literature attributes this success to monitoring, peer pressure, mutual insurance, information transfer and the costs of entering new relationships. While these explanations may be applicable to programs abroad, they do not adequately describe the dynamics of many programs in North America due to the vast difference in economic environment. A number of North American programs initially patterned off the peer group micro-lending program implemented by the Grameen Bank have evolved or are evolving into programs with much different requirements and structures. These changes in program structure, which have often positively affected the program's performance, have developed as many programs adapt to their economic environment.

I present an alternative explanation of why peer group micro-lending programs exist in North America. I use evidence from existing programs to provide support for my explanation that peer groups are used as a mechanism to impose fixed costs (such as attending training sessions and writing business plans) on the entrepreneurs while minimizing the program's overhead costs. These fixed costs serve as a screening mechanism by deterring those entrepreneurs who are not as likely to be successful from obtaining a loan. In addition, the fixed costs increase the expected profits for those entrepreneurs who do obtain a loan and will, thereby, likely increase the probability that the entrepreneurs repay the loan.

The paper is organized in the following manner. Section 2 discusses the existing theoretical literature on peer group micro-lending programs. Section 3 describes several of the larger peer group micro-lending programs in North

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<sup>1</sup> In 1995, 51 programs in the United States provided capital to entrepreneurs using peer groups with the average program having 19 groups. The large majority of these programs are small in scale but the number of peer group micro-lending programs has increased substantially in recent years.

America. Evidence from these peer group micro-lending programs is used to construct a model that is presented on Section 4. Section 5 presents the conclusions of the analysis.

## 2. Peer group micro-lending programs

The Grameen Bank of Bangladesh, founded in 1976 by American-trained economics professor Muhammad Yunus, was the first to implement a peer group micro-lending program which provides low-income entrepreneurs access to capital. The structure of the program involves groups of entrepreneurs forming “lending circles.” An entrepreneur’s access to financing is dependent on the timely repayment of existing loans by her lending circle and on her active participation in the lending circle.<sup>2</sup> The available loan size increases over time conditional on the timely payment of previous loans to the lending circle. The success of this program in Bangladesh, with a 98% loan repayment rate, has been widely publicized. This success resulted in many Third World countries and eventually low-income communities in North America implementing similar programs. The existing theoretical literature uses monitoring (Stiglitz, 1990), peer pressure (Besley and Coate, 1995), mutual insurance (Varian, 1990 and Townsend, 1994), information transfer (Varian, 1990), and the costs of entering into new relationships (Ghosh and Ray, 1994) to explain the existence and success of peer group micro-lending programs.

Stiglitz (1990) demonstrates how a lender can benefit from peer monitoring among borrowers. The paper models peer monitoring as a borrower who agrees to pay the lender a certain amount if another borrower defaults on a loan. The model has two risk-averse borrowers who each select either a risky project or a safe project. Both the fixed cost and the increase in expected payoff resulting from an increase in loan size (fixing the interest rate) are greater for the risky project. The lender prefers the higher return of the safe project. If there is no peer monitoring and the loan size and/or interest rate is greater than a certain threshold, the

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<sup>2</sup> The following is a condensed description of the Grameen Bank’s peer group micro-lending programs from the IFPRI (International Food Policy Research Institute, 1988) Research Report. “The prospective borrowers are obliged to participate in a group training program for a minimum of 7 days of continuous instruction by the bank worker. The training is intended to make the members thoroughly conversant with the rules and regulations of the bank. Lending circles of five people are then formed and a group chairperson elected. Two members of the group then receive loans. If they pay the weekly installments on a regular basis, the next two members become eligible for loans. The group chairperson is the last member to receive a loan. A repeat loan is not approved for any member until the accounts of all members of the group are settled. Each group is required to meet weekly at which time they contribute to a Group Fund and an Emergency Fund. In addition, group members participate in a social development program which requires them to abide to certain codes of conduct and partake in physical training.”

borrower chooses the risky project. By requiring a borrower to pay if another borrower defaults, the lender can increase this threshold and, thereby, benefit from this peer monitoring. The cost associated with the peer monitoring is that the borrowers must bear more risk. Stiglitz proves that the benefit is greater than the cost if a borrower's payment (due to another borrower's default) is less than a critical value.

Besley and Coate (1995) use a game theoretic argument to demonstrate that social collateral (which I term peer pressure) can have a positive effect on repayment levels in group lending. Their model has two ex-ante identical borrowers form a group. The group receives a loan that is divided evenly among the borrowers. The borrowers are jointly responsible for the loan's repayment. Prior to investing the loan, the borrower's return is uncertain. After investing the loan and realizing their return, each borrower decides whether to repay her share of the loan. If one borrower chooses not to repay, the other borrower can decide to repay the entire loan. Besley and Coate (1995) argue that if a borrower is able to impose social penalties on a borrower who defaults on her portion of the loan, the probability of loan repayment increases.

Varian (1990) models mutual insurance among agents to explain the success of the Grameen Bank. The paper demonstrates that if risk-averse agents are able to insure each other across states not observed by the principal, the principal is made strictly better off compared to if mutual insurance is not possible. Varian (1990) also addresses how information transfer among agents can benefit the principal. Varian models this information transfer by having two types of agents: a high productivity agent and a low productivity agent. The high productivity agent has lower total cost and marginal cost than the low productivity agent. The high productivity agent can transmit information to the low productivity agent that decreases her cost and, in effect, makes the low productivity agent a high productivity agent. Groups of two agents are formed and the principal offers incentive schemes to each sequentially. An incentive scheme consists of a payment for a certain level of output. Suppose a low and high productivity agent form a group with the low productivity agent receiving the first incentive scheme. The principal can ensure the high productivity agent transmits information to the low productivity agent by having the incentive schemes available to the high productivity agent dependent on the low productivity agent's output. In terms of the Grameen Bank, this is analogous to having an entrepreneur's receipt of a loan dependent on repayment of existing loans by other entrepreneurs in her peer group. In this manner, entrepreneurs interested in obtaining a loan would have incentive to transmit information to entrepreneurs who have already obtained loans in order to increase the probability of their repayment.

Ghosh and Ray (1994) consider cooperation (such as a loan repayment that enables others to obtain loans) in communities (such as peer groups) where information on an individual's past actions is not available. Individuals are either myopic or have discount factors that allow for the possibility of cooperation.

Cooperation can occur between individuals who are not myopic due to the presence of costs associated with entering into new relationships. These costs relate to the probability of entering into a relationship with a myopic individual.

This theoretical literature addressing peer group micro-lending programs is more applicable to programs abroad because: (1) programs abroad are usually targeted at relatively immobile communities; (2) the majority of individuals in these communities obtain their income through similar entrepreneurial activities; (3) individuals often know one another prior to participating in the program; (4) the business environment is not as complicated or diverse as in Canada and the United States; and (5) credit histories are not as readily available as in Canada and the United States. The economic environment in which programs abroad exist facilitates the use of monitoring, peer pressure, mutual insurance and the cost of entering into new relationships as incentives for loan repayment. It also increases the importance of information transfer between group members in programs abroad.

### 3. Evidence from specific US programs

Programs in Canada and the United States are aware of the difference in economic environment and recognize that these theoretical explanations are not as applicable to their programs. Several of the larger programs are the Women's Self-Employment Project (WSEP), the Good Faith Fund (GFF), the North Carolina Microenterprise Loan (NCMLP) Program and the Calmeadow Metrofund. The experiences of these programs highlight the evolution of many peer group micro-lending programs in Canada and the United States.<sup>3</sup> In addition, they illustrate the vast difference in structure that exist across peer group micro-lending programs in North America.

The WSEP is a non-profit affiliate of South Shore Bank in Chicago whose peer group micro-lending program is more similar to the Grameen Bank model than most other programs in Canada and the United States. The program was founded in 1986 and is funded primarily by contributions and loans from foundations and corporations. As of May 31, 1994, the WSEP had distributed over US\$650,000 in

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<sup>3</sup> The Investment Vision (1991) (August/September) states, "(T)he American experience has been a constant process of adapting the third world model." It also quotes Julia Vindasius, an observer of Prof. Yunus' work in the villages in Bangladesh and the executive director of the Good Faith Fund (GFF), who states that, "(A)fter three years at the GFF, one of the essential purposes of (my) leadership is to discover ways in which we are not Bangladesh." Julia Vindasius also indicates that peer pressure is much more significant in a place like Bangladesh than in rural Arkansas. In the Arkansas Times (1992) (June 11 issue) she states: "Here, the business environment's more complicated (than in Bangladesh). The market environment's more complicated: there isn't a long history of entrepreneurship in the area."

loans to over 750 businesses and had a loan default rate of less than 5%. Typically, an entrepreneur's first loan is in the US\$1500 range with subsequent loans increasing in size. Prior to receiving the initial loan, an entrepreneur must finish a free 12-session training course. Individuals receiving loans are then required to attend bi-weekly meetings. The administrative costs of the WSEP are relatively high. The *Wall Street Journal* (1992) (June 23 issue) states: "WSEP lent a total of US\$200,000 to 200 women. But it spends more than it lends. Ms. Evans (WSEP's director) estimates that about US\$280,000 of its US\$700,000-a-year budget goes to running the two loan programs, and some of the rest goes for related overhead." Interestingly, the WSEP offers larger loans outside their peer group micro-lending programs. Thus, entrepreneurs who are successful in the peer group program can maintain their relationship with and obtain larger loans from the WSEP.

The GFF of Southern Development Bancorporation is located in southeast Arkansas and was established in 1988 using a US\$500,000 grant. The Southern Development Bancorporation is a holding company established by the Winthrop Rockefeller Foundation, the South Shore Bank and the MacArthur Foundations. As of March 31, 1994, the GFF had 206 members of which 149 received loans totaling US\$438,488. Members are in such diverse occupations as home day care, seamstress/tailor, catering, cake decorator, auto detailing, advertising service, tax service, crayfish raising, concrete finishing, fertilizer producer, hog farming and casket builder. Patterned off the Grameen Bank model, the GFF had a 40% default rate the first 2 years of operation. The program was restructured by: (1) allowing members to form groups only after participating in training and orientation classes; (2) not requiring all the members of a group to take out a loan; and (3) not having a loan default prevent other group members from obtaining a loan. By their third year of operation, the default rate was reduced to 3%. The GFF initially distributed first loans of up to US\$1200 for 1 year and then made subsequent loans in larger amounts not exceeding US\$5000. Recently, the size of the first loan has been reduced and the interest on these loans has been increased to the market rate. These changes were implemented in an effort to achieve self-sufficiency by reducing the program's reliance on outside contributions. To qualify for a loan from the GFF, an entrepreneur must now attend seven bi-monthly "Business and Orientation Training" classes (which cost US\$20 and last 3 h each), form a group, contribute to a group and emergency savings funds, and have a loan proposal approved by the group. The GFF recently reduced the frequency of the mandatory meetings after the initial loan from weekly to bi-monthly and required groups to organize these meetings. Similar to the WSEP, larger loans are available from the GFF outside their peer group micro-lending programs.

The NCMLP, which began in the fall of 1989, provides capital and training to entrepreneurs through a peer group and an individual lending program. The amount of capital lent through the individual program is approximately three times as much as through the peer group program. NCMLP's peer group microlending

was modeled after the Grameen Bank program and the GFF but used existing organizations to distribute the loans and provide business training. These organizations consist of existing development programs throughout North Carolina (a number of which are based at community colleges). The primary reasons for distributing through these sites are to reduce overhead and gain access to entrepreneurs who would benefit from the capital. The loan funds were obtained from the North Carolina General Assembly and the administrative funds were provided by foundations such as Z. Smith Reynolds, Ford and Charles Stewart Mott. The program is overseen by a statewide advisory board which is comprised of a number of representatives from the banking industry.

The major changes to the structure of the program occurred in November of 1992 and throughout 1995. At the start of the program, the official policy was to prevent all other group members from obtaining further loans if a single group member defaulted on a loan. Initially, first loans ranged from US\$500 to US\$2500, second loans ranged from US\$2500 to US\$5000 and third loans ranged from US\$5000 to US\$8000. The usual repayment periods for the first, second and third loans were 1, 2 and 3 years, respectively. The interest rate charged on all loans was 16%. Before receiving a loan, entrepreneurs had to attend business training programs. After receiving the initial loan, the entrepreneurs were required to attend bi-weekly meetings where guest speakers often discussed topics relevant to the small business person.<sup>4</sup> In November of 1992, the training program was expanded and entrepreneurs' credit histories were required. To receive a loan, group members were now required to attend six meetings and submit a loan proposal. The consequences of loan delinquency and default were stressed at one

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<sup>4</sup> In December of 1991, MDC, a private consulting firm, conducted a comprehensive study of the NCMLP and recommended numerous substantive changes to the program (MDC, 1991). MDC's suggestions include: (1) resolving the group ramifications of a loan default; (2) decreasing the initial loan amount to a maximum of \$500; and (3) educating borrowers on the penalties associated with loan default. The study identifies several alternative policies regarding group ramifications of a loan default. These include allowing groups to appeal their cases when mitigating circumstances caused the default and restricting the amount of time group members are limited from borrowing. MDC's study also discusses the importance of penalizing a loan default and providing a link to conventional lending institutions. The study states: "Members must clearly see the repercussions of defaults. Upfront education about sanctions that will occur must be presented and opportunities must be taken to reinforce the consequences of default. Making more of members' opportunities to build a good credit history might be a way of keeping some on track." The study notes that overhead costs for the NCMLP have increased substantially and that long-term sustainability will be determined by whether costs per member can be reduced through economies of scale. It also indicates that while these overhead costs may be high due to the program's experimentation and relatively small scale, even if the program matures and achieves economies of scale, a continued subsidy will be required. MDC's study states that it is impossible to achieve these economies of scale if specific types of businesses are targeted, especially in rural areas. Finally, the study discusses the vulnerability of the program to "bad" characters and how a "con artist" or "scam" runner could certainly test this type of lending program.

of the meetings. In terms of the group ramifications of a loan default, the program gave much of the authority to the sites beginning in 1992. However, the program did establish certain delinquency and default threshold requirements that sites must satisfy in order to maintain access to the funds. Conversations with several site directors indicate that the common response to an individual defaulting is the delay of subsequent loans to the other group members (approximately 30 days) or to have the other group members join another group. In addition, a loan portfolio manager was hired in 1993 to pursue delinquent and defaulted loans. This individual often sought judgments in these cases from Small Claims Court. In 1993, the interest rates charged on second and third loans were reduced from 16% to 14% and 12%, respectively. In 1995, the requirements prior to obtaining a loan were further standardized. Entrepreneurs were now required to attend meetings and submit a formal business plan. At this time, the maximum size of the initial loan was decreased to US\$1500. The average size of a lending group has been relatively constant at five since the start of the program.

Table 1 provides information on NCMLP's peer group microlending by fiscal year. The most striking observations from the information provided in the table are the fluctuation of the program's size, the increase in the amount of loan repayments, the improvement in the program's performance and the increase in total overhead costs across years. If number of loans is used as the measure for size, the peer group microlending program has experienced substantial size variation. The maximum number of loan dispersed is 89 which occurred in 1993. The repayment

Table 1  
NCMLP's peer group microlending

Fiscal year <sup>a</sup>	Number of individuals receiving loans	Amount of loan repayments	Amount of defaulted loans/ amount of loan repayments <sup>b</sup>	Amount of delinquent loans/ amount of loan repayments <sup>c</sup>	Overhead costs <sup>d</sup>
1996	58	468279	0.04 (8)	0.05 (13)	710914
1995	27	402586	0.03 (14)	0.06 (11)	690472
1994	50	335254	0.10 (24)	0.06 (22)	677877
1993	89	226374	0.07 (9)	0.10 (16)	470350
1992	26	120356	0.18 (7)	0.21 (14)	423807
1991	39	71667	0.18 (4)	0.51 (18)	406404
1990	34	15793	1.1 (10)	0.26 (2)	

<sup>a</sup>Fiscal year ends June 30th of specified year.

<sup>b</sup>A loan is considered in default if it is more than 180 days late. The value in parentheses indicates number of defaulted loans.

<sup>c</sup>A loan repayment is considered delinquent if it is past due. The value in parentheses indicates number of delinquent loans.

<sup>d</sup>Overhead costs include costs associated with individual loan program.

amount from existing loans has steadily increased from 1991 to 1996 at an average annual rate of 45%. Some of these repayments are from loans dispersed in the prior year. The program's performance has improved across years if the measure is the amount of delinquent and defaulted loans relative to the amount of loan repayments. If program improvement is measured by the ratio of the loan amount that has been defaulted to repaid, dramatic improvements occurred from 1992 to 1993 and from 1994 to 1995. This ratio decreased from 0.18 in 1992 to 0.07 in 1993 and from 0.10 in 1994 to 0.03 in 1995. Perhaps this is due to the changes in program requirements. Similar to the ratio of the loan amount that has been defaulted to repaid, there has also been a significant decrease across years in the ratio of the loan amount that has been delinquent to repaid. Finally, Table 1 indicates that there has been an increase in overhead expenditures. However, the numbers presented in the table include overhead costs associated with the individual lending program whose size has also increased across years.

The Calmeadow Metrofund is a peer group microlending program in Toronto, Canada which began in April of 1994. Donations from private individuals, companies and foundations cover the majority of operating expenditures. The size of the groups range from four to seven entrepreneurs and the entrepreneurs self select into groups. If a group member defaults on a loan, another member in the group can receive a subsequent loan through Calmeadow if they repay a portion of the defaulted loan. The entire defaulted loan need not be repaid, only a portion.<sup>5</sup> Prior to March of 1997, a defaulted loan would result in all group members being denied further loans until the defaulted loan was fully paid. All group members, except one, are required to have been in business for 6 months or have graduated from a self-employment training program. These training programs are primarily operated by government agencies or community colleges and are not sponsored by Calmeadow. This was not a requirement when the program started in 1994. In addition, entrepreneurs have to complete a loan application and meet regularly with group members. The loan application requires personal and business financial information which is verified by group members and Calmeadow. Group members typically call references, check business associates and review the loan application while Calmeadow runs a credit check. Prior to the Summer of 1996, group members were entirely responsible for checking the information on the loan application. The current policy of sharing the verification responsibility is one reason why Calmeadow Metrofund's staff increased from two to five in December of 1996. In regards to loan sizes, first loans are typically US\$1000 and subsequent loans are typically US\$2000. The cost of a loan to the entrepreneur includes a 12% interest rate and a 6.5% administration fee. In the Summer of 1996, late fees were assessed on delinquent loans.

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<sup>5</sup> Specifically, if there are  $n$  members in the group and one entrepreneur defaults on a loan of  $Y$ , another entrepreneur in the group can obtain a subsequent loan if she pays  $Y/(n-1)$ .

Table 2 provides information on Calmeadow's peer-group microlending program. Since its inception in April of 1994, the size of the program has increased and the program's performance has improved. The growth of the program is demonstrated by the increase in the average monthly amount of loans dispersed and the average monthly number of loans dispersed. This growth has been especially rapid from the end of 1996 to the present. The average monthly number of loans dispersed has increased over three-folds during this time. If program performance is measured by the ratio of loan amount defaulted to repaid, dramatic improvement began to occur at the end of 1996. This ratio was 0.24 from April 1996 to September 1996, 0.13 from October 1996 to March 1997, and 0.04 from April 1997 to September 1997. This improvement coincides with the major changes in program structure.

The Women's Economic Development (Wedco) is located in Minneapolis, MN and experimented with the peer group lending concept in the early 1990s but terminated the program due to its limited success. The South Madison Neighborhood Housing Service in Madison, WI also experimented with a peer group micro-lending program and had even less success than Wedco. The program started in January of 1993 with limited funding from the City of Madison. By the summer of 1994, the program had been terminated without having made a single loan. The funds were used entirely for administrative costs.

These programs highlight some major differences between peer group microlending programs in North America and abroad. Perhaps the most dramatic differences are the group ramifications of a loan default and the requirements associated with obtaining a loan. While the Grameen Bank prevents all group members from obtaining additional loans if a single group member is late with a payment, Canadian and US programs have reduced or eliminated the group ramifications of a loan default. In addition, the more complicated and diverse business environment has caused several of these programs to increase the amount of training and assistance entrepreneurs receive. A number of programs have developed comprehensive training sessions and require entrepreneurs to submit a business plan or loan proposal. Evidence from these programs suggest that these training sessions, business plans and loan proposals contributed to the decrease in loan default rates. This decrease is due to increasing the likelihood that entrepreneurs succeed and/or more effectively deterring undesirable individuals from participating in the program.<sup>6</sup> Another difference is that the ratio of overhead costs to the amount of capital distributed is much greater for North American programs. This can be attributed to the high costs associated with training

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<sup>6</sup> In *Investment Vision* Angela Dooley, a loan representative at the GFF, states: "...with all the meetings you have to go to and all the talking and learning that goes on, a real scam artist isn't gonna hang around just to get 1200 bucks."

Table 2  
CALMEADOW'S peer group microlending

Time period	Outstanding balance	Amount of loans dispersed	Average amount of loans dispersed per month	Average number of loans dispersed per month	Amount of defaulted loans <sup>b</sup>	Average number of defaulted loans per month	Amount of loan repayments	Amount of loans at collection <sup>c</sup>	Amount of defaulted loans/Loan repayments
April 1997 to September 1997	431,513	445,200	74,200	43	7220	1.5	188,211	3252	0.04
October 1996 to March 1997	184,995	195,000	32,500	28	11,224	1.8	87,518	5051 <sup>d</sup>	0.13
April 1996 to September 1996	93,788	118,500	19,750	13	17,862	3.5	72,953	8038 <sup>d</sup>	0.24
October 1995 to March 1996	74,141	70,500	11,750	6	34,797 <sup>a</sup>	1.8	136,902	15659 <sup>d</sup>	0.25
April 1995 to September 1995	77,328	44,000	7333	6					
April 1994 to March 1995	79,085	147,000	12,250	11					

<sup>a</sup>This number represents the total amount of defaulted Loans from April 1994 through March 1996. Information is not available for the amount of defaulted loans in each time period specified.

<sup>b</sup>A loan is considered in default if it is more than 120 days past due.

<sup>c</sup>A loan is sent to collection if it is 60 days past due.

<sup>d</sup>Calmeadow did not keep records on the amount of loans at collection prior to April 1997. The amounts prior to April 1997 are estimated assuming the ratio of loan amounts at collection to amount of defaulted loans is constant across years.

entrepreneurs and the inability to achieve economies of scale.<sup>7</sup> Programs realize that long-term viability relies on their ability to maintain their loan base through the repayment of outstanding loans and the reduction of overhead costs. One manner in which programs are addressing this problem is by having groups responsible for organizing the meetings and reviewing loan applications. Finally, North American programs realize that they must provide a link to more traditional channels of credit. The bank affiliations of the WSEP and the GFF enable them to offer larger loans outside their peer group lending programs. The NCMLP and the Calmeadow Metrofund hope to accomplish this by providing their members an opportunity to establish a good credit history.

#### 4. Model and program structure

The goal of many peer group microlending programs abroad is to empower the poor. These programs attempt to achieve this goal by addressing a broad range of issues such as health care, literacy, the status of women, and economic activity. The goal of the non-profit organizations that operate programs in Canada and the US is much more narrow and focuses on increasing entrepreneurship and self-employment. To achieve this goal, these programs provide training and seed capital to local entrepreneurs unable to obtain loans from conventional institutions. The ultimate goal of the seed capital is to provide the means for the entrepreneurs to expand their businesses and eventually qualify for larger loans from conventional institutions. Prior to qualifying for a loan, entrepreneurs must incur fixed costs associated with attending training sessions, writing business plans and completing loan forms. One purpose of these fixed costs is as a screening mechanism where entrepreneurs with greater expected profits generated from the loan incur the fixed costs in order to obtain a loan. Entrepreneurs with lower expected profits do not incur the fixed costs. The single crossing condition arises from the fact that entrepreneurs with greater expected profits benefit more from obtaining the loan. The fixed costs also increase the entrepreneurs' expected profits and likely increase the probability entrepreneurs repay the loans.

The non-profit organization distributes an initial loan to those entrepreneurs who incur the fixed costs and then distributes a second loan to those who successfully repay the first loan and incur additional fixed costs. If the profits generated from the first loan are sufficiently high, obtaining a second loan and

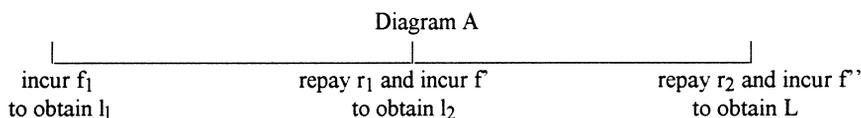
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<sup>7</sup> The August/September 1991 issue of *Investment Vision* states, "...the relatively small size of existing (peer group micro-lending programs) makes it extremely difficult to operate in the black. Under current conditions, truly profitable micro-lending operations will remain unlikely until staff lenders handle an average of 300 loans apiece, as at the Grameen Bank. Particularly in Canada and the United States, the costly educational and support component makes that ratio unlikely for at least the remainder of the decade."

avoiding a bad credit rating provide enough incentive for entrepreneurs to repay the first loan and incur the additional fixed costs. Entrepreneurs whose profits are sufficiently high from the second loan have incentive to repay and incur additional fixed costs in order to qualify for additional capital from a conventional lending institution. The structure of the program (in terms of the group size, the number of groups, the fixed costs incurred by the entrepreneurs, the loan sizes and the interest rate) is such that the non-profit organization maximizes the consumption and production in their communities while satisfying a balanced budget constraint. Peer groups are required to qualify for a loan not for peer pressure, monitoring, mutual insurance or information transfer purposes. Instead, peer groups are used as a mechanism to impose fixed costs on the entrepreneurs while minimizing the program's overhead costs.

#### 4.1. Model

The non-profit organization initially provides seed capital to the risk-neutral entrepreneurs in the program with a loan,  $l_1$ . To qualify for this first loan, an entrepreneur must join a group and incur certain fixed costs,  $f_1$ . An entrepreneur can obtain a second loan,  $l_2$ , if she repays the first loan,  $r_1$ , and incurs additional fixed costs,  $f'$ . The repayment associated with the second loan is  $r_2$ . If an entrepreneur repays the first and second loans, she is then able to obtain additional capital,  $L$ , from the conventional lending institution due to her good credit rating. The additional capital  $L$  is based on the loans from and the repayments to the conventional lending institution. To qualify for a loan from the conventional lending institution, the entrepreneur must incur fixed costs of  $f''$ . Let  $f_2 = f_1 + f'$  and  $f_L = f_1 + f' + f''$ . (Diagram A depicts a time line for an entrepreneur who obtains  $l_1$ ,  $l_2$ , and  $L$ .) The amount of capital an entrepreneur has obtained from the non-profit organization and conventional lending institution equals the sum of the loans minus the sum of the repayments. An entrepreneur has capital of  $c_1 = l_1$  after receiving the first loan,  $c_2 = l_1 - r_1 + l_2$  after receiving the second loan and  $c_L = l_1 - r_1 + l_2 - r_2 + L$  after receiving the conventional lending institution's loan.



There are two types of entrepreneurs in the population: “good” and “bad.” Let  $i$  index the type with  $i = g$  for the good entrepreneur and  $i = b$  for the bad entrepreneur. If entrepreneur  $i$  obtains and does not repay the initial loan,  $l_1$ , her

expected per period profit is  $E\pi_1^i(c_1, f_1)$ .<sup>8</sup> The realization of this per period profit is denoted as  $\pi_1$ . If entrepreneur  $i$  realizes per period profit of  $\pi_1$  and obtains but does not pay back the second loan, her expected per period profit is  $E\pi_2^i(c_2, f_2|\pi_1)$ . These specifications of the expected per period profit assume that the entrepreneur cannot obtain capital from any other source if she defaults on a loan due to a bad credit rating. Entrepreneur  $i$ 's expected per period profit from obtaining the loan from the conventional lending institution is  $E\pi_L^i(c_L, f_L|\pi_2)$  where  $\pi_2$  is the realized per period profits from the second loan.

The following assumptions are made on these expected per period profit functions.

1.  $(\partial E\pi_j^i(\cdot))/(\partial c_j) > 0$ ,  $(\partial^2 E\pi_j^i(\cdot))/(\partial c_j^2) < 0$ ,  $(\partial E\pi_j^i(\cdot))/(\partial f_j) > 0$ , and  $(\partial^2 E\pi_j^i(\cdot))/(\partial f_j^2) < 0$  for  $i = g, b$  and  $j = 1, 2, L$ .
2.  $\pi_2^i(c_2, f_2|\pi_1') - \pi_1'$  first-order stochastically dominates  $\pi_2^i(c_2, f_2|\pi_1'')$  for  $\forall \pi_1' > \pi_1''$  and  $i = g, b$ .  $\pi_L^i(c_L, f_L|\pi_2')$  first-order stochastically dominates  $\pi_L^i(c_L, f_L|\pi_2'')$  for  $\forall \pi_2' > \pi_2''$  and  $i = g, b$ .
3.  $\pi_j^g(\cdot)$  first-order stochastically dominates  $\pi_j^b(\cdot)$  for  $\forall c_1, c_2, c_L, f_1, f_2, f_L, \pi_1, \pi_2$  and  $j = 1, 2, L$ .
4.  $E\pi_2^i(c_2, f_2|\pi_1^i(c_1, f_1) \geq \pi_1) - E\pi_1^i(c_1, f_1|\pi_1^i(c_1, f_1) \geq \pi_1)$  and  $E\pi_L^i(c_L, f_L|\pi_2^i(c_2, f_2|\pi_1) \geq \pi_2) - E\pi_2^i(c_2, f_2|\pi_1, \pi_2^i(c_2, f_2|\pi_1) \geq \pi_2)$  are greater when  $i = g$  than when  $i = b$  for  $\forall c_1, c_2, c_L, f_1, f_2, f_L, \pi_1, \pi_2$ .

The first assumption states that the entrepreneur's expected profits increase, at a decreasing rate, with an increase in capital or fixed costs. The distribution of profits from a subsequent loan depends on the profit the entrepreneur generates from her previous loan. The second assumption indicates that the distribution of the benefit from obtaining a subsequent loan, when current profit is  $\pi_j'$ , first-order stochastically dominates the distribution when current profit is less than  $\pi_j'$ . Therefore, the expected benefit from a subsequent loan increases with an increase in the profits from the prior loan. The third assumption states that the distribution of profits for the good entrepreneur first-order stochastically dominates the bad entrepreneur's distribution. Finally, the fourth assumption indicates that the good entrepreneur's expected benefit from obtaining  $l_2$  [ $L$ ] is greater than the bad entrepreneur's expected benefit given that the expected per period profits from the first [second] loan is greater than  $\pi_1$  [ $\pi_2$ ]. The second, third and fourth assumptions ensure that good entrepreneurs benefit more from obtaining a loan than bad entrepreneurs. These assumptions are sufficient conditions for the single crossing condition to be satisfied. Finally, I assume that the number of good entrepreneurs in the population is large enough so as not to restrict the non-profit organization's optimal choice of the number of groups,  $n$ , or the number of entrepreneurs in each group,  $e$ .

<sup>8</sup> For simplicity, I assume that profits are the same across all periods.

Consider the incentive of an entrepreneur to repay a loan. Entrepreneur  $i$  has incentive to pay back the second loan and incur additional fixed costs  $f''$ , in order to obtain additional capital  $L$ , if the following inequality is satisfied.

$$E\pi_L^i(c_L, f_L | \pi_2) - (1 - D)f'' \geq \pi_2 \tag{i}$$

The fixed costs are normalized, where  $D$  is the discount factor, because the payoffs represent per period profits. Let  $\hat{\pi}_2^i$  be such that the equation holds with equality. Due to Assumption 2, entrepreneur  $i$  will repay the second loan if her realized per period profits after the second loan is not less than  $\hat{\pi}_2^i$ . Entrepreneur  $i$  will obtain the second loan by repaying the first loan and incurring fixed costs  $f'$  if the following inequality holds.

$$\begin{aligned} & \left\{ (1 - D)E\pi_2^i(c_2, f_2 | \pi_1) + Dp_2^i(\cdot) \left[ E\pi_L^i(c_L, f_L | \pi_2^i(c_2, f_2 | \pi_1)) \geq \hat{\pi}_2^i \right] \right. \\ & \quad \left. - (1 - D)f'' \right\} + D \left[ 1 - p_2^i(\cdot) \right] E\pi_2^i(c_2, f_2 | \pi_1, \pi_2^i(c_2, f_2 | \pi_1) < \hat{\pi}_2^i) \\ & - (1 - D)f' \geq \pi_1 \end{aligned} \tag{ii}$$

The left-hand side represents the normalized expected payoff if the entrepreneur obtains the second loan where  $p_2^i(\cdot)$  represents the probability that  $\pi_2^i(c_2, f_2 | \pi_1) \geq \hat{\pi}_2^i$ . Let  $\pi_{N2}^i(\cdot)$  denote this normalized expected payoff. Both  $p_2^i(\cdot)$  and  $\pi_{N2}^i(\cdot)$  are functions of the size of the loans, the fixed costs, the repayment levels and the realization of  $\pi_1$ . Let  $\hat{\pi}_1^i$  be the per period profit after receiving the first loan which makes the above equation hold with equality (i.e.,  $\pi_{N2}^i(\cdot) = \hat{\pi}_1^i$ ). Therefore, the entrepreneur obtains the second loan if  $\pi_1 \geq \hat{\pi}_1^i$ . Entrepreneur  $i$  will obtain the first loan if inequality (iii) holds where  $p_1^i(\cdot)$  is the probability that  $\pi_1^i(c_1, f_1) \geq \hat{\pi}_1^i$ .

$$\begin{aligned} & \left\{ (1 - D)E\pi_1^i(c_1, f_1) + Dp_1^i(\cdot) E\pi_{2N}^i(c_2, f_2 | \pi_1^i(c_1, f_1) \geq \hat{\pi}_1^i) \right. \\ & \quad \left. + D \left[ 1 - p_1^i(\cdot) \right] E\pi_1^i(c_1, f_1 | \pi_1^i(c_1, f_1) < \hat{\pi}_1^i) \right\} - (1 - D)f_1 \geq 0 \end{aligned} \tag{iii}$$

The left-hand side, which represents the normalized expected payoff if the entrepreneur obtains the first loan, will be denoted as  $\pi_{N1}^i(\cdot)$ . Similar to  $p_2^i(\cdot)$  and  $\pi_{N2}^i(\cdot)$ ,  $p_1^i(\cdot)$  and  $\pi_{N1}^i(\cdot)$  are also functions of the size of the loans, the fixed costs and the repayment levels. Let  $E p_2^i(\cdot)$  be the expected probability that entrepreneur  $i$  repays the second loan where the expectation is taken over  $\pi_1$ .

Lemma 1 states that loan sizes, fixed costs and repayment levels can be selected such that good entrepreneurs participate in the micro-lending program while bad entrepreneurs select not to participate.

**Lemma 1:** *There  $\exists$   $l_1, l_2, f_1, f_2, r_1$ , and  $r_2$  such that the following condition is satisfied.*

$$\pi_{N1}^g(\cdot) \geq 0 > \pi_{N1}^b(\cdot)$$

See Appendix A for proof.

The loan sizes, repayment levels and fixed costs not only influence an entrepreneur’s incentive to obtain an initial loan but also to repay the loans. When

selecting the program structure, the non-profit organization considers all these factors. A likely reason why the programs are structured with a sequence of progressively larger loans is because repayment of the initial loan is an indication that the entrepreneur will be successful with subsequent loans. This idea is captured in Assumption 2 which ensures that the entrepreneur's expected profit from a subsequent loan is greater if her current profit is greater. In addition, this assumption causes entrepreneurs with larger expected profits to obtain a subsequent loan.

The goal of the non-profit organizations that operate these programs is to increase the consumption and production in their communities while maintaining their loan base. To maintain the loan base, the amount a program lends plus their overhead costs must equal the amount repaid on existing loans plus the amount donated. With this in mind, I consider the optimal structure of a program in the steady state. If only good entrepreneurs receive loans and these entrepreneurs repay the loans if their profits from the prior loan are greater than a certain threshold, then the steady state number of entrepreneurs who receive loan  $l_1$  is  $(ne)/(1 + p_1^g(\cdot))$  and who receive loan  $l_2$  is  $(p_1^g(\cdot)ne)/(1 + p_1^g(\cdot))$ . The organization's balanced budget constraint is given below.

$$\begin{aligned} & \frac{ne}{1 + p_1^g(\cdot)} [l_1 + p_1^g(\cdot)l_2] + F(n, e, f_1 + f') \\ & = \frac{ne}{1 + p_1^g(\cdot)} [p_1^g(\cdot)r_1 + p_1^g(\cdot)E p_2^g(\cdot)r_2] + d \end{aligned}$$

The first term on the left hand side is the amount the organization lends to the entrepreneurs. The second term is the organization's overhead costs which is a function of the number of entrepreneurs in a group, the number of groups and the fixed costs imposed on the entrepreneurs with  $\partial F/\partial n > 0$ ,  $\partial^2 F/\partial n^2 > 0$ ,  $\partial F/\partial e > 0$ ,  $\partial^2 F/\partial e^2 > 0$ ,  $\partial F/\partial f > 0$  and  $\partial^2 F/\partial f^2 > 0$ . The right hand side is the expected repayment from existing loans plus the amount of donations ( $d$ ).

The model is such that the non-profit organization selects the program's group size, number of groups, loan sizes, fixed costs and repayment levels. The objective of the peer group micro-lending programs is to increase local consumption and production in their communities. Measuring this increase is practically impossible and, therefore, it is difficult to identify the organization's "payoff function". I assume a general payoff function of  $ne\Omega(l_1, l_2, f_1, f_2, r_1, r_2)$  where the payoff per good entrepreneur is  $\Omega(l_1, l_2, f_1, f_2, r_1, r_2)$ .<sup>9</sup> A non-profit organization structures the program so that bad entrepreneurs are deterred from obtaining loans

<sup>9</sup> The large majority of entrepreneurs involved in these programs start businesses whose employees and customers are in the local community. Perhaps a reasonable proxy of a program's effect on local consumption and production are the profits of participating entrepreneurs.

and good entrepreneurs not only obtain loans but repay the loans if their businesses are reasonably successful. Thus in the steady state, the non-profit organization selects the program structure that solves the following constrained maximization problem.

$$\text{Max}_{l_1, l_2, f_1, f_2, r_1, r_2, n, e} ne\Omega(l_1, l_2, f_1, f_2, r_1, r_2)$$

subject to:

$$\begin{aligned} & \frac{ne}{1 + p_1^g(\cdot)} [l_1 + p_1^g(\cdot)l_2] + F(n, e, f_1 + f') \\ & = \frac{ne}{1 + p_1^g(\cdot)} [p_1^g(\cdot)r_1 + p_1^g(\cdot)E p_2^g(\cdot)r_2] + d \end{aligned} \quad (1)$$

$$\pi_{N1}^g(\cdot) \geq 0 \quad (2)$$

$$\pi_{N1}^b(\cdot) \leq 0 \quad (3)$$

The effect of the loan sizes, fixed costs and repayment levels on  $p_1^i(\cdot)$ ,  $p_2^i(\cdot)$ ,  $\pi_{N1}^g(\cdot)$  and  $\pi_{N1}^b(\cdot)$  depend on Eqs. (i), (ii) and (iii) above.

#### 4.2. Program structure

The non-profit organization's choice of program structure depends on the program's objective function, how capital and fixed costs affect the distribution of entrepreneurs' profits, how group configuration and fixed costs influence the program's overhead costs, and the amount of capital and fixed costs associated with the conventional lending institution. To determine the optimal program structure, explicit functional forms must be specified for the organization's payoff function, the entrepreneur's profits and the overhead costs. The selection of explicit functional forms would be arbitrary and provide only minimal additional insight into the choice of program structure. Therefore, I consider the trade-offs when selecting the optimal fixed costs, loan sizes, repayment levels, and group configuration.

The proof of Lemma 1 demonstrates that the fixed costs, loan sizes and repayment levels cannot be selected so that both the good and bad entrepreneur's participation constraints bind. Whether the bad or good entrepreneur's constraint binds or whether neither bind depends on, among other things, how fixed costs influence the entrepreneurs' payoff functions. For instance, suppose the fixed costs have no effect on these payoff functions. In this case,  $f_1$  and  $f_2$  would be selected to minimize overhead costs while ensuring that the bad entrepreneur is deterred from participating in the program. This would cause the bad entrepreneur's constraint to bind. If the fixed costs do affect the payoff functions, then the

non-profit organization selects  $f_1$  and  $f_2$  by weighing this benefit with the increase in overhead costs (while still ensuring that the good entrepreneurs obtain the loan and the bad entrepreneurs do not obtain a loan). This benefit includes increasing the good entrepreneurs' expected profits as well as increasing the probability of loan repayment.

Consider the benefits of reducing the size of the first loan ( $l_1$ ) and the amount of additional capital after the first loan ( $l_2 - r_1$ ). One benefit is that lower fixed costs are required to deter bad entrepreneurs from participating in the program. This is more likely to be beneficial if overhead costs increase substantially with fixed costs and if the fixed costs have minimal effect on the entrepreneur's payoff functions. Another benefit of reducing  $l_1$  and  $l_2 - r_1$  results from the fact that  $\partial E^2 \pi_j^i(\cdot) / \partial c_j^2 < 0$ . For a given amount of capital, the total expected profits of all entrepreneurs increase as the capital received by each entrepreneur decreases and the number of entrepreneurs receiving capital increases. The cost of reducing  $l_1$  and  $l_2 - r_1$  is that to have a noticeable impact on the consumption and production in the local community, the non-profit organization must distribute many loans. This is achieved by having a large number of groups and/or a large number of entrepreneurs in each group which increase overhead costs.

The repayment level associated with the second loan ( $r_2$ ) influences whether the good and bad entrepreneurs participate in the program. It also affects the amount of funds available for future loans. By increasing  $r_2$ , the non-profit organization decreases the expected profits of the good entrepreneurs and decreases the incentive for bad entrepreneurs to participate in the program. A larger repayment level also increases the capital available to make loans in the future. In this manner, the repayment level influences how much capital the non-profit organization transfers from entrepreneurs who can qualify for a loan from a conventional lending institution to entrepreneurs who are seeking first loans. Because the number of groups and the size of groups are influenced by this transfer of capital, the repayment level indirectly affects overhead costs. Fixed costs and loan sizes are also indirectly affected because the repayment level influences the entrepreneurs' incentives to participate in the program.

The optimal group configuration in terms of group size and number of groups satisfies  $e/n = (\partial F / \partial n) / (\partial F / \partial e)$ . This condition follows directly from the first order conditions of the constrained maximization problem. Group size and number of groups are selected to minimize the program's overhead costs conditional on the total number of loans distributed and the level of fixed costs imposed on the entrepreneurs.

## 5. Conclusion

There are numerous competing explanations for the existence and success of peer group micro-lending programs. My model provides an alternative explanation

where micro-lending programs use peer groups as a mechanism to reduce overhead costs. Peer groups enable fixed costs (such as meetings, training seminars and business plans) to be imposed on the entrepreneurs while minimizing the program's overhead costs. These fixed costs deter bad entrepreneurs from participating in the program and increase the expected profits for good entrepreneurs who enter the program and obtain loans. The good entrepreneurs have incentive to repay loans in order to obtain subsequent loans and avoid a bad credit rating.

While I believe that monitoring, peer pressure, mutual insurance and information transfer do exist in many programs, I use evidence from programs in Canada and the United States to argue that my model better explains these peer group micro-lending programs. To empirically test which explanation best fits these programs, group level data are required. For instance, suppose groups composed of entrepreneurs in similar businesses are more likely to repay loans. This would suggest that information transfer plays an important role in these programs. If groups composed of family members are more likely to repay loans, then peer pressure may be an important factor. Obtaining reliable data is difficult at this time because most North American programs are relatively new and their structures have been constantly evolving to adapt to the peculiarities of their economic environment.

Although there has been an increase in the overall number of peer group programs in the United States and Canada, there has also been many programs terminated due to lack of success. In addition, the overall success of programs in the United States and Canada has not matched the success of many of the programs abroad. These two facts bring into question the long-term viability of peer group microlending programs in the United States and Canada. One possible reason for the limited success in the United States and Canada is that they do not have the advantage of monitoring, peer pressure, mutual insurance and information transfer that exist in programs abroad. Another potential reason is the inability of programs in the United States and Canada to adapt the peer group lending concept to their economic environment. Perhaps they relied on the belief that monitoring, peer pressure, mutual insurance and information transfer would lead to the program's success instead of designing peer group programs with the primary objective of training participating entrepreneurs while managing overhead costs. Whether peer group microlending programs are viable in the long term depends on the reason for their limited success and how the programs are able to adapt to the economic environment of the United States and Canada.

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**Appendix A. Proof of Lemma 1**

The proof of Lemma 1 is accomplished in five steps.

(1)  $\hat{\pi}_2^g < \hat{\pi}_2^b$ . Assumption 3 ensures that  $E\pi_L^g(c_L, f_L|\pi_2) - \pi_2 - (1 - D)f'' > E\pi_L^b(c_L, f_L|\pi_2) - \pi_2 - (1 - D)f''$ .  $\hat{\pi}_2^g$  and  $\hat{\pi}_2^b$  are defined such that  $E\pi_L^g(c_L, f_L|\hat{\pi}_2^g) - \hat{\pi}_2^g - (1 - D)f'' = 0$  and  $E\pi_L^b(c_L, f_L|\hat{\pi}_2^b) - \hat{\pi}_2^b - (1 - D)f'' = 0$ . Because  $E\pi_L^i(c_L, f_L|\pi_2) - \pi_2$  increases with an increase in  $\pi_2$  based on Assumption 2,  $\hat{\pi}_2^g < \hat{\pi}_2^b$ .

(2)  $\pi_{N_2}^g(\cdot) > \pi_{N_2}^b(\cdot)$ . The normalized expected payoff if entrepreneur *i* obtains the second loan can be expressed as  $E\pi_2^i(c_2, f_2|\pi_1) + Dp_2^i(\cdot)[E\pi_L^i(c_L, f_L|\pi_2^i(c_2, f_2|\pi_1) \geq \hat{\pi}_2^i) - (1 - D)f'' - E\pi_2^i(c_2, f_2|\pi_1, \pi_2^i(c_2, f_2|\pi_1) > \hat{\pi}_2^i)]$ . Let  $\pi_{N_2}^{g(b)}(\cdot)$  be the good entrepreneur’s normalized expected payoff if she repays the second loan when  $\pi_2 \geq \hat{\pi}_2^b$ . Therefore,  $\pi_{N_2}^{g(b)}(\cdot) = E\pi_2^g(c_2, f_2|\pi_1) + Dp_2^{g(b)}(\cdot)[E\pi_L^g(c_L, f_L|\pi_2^g(c_2, f_2|\pi_1) \geq \hat{\pi}_2^b) - (1 - D)f'' - E\pi_2^g(c_2, f_2|\pi_1, \pi_2^g(c_2, f_2|\pi_1) \geq \hat{\pi}_2^b)]$  where  $p_2^{g(b)}(\cdot)$  is the probability  $\pi_2^g(c_2, f_2|\pi_1) \geq \hat{\pi}_2^b$ . Assumption 3 causes  $E\pi_2^g(c_2, f_2|\pi_1) > E\pi_2^b(c_2, f_2|\pi_1)$  and  $p_2^{g(b)}(\cdot) > p_2^b(\cdot)$ . Assumption 4 and the definition of  $\hat{\pi}_2^b$  cause  $E\pi_L^g(c_L, f_L|\pi_2^g(c_2, f_2|\pi_1) \geq \hat{\pi}_2^b) - E\pi_2^g(c_2, f_2|\pi_1, \pi_2^g(c_2, f_2|\pi_1) \geq \hat{\pi}_2^b) > E\pi_L^b(c_L, f_L|\pi_2^b(c_2, f_2|\pi_1) \geq \hat{\pi}_2^b) - E\pi_2^b(c_2, f_2|\pi_1, \pi_2^b(c_2, f_2|\pi_1) \geq \hat{\pi}_2^b) > 0$ . These inequalities ensure that  $\pi_{N_2}^{g(b)}(\cdot) > \pi_{N_2}^b(\cdot)$ . Because  $\hat{\pi}_2^g < \hat{\pi}_2^b$ ,  $E\pi_L^g(c_L, f_L|\pi_2^g(c_2, f_2|\pi_1) \geq \pi_2) - (1 - D)f'' - E\pi_2^g(c_2, f_2|\pi_2^g(c_2, f_2|\pi_1) \geq \pi_2) > 0$  when  $\hat{\pi}_2^g < \pi_2 < \hat{\pi}_2^b$ . Thus,  $\pi_{N_2}^g(\cdot) > \pi_{N_2}^{g(b)}(\cdot)$  and  $\pi_{N_2}^g(\cdot) > \pi_{N_2}^b(\cdot)$ .

(3)  $\hat{\pi}_1^g < \hat{\pi}_1^b$ . Proof is analogous to the argument in Step 1.

(4)  $\pi_{N_1}^g(\cdot) > \pi_{N_1}^b(\cdot)$ . Proof is analogous to the argument in Step 2.

(5)  $\pi_{N_1}^g(\cdot) \geq 0 > \pi_{N_1}^b(\cdot)$ . Based on Assumption 1 and  $\pi_{N_1}^g(\cdot) > \pi_{N_1}^b(\cdot)$ , it must be the case that there exists  $l_1, l_2, f_1, f_2, r_1$ , and  $r_2$  such that  $\pi_{N_1}^g(\cdot) \geq 0 > \pi_{N_1}^b(\cdot)$ .

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