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EMPIRICAL MEASUREMENTS OF HOUSEHOLDS' ACCESS TO CREDIT AND CREDIT CONSTRAINTS IN DEVELOPING COUNTRIES: METHODOLOGICAL ISSUES AND EVIDENCE

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ABSTRACT

This paper presents a new methodological framework for measuring the level of household access to credit. It provides an analytical framework for examining the determinants of household credit limits and derives implications on information needed to examine the extent to which households are credit constrained. Empirical application of this method involves directly eliciting credit limit information in household surveys. Illustrations are provided using data from Bangladesh and Malawi.

CONTENTS

Acknowledgments vii

1. Introduction 1

2. Review of Existing Approaches of Measuring Access to Credit and Credit Constraints 4

    Detection of Credit Constraint Through Violation of Life-Cycle Hypothesis 4
    Detection of Credit Constraint by Directly Asking Households 6

3. Extension of the Direct Method: The Credit Limit Variable 8

    The Concept of Credit Limit 9
    The Contract-Theoretic Framework of the Credit Market 12
    Credit Constraint, Credit Rationing, and Access to Credit 15
    Access to Credit and Participation in Formal Credit Programs 19
    Implications for the Measurement of the Impacts of Access to Credit 20
    “Expectations” and Observability of the Credit Limit 21

4. Extent of Household Access to Formal and Informal Credit in Malawi and Bangladesh 28

    Empirical Distribution of Credit Limits and Unused Credit Lines 31
    Access to Credit, Credit Constraints, and Participation in Credit Programs 34

5. Conclusion 36

Appendix 39

Tables 41

Figures 45

References 51

TABLES

1 Average maximum credit limit and unused credit line in the informal and formal market, by country and by gender of respondent 43

2 Percentage of households having access to informal and formal credit: by membership in group-based credit program and by country 44

3 Percentage of households experiencing a binding credit constraint in the informal and formal market, by membership in group-based credit program and by country 44

FIGURES

1 Distribution of formal and informal credit limits in Bangladesh and Malawi: Box plot diagrams 47

2 Distribution of unused formal and informal credit lines in Bangladesh and Malawi: Box plot diagrams 48

3 Distribution of formal and informal credit limits in Bangladesh and Malawi: Box plot diagrams by gender of respondents 49

4 Distribution of unused formal and informal credit lines in Bangladesh and Malawi: Box plot diagrams by gender of respondents 50

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1. INTRODUCTION

Most policy and research interests regarding rural credit markets revolve around the perception that poor rural households in developing countries lack adequate *access to credit*, which is believed to have significant negative consequences on various aggregate and household-level outcomes, including technology adoption, agricultural productivity, food security, nutrition, health, and overall household welfare.

Access to credit affects household welfare outcomes through at least two channels. First, it alleviates the capital constraints on agricultural households. Expenditures on agricultural inputs must be incurred during the planting and growth periods of crops, while returns are received only after the harvest several months later. Therefore, to finance the purchase of inputs, the farm household must either dip into savings or obtain credit. Hence, access to credit can significantly increase the ability of poor household with no or little savings to acquire needed agricultural inputs. Access to credit also reduces the opportunity costs of capital-intensive assets relative to family labor, thus encouraging labor-saving technologies and raising labor productivity, a crucial factor for development, especially in many African countries (Delgado 1995; Zeller et al. 1997).

The second channel through which access to credit affects household welfare is by increasing its risk-bearing ability and altering its risk-coping strategy. Just the knowledge that credit will be available to cushion consumption against an income shortfall should a potentially profitable, but risky, investment turn out badly will induce the household to bear the additional risk. The household may therefore be willing to adopt new, more risky technologies (Eswaran and Kotwal 1990). A household may also benefit from mere access to credit, even if it is not borrowing, because with the option of borrowing it can avoid adopting risk-reducing, but inefficient, income diversification strategies or engaging in precautionary savings with negative returns.

For these reasons, most developing countries' governments and donors during the past 40 years have set up credit programs aimed at improving rural households' access to credit. The vast majority of these programs, especially the so-called "agricultural development banks" that provide credit at subsidized interest rates, have failed both to achieve their objectives to serve the rural poor and be sustainable credit institutions (Adams, Graham, and von Pischke 1984; Braverman and Guasch 1986; Adams and Vogel 1985). Meanwhile, most rural households in developing countries continue to rely on the informal credit market for their intertemporal transfer of resources. They use complex strategies to increase their productive capacity, share risk, and smooth consumption over their life cycles. These strategies generally work through self-enforcing informal contracts among friends, neighbors, and members of the extended family, and are arranged within networks of informal institutions of diverse natures (Fafchamps 1992; Coate and Ravallion 1993; Lund and Fafchamps 1997). One hypothesis, often advanced by researchers and policymakers, is that government and NGO-supported credit programs may crowd out the financial services offered by these informal financial institutions. Hence, understanding how the nonmarket informal institutions serve households' demand for financial services and interact with the formal credit institutions set up by governments and NGOs is critical in identifying policies, institutional designs, and financial services that expand and complement rather than substitute for the services offered by the existing informal credit market. An important step for obtaining this policy-relevant information is to quantify the extent and determinants of households' access to nonformal and formal credit markets as well as the severity of their credit constraints.

The objectives of this paper are twofold: to present a new methodological framework for measuring the level and determinants of household access to credit and credit constraints, and the effects of access to credit on household behavior and welfare; and to exemplify the methodology with data collected in Malawi and Bangladesh on the extent of rural households' access to credit and credit constraints in developing countries. Since the novelty of the methodology is mainly the nature of the data collected, the method of presenting the empirical evidence is almost exclusively tabular and descriptive. The *credit limit* is the key variable in the methodology and, to the authors' knowledge, data on it have never been collected before. Therefore, the paper discusses data collection issues regarding this variable. An econometric analysis that formalizes the methodology of this paper is presented in Diagne (1997, 1999).

The paper is organized as follows. Section 2 reviews briefly the methodologies that have been used in the literature to measure household access to credit and credit constraints. Section 3 presents the new methodology for measuring access to credit and its effects on household welfare outcomes and discusses the various credit-related concepts underlying the methodology. Section 4 presents the empirical evidence on the extent of household access to credit and credit constraints in Malawi and Bangladesh. Section 5 concludes the paper with remarks on the policy relevance of the methodology and empirical evidence.

2. REVIEW OF EXISTING APPROACHES OF MEASURING ACCESS TO CREDIT AND CREDIT CONSTRAINTS

Broadly speaking, there are two methodologies for measuring household access to credit and credit constraints. The first and indirect method infers the presence of credit constraints from violations of the assumptions of the life-cycle or permanent income hypothesis, while the second collects information directly from household surveys on whether households perceive themselves to be credit constrained.

DETECTION OF CREDIT CONSTRAINT THROUGH VIOLATION OF LIFE-CYCLE HYPOTHESIS

One of the testable implications of the simple version of the life-cycle/permanent income hypothesis (LC/PIH) is that *in the absence of liquidity and borrowing constraints, transitory income shocks should not affect consumption* (see, for example, Hall 1978, and Deaton 1992). Empirical models testing for the presence of credit constraints based on the life-cycle/permanent income or “consumption-smoothing” hypotheses use household consumption and income data to look for a significant dependence (or “excess sensitivity”) of consumption on transitory income. Empirical evidence of a significant dependence is taken as an indication of a borrowing or liquidity constraint. The LC/PIH literature is extensive and is reviewed by Browning and Lusardi (1996), Besley (1995), Deaton (1992; 1989), Alderman and Paxson (1992), and Gersovitz (1988), among others. In general, the empirical evidence based on the LC/PIH approach has been inconclusive. At first, one may think that this is due to the fact that empirical testing of the implications of the LC/PIH requires repeated observations on the same household, whereas most of the studies are based on relatively short panels. However, there are more fundamental reasons why the evidence from the LC/PIH approach for detecting credit constraint has been inconclusive.

First, and perhaps most important, under conditions of uncertainty, violation of the implications of the LC/PIH can result from prudent or precautionary behavior even if the household is not credit constrained (Zeldes 1989b; Kimball 1990; Carroll 1991). Several authors have extended the standard life-cycle model to explicitly incorporate both liquidity constraint and precautionary behavior, and assess either through simulation or empirical testing the importance of each effect (Zeldes 1989b; Morduch 1990; Deaton 1991; Paxson 1992). However, due to identification problems, it is nearly impossible to disentangle the effects of credit constraint and precautionary behavior from the type of income, consumption, and asset data typically available for these studies (Browning and Lusardi 1996). Second, if conditions of uncertainty are negatively correlated with wealth, then current income will be negatively correlated with consumption growth, even in the absence of borrowing constraints (Carroll 1991). Moreover, as Deaton (1990) points out, the effect of negative income shocks on consumption also depends on the initial asset position of households. Browning and Lusardi (1996, 1832) list several other reasons why the implications of the LC/PIH may be violated even without a credit constraint. Furthermore, an important insight from the simulation results of Deaton (1991) is that a credit-constrained household may still be able to smooth consumption with precautionary saving and thus not violate any implication of the LC/PIH. Hence, one can conclude that the violation of an implication of the LC/PIH is neither a sufficient nor necessary condition for being credit constrained.

DETECTION OF CREDIT CONSTRAINT BY DIRECTLY ASKING HOUSEHOLDS

The second method of detecting the presence of credit constraint uses information gained directly from household members on their participation and experiences in the credit market to determine if they are credit constrained. In practice, households are classified as credit constrained, based on their responses to several *qualitative* questions regarding their loan applications (or lack of) and rejections during a given recall period. This classification is then used in reduced-form regression equations to analyze the determinants of the likelihood of a household being credit constrained and the effects of this likelihood on various household outcomes. The method was first applied by Jappelli (1990) using data from the U.S. 1983 Survey of Consumer Finances and by Feder et al. (1990) using data from a household survey in China. The method was subsequently used by Zeller (1994), Schrieder and Heidhues (1995), and Zeller, Sumiter, and Sharma (1996) with household survey data from Madagascar, Cameroon, and Pakistan; and by Barham and Boucher (1994) with data from Guatemala. The theoretical justification for the direct method itself can be found in the extended version of the life-cycle/permanent income model that explicitly allows for the possibility of a credit constraint. For example, Jappelli (1990) used the credit constraint inequality in the extended model to derive reduced-form equations for the determinants of the likelihood of a household being constrained. The information on household credit-market experiences collected in the direct method is also an important contribution toward empirically identifying the respective effects of liquidity constraint and precautionary behavior in life-cycle models (Browning and Lusardi 1996).

However, despite representing a substantial improvement compared to trying to detect presence of credit constraint through violation of the LC/PIH, the direct method, as it has been applied so far, is still incapable of providing a framework that allows the quantification of the extent to which households are credit constrained or a satisfactory assessment of the impact of access to credit on household welfare outcomes. Indeed, the approach is still qualitative in the sense that households are classified as either credit constrained or not with no information on how severely credit constrained they are. Similarly, the estimation of the determinants of credit constraint provides only information on what socioeconomic factors affect the likelihood of a household being credit constrained. It does not provide the answer to the question of how these socioeconomic factors affect the *extent* to which a household is credit constrained. The approach also does not allow an assessment of the effects of loosening, but not completely relaxing, the credit constraint has on household welfare outcomes. This would valuable information for policymakers, who are often faced with the need to allocate limited resources to several competing projects, all of which aim to increase the poor's welfare. To correct the shortcomings of the direct method, the next section develops a conceptual framework and data collection methodology that aims to measure the extent to which households are credit constrained.

3. EXTENSION OF THE DIRECT METHOD: THE CREDIT LIMIT VARIABLE

The credit market can be—and often is—analyzed as any other commodity market would be, using the concept of demand and supply of credit, with the interest rate being the price of credit. In this framework, the supply and demand curve represents, respectively, the amount the lender is willing to lend and the amount the borrower is willing to borrow at exogenously given interest rates. This simplistic Walrasian equilibrium view of the credit market is, however, not useful for understanding the nature of credit transactions and their outcomes (Stiglitz and Weiss 1981; Freixas and Rochet 1997). For one, the assumption of price-taking behavior on the part of the lender is hardly realistic, especially in a developing country context. For example, village moneylenders are often known to behave monopolistically toward borrowers, determining interest rates based on the characteristics of the borrower and on the size of the loans. In the vast majority of cases of mutual lending between friends and relatives (which dominates the informal credit market of Sub-Saharan Africa), lenders choose not to charge interest. Even in the semiformal credit market dominated by NGOs and government-supported credit programs targeted at particular sections of the population, lenders set various interest rates according to criteria related to accessibility, equity, poverty alleviation, or the desire to increase agricultural output.[1]

Even without the unrealistic price-taking behavior assumption, more fundamental problems related to information asymmetries and contract enforcement make the simplistic Walrasian equilibrium view of the credit market inappropriate for understanding the nature of credit transactions and their outcomes. These problems are discussed in the next section.

THE CONCEPT OF CREDIT LIMIT

The inappropriateness of the Walrasian equilibrium view of the credit market can be seen when the analysis focuses at the level of an individual credit transaction. It is noted at the outset that credit from any possible source is of limited supply, i.e., lenders are constrained by factors beyond their control on the maximum amount they can possibly lend to any potential borrower. This maximum is a function of available resources and is independent of the interest rate that can be charged and of the likelihood of default. This is especially true in developing countries, where even established commercial banks are very limited in their ability to raise capital for on-lending. Consequently, any borrower, however creditworthy, faces a limit on the overall amount he can borrow from any given source of credit; regardless of the interest rate he is willing to pay, or collateral he is willing to put up.

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[1] Thus, it is extremely rare to find two credit programs charging the same interest rate even if they operate in the same geographical areas.

Furthermore, due to the possibility of default and lack of effective contract enforcement mechanisms, lenders have additional incentives to restrict the supply of credit, even if they have more than enough to meet a given demand and the borrower is willing to pay a high enough interest rate (Avery 1981; Stiglitz and Weiss 1981). As shown by Stiglitz and Weiss (1981), the possibility of adverse selection arising from the asymmetry of information between the lender and the borrower will usually prevent the lender from using the interest rate as a way to ration credit (i.e., to eliminate excess demand for credit).

From the borrower’s view, the relevant limit on supply is not the maximum the lender is *able* to lend, but rather the maximum the lender is *willing* to lend. The wedge between the *willing* and *able* represents the extent of the credit rationing that arises mainly because of information asymmetries. However, whether there is credit rationing or not, there is a perceived *maximum limit* that cannot be exceeded when borrowing, regardless of the interest rate one is willing to pay. This *credit limit* is the focus of the methodology for quantifying the extent of household access to credit presented here.

Before elaborating further on the credit limit, it should be pointed out that there is nothing new in the concept, as it explicitly or implicitly underlies any discussion of credit or liquidity constraints in the LC\PIH literature. However, the formulation of the credit constraint in the LC\PIH literature focuses on household assets, income, and consumption variables, and abstracts from all the variables related directly to the credit market. The former set of variables do affect credit transactions, but only indirectly (except the case of an asset being used as collateral). The most important credit variable, the actual amount borrowed, is almost never explicit in a formulation of the credit constraint in the LC\PIH literature. It is reduced to being simply the residual $c_t - y_t - A_t$, where c_t, y_t, and A_t are household consumption, labor income, and net asset holding, respectively. The credit limit variable is almost always implicit in the LC/PIH framework. Even in Jappelli's formulation where the credit limit variable is explicit, it ends up being eliminated through a reduced-form specification of its determinants. Consequently, undertaking an empirical analysis based on this formulation of the credit constraint implies either not collecting or discarding important information. A conceptual framework that explicitly accounts for the credit limit is presented in the following sections.

THE CONTRACT-THEORETIC FRAMEWORK OF THE CREDIT MARKET

Because the credit limit is the central concept in this paper's methodology for quantifying the extent of household access to credit and the effects that access to credit has on its welfare outcomes, a model of loan transaction focusing explicitly on the concept will be presented. The model follows a contract-theoretic view of loan transaction (e.g., Freixas and Rochet 1997). Essentially, the lender chooses the credit limit and the amount he wants to be repaid; the borrower then chooses the amount to be borrowed within this range and once the loan is disbursed, whether and when to pay back the loan.

More precisely, the lender chooses the pair $(b_{max}\ ,\ \boldsymbol{R}^{l}(.))$ where b_{max} is the maximum amount he is *willing* to lend, and $\boldsymbol{R}^{l}$ is a repayment function $\boldsymbol{R}^{l}:\ [0\ ,\ b_{max}] \rightarrow \mathbb{R}$ specifying how much, when, and under what conditions he wants to be repaid for any given loan size $b \in [0\ ,\ b_{max}]$.[2] The lender then lets the potential borrower choose the optimal amount $b^{*} \in [0\ ,\ b_{max}]$ to borrow. In other words, the lender offers the contract $(b_{max}\ ,\ \boldsymbol{R}^{l}(.))$ to the borrower who accepts or rejects it by his choice of $b^{*} \in [0\ ,\ b_{max}]$. The contract is accepted if b^{*} is strictly positive, and rejected if $b^{*} = 0$.[3] Once the loan is disbursed, the borrower chooses the timing and amount(s) of the actual repayment(s) R^{b}. Default occurs when $0 \leq R^{b} < \boldsymbol{R}^{l}(b^{*})$.[4] Of course, in its choice of b_{max}, the lender is constrained himself by the maximum amount he is *able* to lend to any borrower, b^{a}_{max}.[5]

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[2] Due to fixed transaction costs, lenders in the formal and semiformal credit markets have also minimum loan sizes. That is, the amount to be borrowed is restricted to lie in a interval of the form $[b_{min}\ ,\ b_{max}]$, with $b_{min} > 0$. Extension to this case is straightforward, and there is no loss of generality in using 0 as a lower bound for loan sizes.

[3] We have abstracted from issues regarding collateral in order to simplify the exposition. One specification for $\boldsymbol{R}^{l}$ is the linear repayment function $\boldsymbol{R}^{l}(b) \equiv (1+r)b$, where r is the interest rate endogenously chosen by the lender. A more general specification for $\boldsymbol{R}^{l}$ that allows state-contingent repayment of loans is $\boldsymbol{R}^{l}(b,\text{ù}) \equiv (1+r)b + \boldsymbol{\text{ç}}(\text{ù})$, where ù is an element of the set of possible states of nature, Ù, and $\boldsymbol{\text{ç}}:\ \text{Ù} \rightarrow \mathbb{R}$ is an exogenous, real-valued random variable. State-contingent repayments of loans is also a very important feature of the informal credit market as documented by Udry (1995).

[4] This is not the only sufficient condition for breaching the terms of the contract. Even if $R^{b} = \boldsymbol{R}^{l}(b^{*})$, breach of contract may still have occurred if the timing of the repayment (possibly in partial amounts) does not correspond with what was specified in the contract. To simplify the notation, we did not include timing issues in the specification of the repayment function $\boldsymbol{R}^{l}()$.

Some may argue that it is the borrower who first asks for the loan. Then, the lender, after having received the loan application, decides whether to grant the amount asked or offer a lesser amount. Furthermore, one can argue that often a loan transaction involves some bargaining. However, the sequential order in which the loan transaction is started and whether some bargaining has occurred are details that, in most cases, are not important for the characterization of the outcome of the loan transaction. What is important is that, at the end, it is the lender who offers a contract to the borrower who, at his free will, decides to accept or reject the contract.

Note that the lender's optimal choice of the credit limit b_{max}, which is interpreted here as the supply for credit, is a function of the maximum he is able to lend, b^{a}_{max}. It is also a function of the lender's subjective assessment of the likelihood of default and of other borrower's characteristics. However, this function is not a supply-for-credit function in the traditional meaning of the term where, under the assumption of price-taking behavior, the supply-for-credit function represents the schedule of what the lender is willing to lend as the market interest rate varies. This traditional supply function for credit is not defined in this context where the lender himself chooses the interest rate. Similarly, the optimal interest rate r chosen by the lender is a function of b^{a}_{max}, the lender's subjective assessment of the likelihood of default, and of other borrower's characteristics. The reader is referred to Avery (1981) and Stiglitz and Weiss (1981), respectively, for an empirical and a formal analysis of how the lender's assessment of the likelihood of default affects the optimal choice of both b_{max} and r.[6] On the other hand, the function defining the borrower's optimal choice of loan size b^* is a demand-for-credit function in the traditional meaning of the term, i.e., the schedule of what the borrower is willing to borrow when the interest rate varies. The fact that b^* is a function of b_{max} in addition to being a function of the interest rate is a mere reflection of the borrowing constraint. However, because of imperfections in the enforcement of the loan contract and the resulting adverse selection, the demand for credit need not be a downward-sloping function of the interest rate. Hence, as pointed out by Stiglitz and Weiss (1981), lenders cannot use the interest rate as a way to ration credit.

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[5] For simplicity, we abstracted from issues related to how b^{a}_{max} is determined by conditions in the market for on-lending funds (possibility to raise capital from savers or the central bank, determination of interest paid on savings, regulations from the central bank, etc.).

CREDIT CONSTRAINT, CREDIT RATIONING, AND ACCESS TO CREDIT

The arguments in the previous sections have postulated that any borrower is *constrained to some extent* in his demand for credit from any source. In other words, at any point in time any potential borrower faces a constraint in the form:

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[6] In the framework of Stiglitz and Weiss (1981) the optimal interest rate r ($\hat{r}^*$ in their notation) is the interest rate that maximizes the lender's expected return from lending to a borrower; taking into account the possibility of default. It is this expected return which determines b_{max} (for a given level of b^a_{max}). Avery (1981) also uses the same expected return concept to justify the existence of credit limits for borrowers. His arguments and econometric specification of the determinants of borrowers' credit limits were based mostly on interviews with loan officers in New Jersey.

$$0 \leq b \leq b_{max} \quad . \qquad \textbf{(1)}$$

The question is not whether this constraint exists, but rather how it is formulated. One advantage of the formulation of the borrowing constraint in equation (1) compared to the standard formulation in the LC/PIH literature is the fact that the variables directly related to the credit market are explicit in equation (1). Also, with this formulation there can be a separate credit constraint for each source of credit (e.g., formal and informal credits).

The term *credit rationing* is often used interchangeably with *credit constraint*. But they express two different concepts. Credit rationing occurs because there is a wedge between what a lender is *willing* and *able* to lend and, from the analysis of Stiglitz and Weiss (1981), this wedge results from the exclusive choice of the lender. In other words, it is the lender's decision to further restrict the supply of credit below the amount he is actually able to lend that causes credit rationing. On the other hand, whether or not a borrower ends up being effectively credit constrained depends on his optimal loan demand. Even if, given the constraint set by the lender, the borrower ends up optimally borrowing an amount strictly less than what the lender is willing to lend, the credit transaction is still characterized by credit rationing. Furthermore, even though in this particular case the credit constraint ends up not being binding in the sense that the optimal amount borrowed is strictly less than the maximum amount that could be borrowed, the borrower may or may not be characterized as being credit constrained.

To illustrate this point, take the example of a borrower who wants to borrow for the sole purpose of buying an indivisible durable good. To be more precise, assume that he wants to finance a new car at $15,000. Also assume that the potential lender is rich enough to be able to lend up to $20,000, but after assessing the borrower's likelihood of repaying the loan, he decides that, for whatever purpose, the maximum he is willing to gamble on this particular borrower is $8,000. Under these circumstances, the borrower may decide optimally not to borrow at all because any amount borrowed will not be enough to cover the cost of the car.[7] In this case, although the borrower ends up borrowing an amount strictly less than what the lender is willing to lend him, there has been credit rationing in the amount of $12,000. Clearly, the borrower is also credit constrained in the sense that he could not borrow as much as he wanted. Yet, his credit constraint is not binding because the optimal amount actually borrowed is strictly less than the $8,000 credit limit. The borrower would not have been credit constrained if the car he wanted to buy costed only $5,000. But, in this latter case there still would have been credit rationing in the same amount of $12,000 (it just did not matter for the borrower). In other words, a borrower may be credit rationed without being credit constrained. On the other hand, if the maximum the lender is *able* to lend were in reality $8,000 instead of

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[7] Or he may decide to borrow just $3,000 to buy a used car.

$20,000, then there would be no credit rationing, yet the borrower would be credit constrained if he wanted to finance a new car at $10,000.

The example illustrates the difference between being credit constrained and being credit rationed. It also illustrates the ambiguity in the current meaning and use of the concept of credit constraint. For many, being credit constrained means having a binding credit constraint, i.e., when the optimal amount borrowed b^* is exactly equal to the credit limit b_{max} (in other words, when the borrower has exhausted his credit line). But, as we have seen in the example above, this definition does not correspond to the meaning of the concept of not being able to borrow as much as one wants. It can be seen that the definition will capture the meaning of the concept only when the loan is sought for the purpose of acquiring a divisible good; with the additional assumption of monotonic preference (or local nonsatiation). The formal definition of being credit constrained that captures or translates the meaning of not being able to borrow as much as one wants is that *the optimal amount borrowed when borrowing under the credit constraint* (1) *is strictly less than the optimal amount that would be borrowed if the credit constraint* (1) *did not exist*. This definition covers both cases of divisible and indivisible goods.

Although a binding credit constraint is not a necessary condition for being credit constrained, it is still important to know whether or not the *credit constraint* (1) *is binding* at the time credit was sought; and if so, how severe is the binding of the constraint, i.e., how close to zero is b_{max}. The *lack of access to credit* from a given source of credit can be seen to be an special and extreme case of a severe binding credit constraint, occurring when the credit limit b_{max} for that source of credit is zero. By definition then, one *has access* to a certain type of credit when its credit limit b_{max} for that type is strictly positive; and one *improves* one's access to that type of credit by increasing b_{max} for that type of credit.

It is important to note that with this definition of *access to credit*, someone may lack access to credit without being credit constrained. For example, in the empirical evidence presented below, there were respondents who said they could not obtain any loan from a formal lender, but gave the reason of not needing any loan or disliking any borrowing when answering the question, "Why did not you ask for any loan from a formal lender?" Hence, by definition, these households lack access to formal credit (since $b_{max} = 0$), but they are not credit constrained in the formal sector since the optimal amounts they would have borrowed from a formal lender were the same (zero) with or without the credit constraint (1). This is also another illustration of the difference between being credit constrained and having a binding credit constraint ($b^* = b_{max}$ in this case).

ACCESS TO CREDIT AND PARTICIPATION IN FORMAL CREDIT PROGRAMS

Access to formal credit is often confused with participation in formal credit programs. Indeed, the two concepts are often used interchangeably in many credit studies. The crucial difference between the two concepts lies in the fact that participation in a credit program is something that households *choose* to do, while access to a credit program is a limiting constraint put upon them (e.g., availability and eligibility criteria of credit programs). In other words, consistent with the arguments and definitions in the previous sections, participation is more of a demand-side issue related to the potential borrower's choice of the optimal loan size b^*, while access is more of a supply-side issue related to the potential lender's choice of the credit limit b_{max}.

The difference between the two concepts may become clearer by remembering from the arguments above that in any area with a formal credit program, the group of nonparticipants can be divided into two subgroups, the first consisting of the nonparticipants who were constrained through eligibility criteria (i.e., they have $b_{max} = 0$), and the other by those who chose not to participate because their optimal demands for formal credit were zero, i.e., they have $b^* = 0$. If it is assumed that credit program participants are always able to borrow, i.e., $b_{max} > 0$ for participants,[8] then it is clear that the second subgroup of eligible nonparticipant do have access to formal credit. Some may be uncomfortable to see some nonparticipants classified as having access to formal credit. However, this is consistent with the fact that program participation is not a separate spontaneous decision, but is rather part of the demand for formal credit that, under uncertainty, is a *contingent plan* (a sequence of acts contingent on the occurrence of random events) formulated well in advance of the time of possible borrowing. The decision to participate in a credit program is just a contingent act within that contingent plan (which includes other contingent acts such as how much to ask to borrow, when to ask it, etc.); and it is implemented only if the demand for credit is not unconditionally zero, i.e., if b^{*}(ù) > 0 for some ù $\in$ Ù, *and* the events upon which that decision was conditioned do occur. Hence, if a nonparticipant does not anticipate wanting formal credit, i.e., if b^{*}(ù) = 0 for all ù $\in$ Ù, there is no need for him to consider joining a formal credit program, even if, with a $b_{max} > 0$, he could possibly borrow from that program, i.e., by definition he has access to formal credit.

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[8] This is not always the case in some credit programs. For example, both the Grameen Bank in Bangladesh and the PMERW credit program in Malawi have a rule stipulating that at any point in time only half of the members of a group or club can obtain credit. The other half of the group will received credit only when members of the first half have fully paid back their loans.

IMPLICATIONS FOR THE MEASUREMENT OF THE IMPACTS OF ACCESS TO CREDIT

One of the most important policy and research questions regarding credit markets is often phrased in terms of how access or improved access to credit translates into change in household's outcomes such as agricultural output, income, food security, etc. This question is central in many decisions regarding government and NGO-supported credit programs where the economic benefits of providing households access to credit are compared to the economic costs of setting up these programs and delivering the credits to the target households. In the previous sections, *access to credit* and *improvement in access to credit* were identified, respectively, with a *strictly positive* and *increasing* credit limit, b_{max}. Hence, in the framework of this paper the above important policy and research question is translated as how an increase in b_{max} from 0 to a positive value and an increase in b_{max} from any strictly positive value translates into change in the household's behavioral and welfare outcomes of interest. The methodological implications of using the credit limit variable to measure the effect of access to formal credit on household welfare outcomes are discussed in detail in Diagne (1997b), which applies the methodology to data from Malawi.

"EXPECTATIONS" AND OBSERVABILITY OF THE CREDIT LIMIT

To this point in the analysis, the roles of borrowers and lenders have been kept distinct. However, in the informal credit market of developing countries, it is not always possible to classify a household as either a lender or a borrower, because many households are borrowing and lending at the same time. This is explained by the insurance function played by the informal credit market (Fafchamps 1992; Coate and Ravallion 1993; Lund and Fafchamps 1997). Hence, under these circumstances the household demand for credit cannot be modeled separately from its supply, as one of the motivations for giving out loans and gifts to other households is to preserve or improve access to credit in case the need for borrowing arises. In other words, when a household acting as a potential lender is faced with a demand for credit, its choice of a credit limit l_{max} for the borrowing household is naturally influenced by its desire or not to maintain or increase a strictly positive b_{max}, which will be chosen by the borrowing household when there is a need to borrow from that same household.

These observations suggest that the credit limit a borrower faces depends on both the lender and borrower's characteristics and actions. But it also depends on random events that affect the fortune of lenders and other potential borrowers (who may compete with the borrower for the same possible credit). For example, one can expect the occurrence of drought in a rural agriculture-based economy to reduce the supply of informal credit, while increasing the number of people looking for loans. Hence, the credit limit b_{max} facing a potential borrower is a random variable whose value is determined by events, some of which are under the borrower's control, others under the lender's control, and still others outside the control of either both. Therefore, the borrowing constraint (1) is stochastic, and depends on the prevailing state of nature. This implies that whether and where the credit constraint will bind cannot be known in advance for sure. Thus, forward-looking households may anticipate possible binding of their credit constraints and take precautionary measures (e.g., saving and income diversification) to ensure that their consumption and/or production plans will not suffer much when this occurs (Deaton 1991).

That b_{max} depends on random events also implies that its realized value at the times when borrowing actually takes place cannot be known exactly in advance (i.e., with probability 1) by either the lender or the borrower. The fact that b_{max} cannot be known in advance by the borrower is clear, since it ultimately is the result of the lender's choice (although, as explained above, the borrower can influence that choice to some extent). The borrower can only form expectations about the likely value of b_{max} at the time of actual borrowing. However, formal lenders usually provide enough information about their loan policies (eligibility criteria, types of projects funded, collateral and down payment requirements, etc.) to enable potential borrowers to have reasonably accurate expectations about their b_{max} from each source of formal credit. In the cases of NGO- and government-supported credit programs, they even usually set and announce fixed credit limits for all potential borrowers.

In general, the potential lender also cannot know in advance of the time of actual borrowing the exact value of b_{max}, because his choice will depend on b_{max}^{a}, the maximum he would be able to lend at that time, which in turn depends on random events outside of his control. The lender can only form expectations about those random events and about b_{max}^{a}. But, again for formal lenders, b_{max} is usually very small for any single borrower compared to b_{max}^{a}, so that even unexpected (relatively small) changes in the latter would not have any influence in the choice of the former. However, for government- and NGO-supported credit programs, uncertainty about institutional arrangements, program objectives, target clientele, and external funds from donors can have significant influence on b_{max}.

Furthermore, at the time of borrowing, it is only the lender who observes the realized value of b_{max} (which he himself determines), and may or may not have the opportunity to reveal it to the borrower. For example, the outcome of the loan transaction might be characterized by $0 < b^{*}(\text{ù}) \equiv \boldsymbol{b}(r, b_{max}, \text{ù}) < b_{max}(\text{ù})$. That is, if the borrower's realized optimal choice of loan size is strictly positive, but also strictly less than the realized value of b_{max}, then the lender may never have the chance to tell the borrower his actual realized choice of b_{max}.[9] Clearly, if at a particular time a borrower does not ask for a loan from a given source of credit, he will never learn, even in retrospect, about his realized b_{max} from that source of credit at that time (there may be exceptions in the cases of NGO and government-supported credit programs that set and announce fixed credit limits for all potential borrowers). However, the potential borrower will always have expectations on what would have been the likely value of b_{max} at that time. Furthermore, it is precisely the borrower's expectations about the likely value of b_{max} and its variability that influence his behavior and make him decide in particular whether to seek a loan from that particular source of credit. For example, in the direct method of detecting credit constraint discussed in Section 2, the classification of borrowers usually includes a class of "discouraged borrowers" (e.g., Jappelli 1990). These borrowers did not seek any loan because either they *expected* to face zero or very low b_{max}, or they *expected* a relative high cost (including transaction costs) to obtain loans. The discouraged borrowers may have been wrong in their expectations and could perhaps have obtained worthwhile loans at reasonable costs. But, whether they are wrong or not, in the end it was the expectations about their b_{max} that determined their behavior, not the realized values of their b_{max}, which will remain unknown to them. Even when a borrower seeks a loan from a given source of credit, the realized value of the optimal loan size is largely determined by his expectations about his b_{max} (especially if the borrower has reasonably accurate information that allows him to accurately predict the *location* of b_{max}).

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[9] The borrower's optimal loan size b^* depends on other environmental and borrower variables. However, in the expression above we have abstracted from these variables to simplify the notation. Also, to simplify the notation, we use the same notation ù for both the true (but unknown) state of nature and for a generic element of Ù, the set of all possible states of nature. There should be no confusion because the meaning should be obvious from the context.

Because of the above intuitively justified reasons, it is very important that the realized optimal choice $b^*(\grave{u}) \equiv \boldsymbol{b}(r,b_{max},\grave{u})$ be a function of the random variable b_{max}, not of its possible realized value $b_{max}(\grave{u})$. This allows the borrower's realized optimal loan size to be determined not only by the realized value $b_{max}(\grave{u})$ at time of borrowing, but also by his expectations about the likely value of b_{max} and its variability, made well in advance of the time of borrowing. Otherwise, allowing b^* to depend solely on the possible realized value $b_{max}(\grave{u})$ corresponds to a myopic behavior in the part of the borrower, i.e., the borrower would be making his borrowing choices not using his subjective assessment of the relative likelihood of the random events or any relevant information pertaining to those events that determine the realized value of b_{max}.

Note also that the fact that the borrower's optimal loan size depends primarily on his expectations about b_{max} does not mean that in the formulation of the credit constraint (1), b_{max} should be replaced by the borrower's *expected* value for b_{max}. The credit constraint (1) is a stochastic constraint that must be satisfied for every possible state of nature $\grave{u}$, regardless of whether the borrower correctly predicts the location of b_{max}. The way b^* depends on the borrower's expectations about b_{max} is endogenous to the choice problem and is governed by the shape of his utility function (assuming that the objective for borrowing is to maximize the utility of consumption). Although the general functional form of the dependence of b^* on b_{max} has been justified intuitively here, it can be derived rigorously. In general, if the utility function is not too restrictive, under standard assumptions on expectations formation b^* depends not only on the expected value and higher moments of b_{max}, but also on b_{max} separately as a random variable (see Diagne [1994] for examples of univariate and multivariate demand functions derived under uncertainty).

The arguments in the previous paragraphs imply that in the analysis of the demand for credit, the borrower's expectations about b_{max} are much more important in determining the demanded amounts of credit than the realized values of b_{max}. However, from a policy viewpoint, what is of most interest is not the borrower's response to change in his expectations about b_{max}, but his response to change in b_{max} itself, since it is the variable under the lender's control and that determines access to credit. In the empirical evidence presented in the next section, it is the borrower's *expected* b_{max} from different sources of credit that were collected. The survey did not collect data on b_{max}(ù) or the realized values of b_{max}, which only lenders could provide with reasonable accuracy. The survey focused on the demand side of the credit market, and for a relatively large survey it was not feasible to interview the lender for each loan transaction. Moreover, borrowers may not be willing to identify their informal lenders or may refuse to be interviewed if they know that the latter are going to be interviewed too.[10] Hence, the question remains that if the only information collected is *expected* b_{max}, how one can estimate and evaluate the impact of b_{max} itself (or its realized value) on b^* (or on any other household choice or outcome variables). For a purely descriptive analysis aimed at comparing households with regard to the extent of their access to credit (i.e., comparing their b_{max}) and binding credit constraint (i.e., comparing their b_{max} with respect to their b^*), the inference that can be done based solely on *expected* b_{max} and the realized value of b^* is very limited. Furthermore, the classification of households based solely on a descriptive analysis using *expected* b_{max} can only reflect the households' perceptions of their situation on the credit market as in the direct method of detecting credit constraint households (Jappelli 1990; Feder et al. 1990).

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[10] However, Lund (1995) managed to interview both borrowers and lenders in her survey in the Phillippines.

However, with an econometric analysis it is possible to estimate and evaluate the impact of b_{max} on b^* and other household choice or outcome variables based solely on *expected* b_{max}. For this to be possible, it is necessary to assume that the realized b^* and other household choice or outcome variables depend only on *expected* b_{max} and not on higher moments of b_{max} and its realized values. This restriction is plausible if b_{max} does not vary much (so that its variance and higher centered moments are close to zero) and the borrower has reliable information that allows him to predict the location of b_{max} with reasonable accuracy (so that the realized value of b_{max} will have little influence on realized optimal choices). Under this restriction, the assessment of the impacts of b_{max} on household choice and outcomes variables can be done by exploiting the proprieties of the mathematical expectation operator, which, as usual, is identified with the borrower's expectation process (see Appendix for details).

4. EXTENT OF HOUSEHOLD ACCESS TO FORMAL AND INFORMAL CREDIT IN MALAWI AND BANGLADESH

This section presents evidence on the extent of household access to credit in Malawi and Bangladesh. Following the methodology presented in the previous section, the credit limit variable is used to assess the extent of households' access to formal and informal credit, as well as the binding of their credit constraints. As noted in the previous section, there is nothing new in the concept of credit limits. However, to the authors' knowledge, IFPRI's household surveys in Bangladesh (1994) and Malawi (1995) were the first to collect data on the credit limit variable.[11] For this reason, details will be given on the way the credit limit data was collected in the Malawi survey to let the reader be aware of some of the problems encountered in the process.

The Malawi survey was a year-long, three-round survey (February–December 1995) that collected detailed information on various activities undertaken by 404 households in 45 villages in five districts of Malawi. A stratified, random-sampling procedure was used to select the households surveyed. About half of the sample were participants of four credit programs.[12] The second half of the sample was equally divided between past participants (mostly from a failed government credit program), and households that had never participated in any formal credit program. The reader is referred to Diagne, Zeller, and Mataya (1996) for details on the survey and data collection methodology.

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[11] Even Avery (1981) whose study focused on the credit limit did not have data on it. His econometric model was based on a disequilibrium model, where the observed consumer's debt is the minimum of the credit limit (supply of credit) and the demand for credit.

The credit and saving module of the questionnaire was administered to all adult household members over 17 years old. For the question related to the credit limit, they were asked the maximum amount they *could* borrow during the recall period from both informal and formal sources of credit. If the respondent was involved in a loan transaction as a borrower, the question was asked for each loan transaction (both for granted and rejected loan demands). In this case, the credit limit refers to the time of borrowing and to the lender involved in that particular loan transaction. If the respondent did not ask for a loan, the question was asked separately for formal and informal sources of credit with no reference to particular formal or informal lenders. Respondents who were granted loans were also asked the same general question (i.e., with no reference to particular formal or informal lenders) in a way that elicited the credit limit they would face if they had wanted more loans, not just from the same lender, but from the same sector of the credit market (formal or informal) where they had borrowed. Consequently, for both formal and informal credit, the maximum formal and informal credit limits of each adult household member were obtained in each round, even if the member was not involved in any loan transaction. The question on the credit limit in the Bangladesh survey was more or less similar, except it was asked only to those involved in a loan transaction (see Zeller, Ahmed, and Sharma 1996).

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[12] The five credit programs were Malawi Rural Finance Company (MRFC), Promotion of Micro-Enterprises for Rural Women (PMERW), the Malawi Mudzi Fund (MMF), and the Malawi Union of Savings and Credit Cooperatives (MUSCCO). The first three programs are based on group lending while MUSCCO is a union of individual, membership-based local saving and credit unions.

Given the central importance of the credit limit variable for the methodology of the study, several control questions were used to verify the consistency of the answers given by respondents. Such control questions included their program membership status; whether, if they did receive a loan of the same type, they were given a lesser amount than asked for, and if yes, how much had they asked; whether they asked for a loan and were rejected; and why they did not ask for any (or more) loans. In addition, the enumerators were instructed to use other control questions not included in the questionnaires whenever there appeared to be inconsistencies in the respondents' answers.

A good deal of time was spent checking the consistency of answers to these questions and in relation to other parts of the questionnaire. As a result of these checks, during the first round of the survey most respondents were visited at least twice to verify their answers or clarify apparent inconsistencies in their answers. Most inconsistencies occurred in the first days of the survey, and resulted from some misunderstanding of the question, which was often interpreted by either the enumerator or the respondent as asking *the maximum you would like to borrow*. The misunderstanding was resolved by instructing the enumerators to explain to respondents, before they answered the question, the difference between the two questions.

Finally, as explained in the previous section, what is referred here as the credit limit is actually the respondents' perceived or *expected* credit limit. However, with this clarification, for the sake of brevity, the reference to the term *expected* will be dropped in the following discussion of the empirical evidence.

EMPIRICAL DISTRIBUTION OF CREDIT LIMITS AND UNUSED CREDIT LINES

Table 1 presents the average informal and formal credit limits with the corresponding average amounts of unused credit lines, i.e., the average of the differences between the respective credit limits and amounts borrowed, in Bangladesh and Malawi.[13] In the population as whole, the average informal and formal credit limits are, respectively, $40 and $71 in Bangladesh and $7 and $11 in Malawi.[14] To put these figures in perspective, the 1995 per capita GNP were $240 and $170, respectively (World Tables 1997). These average figures are not good indicators of the levels of access to credit, however, because of the truncated nature of the credit limit distributions. The box plot diagrams of the distributions presented in Figure 1 give a better picture of the extent of access to credit in both countries. The figure shows that in Bangladesh the median formal and informal credit limits are, respectively, $50 and $13, and 50 percent of the population can borrow at most $100 from the formal sector and $50 from the informal sector. The ability to borrow is significantly more restricted in Malawi where the median formal and informal credit limits are, respectively, zero and $3. Moreover, 50 percent of the Malawian population can borrow at most less than $10 from either sector of the credit market.

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[13] To correct for the oversampling of credit program participants, the summary statistics in the tables have been weighted using the strata population weights from the village and national population censuses.

[14] In Malawi, the duration of the recall period for which the access to credit was explored was October 1993 to March 1995. For Bangladesh, the recall period was July 1993 to August 1995.

In both countries those who are presently borrowing from the formal sector had higher median formal credit limits ($75 in Bangladesh and $25 in Malawi). But their median informal credit limit is higher only in Bangladesh ($25 in Bangladesh and zero in Malawi). For Malawi, this is likely to be a reflection of the fact that two of the credit programs studied are targeted to poor women who might have been excluded from the few existing sources of informal credit because of their socioeconomic situation (see Figure 3). For Bangladesh, the positive correlation suggests that informal lenders are willing to lend significantly more to those who are participating in the formal credit market than to the rest of the population. One explanation is that perhaps formal sector borrowers are perceived as good credit risks because they are able to negotiate and manage much bigger loans from formal sources. Furthermore, informal lenders may believe that, if necessary, they may divert formal loans to repay their informal ones. However, the distributions of the unused credit lines shown in Figure 2 reveal interesting facts on the behavior toward informal sources of credit of formal sector borrowers in Bangladesh. Indeed, although they have higher informal credit limits compared to the rest of the population, they use less of them. In fact, almost half of them have over $50 of unused informal credit lines and virtually all of them deplete their formal credit lines. This perhaps indicates that higher informal credit limits are coming from professional moneylenders and are too expensive as source of loans compared to formal sources. Another explanation is that despite having higher informal credit limits compared to the rest of the population, formal sector borrowers prefer the formal sector because the types of investment for which formal loans are sought are too big to be financed through informal sources. As Figure 2 shows, in both countries the median unused formal credit lines are zero for the population as a whole and for formal sector borrowers.

Finally, with respect to gender differences in access to credit, Figure 3 shows that, both in Bangladesh and Malawi in the general population, women have higher median formal credit limits but lower median informal credit limits compared to men. However, when the comparison is restricted to formal sector borrowers only, men have higher median credit limits in both sectors of the credit markets. Moreover, Figure 4 shows that in both countries female formal sector borrowers are more likely to have a binding credit constraint in both sectors than their male counterparts. This provides a justification for targeting credit to women since they are more likely to have a binding credit constrained than men and have good reputations in repaying back their loans.

ACCESS TO CREDIT, CREDIT CONSTRAINTS, AND PARTICIPATION IN CREDIT PROGRAMS

To get a picture of how participation in a credit program is related to access to credit at the household level, participating and nonparticipating households have been classified according to the types of access to credit and binding of the credit constraints of their individual members. A household is said to have access to a type of credit if at least one of its members has a strictly positive credit limit for that type of credit. Similarly, a household is classified as credit constrained for a type of credit if at least one of its members is constrained for that type of credit. Tables 2 and 3 present the outcome of this classification according to membership status in a credit program. First, consistent with the conceptual distinction between access to credit and participation in a credit program, Table 2 shows that 16 percent and 8 percent of households that never participated in any formal credit program in Bangladesh and Malawi, respectively, did have access to formal credit during the recall period, i.e., they could obtain a formal loan if they had wanted. However, more than two-thirds of the households in Bangladesh do not have access to any type of credit. The corresponding figure for Malawi is 28 percent.

Second, further illustrating the importance of the distinction between access to credit and participation in a credit program, Table 2 shows that up to 31 percent and 40 percent of households currently participating in formal credit programs in Bangladesh and Malawi, respectively, did not have access to formal credit during the recall period. This means that not only did they not receive any formal loan during that period, but also they could not borrow anything from their own program. Hence, even for participants of credit programs, their continuous access to formal credit cannot be taken for granted and should be considered (together with access to informal credit) as subject to random events. Moreover, from the participating household’s perspective, these fluctuations in its access to formal credit brings some type of uncertainty in its planning and decisionmaking process that can be more difficult to cope with than the uncertainty faced when not participating in a credit program. Indeed, unpredictable institutional changes or abrupt changes in the policy of a credit program can create more damages in the operations of a profitable business than nature-induced events that, while still uncertain, are often predictable.

Finally, Table 3 gives information on whether households' credit constraints were binding or not. It shows a clear positive impact that participation in credit programs can have in relaxing households' credit constraints. Of current members of credit programs, 65 percent and 39 percent, respectively, did not experience any binding informal or formal credit constraint in Bangladesh and Malawi. In contrast, among those households that had never been members of any credit program, only 16 percent and 8 percent, respectively, did not experience any binding credit constraints. Taking Bangladesh as an example, of those households that had never been members, 69 percent experienced at least once a credit constraint in the informal and the formal credit market during the recall period of almost two years. Fifteen percent had binding credit constraints in the formal sector only, but not in the informal sector. These results point out to the changes in credit access and occurrence of credit constraints that can be brought about by expanding microfinance institutions that lend to the rural poor.

5. CONCLUSION

The quantification of the impact of improved access to formal credit on different groups of households is important for policy purposes, not only because it can serve as a guide for the allocation of scarce resources to different and numerous development programs competing for the same funds, but also because it allows one to determine the relative importance of the various factors that make some households in some socioeconomic environments benefit more from access to formal credit than others. This paper has presented a conceptual framework and data collection methodology for measuring the extent of household access to credit and analyzing the socioeconomic determinants and impacts of the extent of access to credit.

The paper reviewed first the two main methodologies that have been used up to now to measure household access to credit and credit constraints and exposed their shortcomings. The first method tries to detect credit constrained households through tests of violation of the life-cycle/permanent income hypothesis. Empirical evidence from this methodology regarding presence or absence of credit constraint has been inconclusive, mostly because violation of the implications of life cycle/permanent income hypothesis is neither a sufficient nor necessary condition for being credit constrained. The second method of measuring access and detecting credit constraint collects household-level credit market information directly from household surveys to determine whether households are credit constrained. This classification is then used in reduced-form regression equations to analyze the determinants of the likelihood of a household being credit constrained and the effects of this likelihood on various household outcomes. Despite representing a substantial improvement in comparison to the first method, it is still incapable of providing the framework that allows one to quantify the extent to which households are credit constrained or to satisfactorily assess the impact of access to credit on household welfare outcomes.

The methodology presented in this paper corrects the shortcomings of the direct method by developing a conceptual framework and data collection methodology that focus on the concept of credit limit. This focus is justified by the fact that every potential borrower faces a credit limit because of asymmetries of information between borrowers and lenders and the imperfect enforcement of loan contracts. Therefore, a household's credit limit from any given source of credit is the best measure of its degree of access to that source of credit.

Furthermore, the changes in household behavioral and welfare outcomes in response to changes in its credit limit represent the effects of access to credit (or improvement in access) on those household outcomes. Hence, once data are collected on households' credit limits, econometric analysis allows one to quantify the determinants of the extent of households' access to credit as well as the effects such access has on household welfare outcomes. This data has been collected for the first time in IFPRI surveys conducted in Bangladesh and Malawi. The descriptive summary statistics from the two surveys presented in this paper illustrate the usefulness of using the credit limit to assess the extent of households' access to credit and the binding of their credit constraints.

APPENDIX

b_{max} WHEN ONLY b_{max} IS OBSERVED

$\partial f(b_{max}, .)/\partial b_{max}$ can be estimated

when b_{max}

value is. First, we recall that the usual partial effect estimated in standard regression

analysis is the quantity $\partial E\left((b \quad ,. \mid b \quad =x\right) \partial x$

of the dependent variable following small changes in the possible values of the random

variable $_{max}$ $\partial\ (b \quad ,. /\partial\ _{max}$, which

involves taking a partial derivative with respect to a random variable (a function!). Hence,

Even the interpretation of “marginal change” is not trivial in this context. However,

because of the underlying metrics, for all practical purposes the two quantities can be

interpreted in the same ways without worrying about all the subtleties involved.

$b \ \equiv f\ b_{max}\ .)$ and

other household choice variables depend only on $_{max}$ and not on higher

moments of b

with the mathematical expectation operator E

generality, we assume a linear dependence and abstract from the other independent

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[5] This is a fu *Fréchet derivative* In fact, in general $\partial f(b_{max},.)/\partial b_{max}$ is a continuous linear function and not a real number, and th int

show here, these technical issues need not be discussed.

variables, i.e., $\mathrm{f}(b_{max}, .) = \hat{a}Eb_{max}$. Thus, $\hat{a}$ is the usual partial effect and the coefficient to be estimated in a standard regression. Because the expectation operator is a linear function, one has $\partial \mathrm{f}(b_{max}, .)/\partial b_{max} = \hat{a}E$, and for all random variables **h**, $\partial \mathrm{f}(b_{max}, .)/\partial b_{max}(\mathbf{h}) = \hat{a}E\mathbf{h}$. In particular, for a “marginal change” in b_{max} of size db_{max}, we have $\partial \mathrm{f}(b_{max}, .)/\partial b_{max}(db_{max}) = \hat{a}Edb_{max}$. In fact, $\partial \mathrm{f}(b_{max}, .)/\partial b_{max}$ can be identified with $\hat{a}$ and interpreted as the *expected* change in b^* following an *expected* change in b_{max}. This proves the claim made in the paper.

TABLES

Table 1—Average maximum credit limit and unused credit line in the informal and formal market, by country and by gender of respondent

	Bangladesh						Malawi					
	All respondents			Formal sector borrowers only			All respondents			Formal sector borrowers only		
Credit limit (in US dollar)	Male	Female	All	Male	Female	All	Male	Female	All	Male	Female	All
Informal credit limit	53	11	40	130	22	69	7	6	7	9	5	6
of which unused	29	7	22	130	22	69	3	3	3	7	3	5
Formal credit limit	71	71	71	159	90	117	10	12	11	60	38	45
of which unused	58	43	52	52	13	28	4	3	3	16	7	10

Source: Bangladesh: IFPRI, Rural Finance and Food Security Survey; Malawi: IFPRI/Bunda, Rural Finance survey.
Note: 1995 per capita GNP for Bangladesh and Malawi are, respectively, $240 and $170 (World Tables 1997).

Table 2—Percentage of households having access to informal and formal credit: by membership in group-based credit program and by country

	Bangladesh			Malawi		
Access to credit during recall period[a]	Current members	Past members	Never been members	Current members	Past members	Never been members
No access	24%	64%	69%	10%	17%	28%
Informal only	7%	9%	15%	30%	50%	64%
Formal only	3%	4%	0%	16%	0%	0%
Informal and formal	66%	23%	16%	44%	32%	8%

Source: Bangladesh: IFPRI, Rural Finance and Food Security Survey, 1994; Malawi: IFPRI/Bunda, Rural Finance survey, 1995.

[a] In Malawi, the duration of the recall period for which the access to credit was explored was October 1993 to March 1995. For Bangladesh, the recall period was July 1993 to August 1995.

Table 3—Percentage of households experiencing a binding credit constraint in the informal and formal market, by membership in group-based credit program and by country

	Bangladesh			Malawi		
Credit constraint during recall period[a]	Current members	Past members	Never been members	Current members	Past members	Never been members
Informal and formal	24%	64%	69%	15%	21%	33%
Informal only	3%	4%	0%	12%	0%	0%
Formal only	8%	9%	15%	34%	50%	60%
No binding constraint	65%	23%	16%	39%	29%	8%

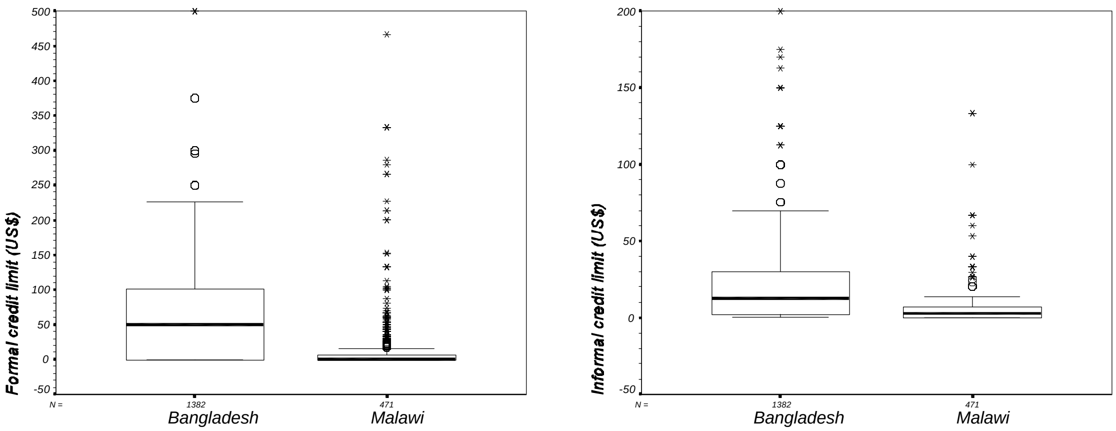
Source: Bangladesh: IFPRI, Rural Finance and Food Security Survey, 1994; Malawi: IFPRI/Bunda, Rural Finance survey, 1995.

[a] In Malawi, the duration of the recall period for which the access to credit was explored was October 1993 to March 1995. For Bangladesh, the recall period was July 1993 to August 1995.

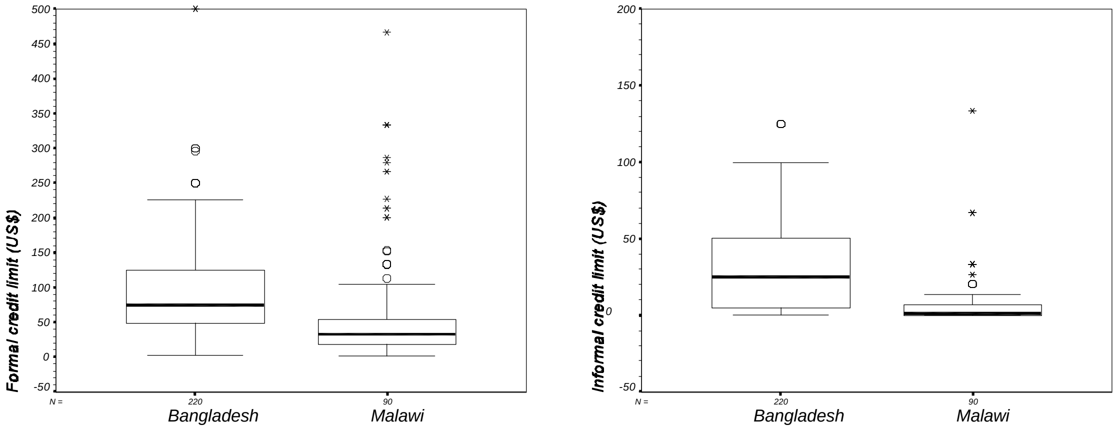
FIGURES

Figure 1—Distribution of formal and informal credit limits in Bangladesh and Malawi: Box plot diagrams

All respondents



Formal sector borrowers only**



Credit limits (US$). All respondents	Bangladesh		Malawi	
	Formal	Informal	Formal	Informal
Mean	71	40	11	7
Median	50	13	0	3
Standard deviation	118	143	33	24
Minimum	0	0	0	0
Maximum	1250	2500	667	800

Source: Bangladesh: IFPRI, Rural Finance and Food Security Survey, 1994; Malawi: IFPRI/Bunda, Rural Finance survey, 1995.

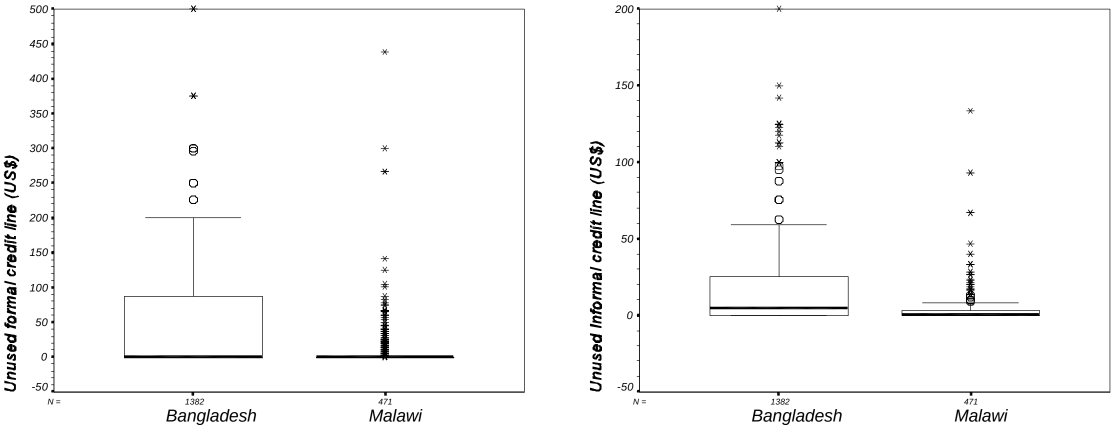
Notes: * Box plot diagrams are interpreted as follow: For each box, 50 percent of cases have values within the box and the solid horizontal line inside is the median. The length of the box is the interquartile range and the lower boundary (resp upper boundary) of the box is the 25th (resp 75th) percentile. Finally, the circles are outliers and the stars are extreme values.

** For Bangladesh, the informal credit limit figures do not include the ones for formal sector borrowers who had no informal loan transaction.

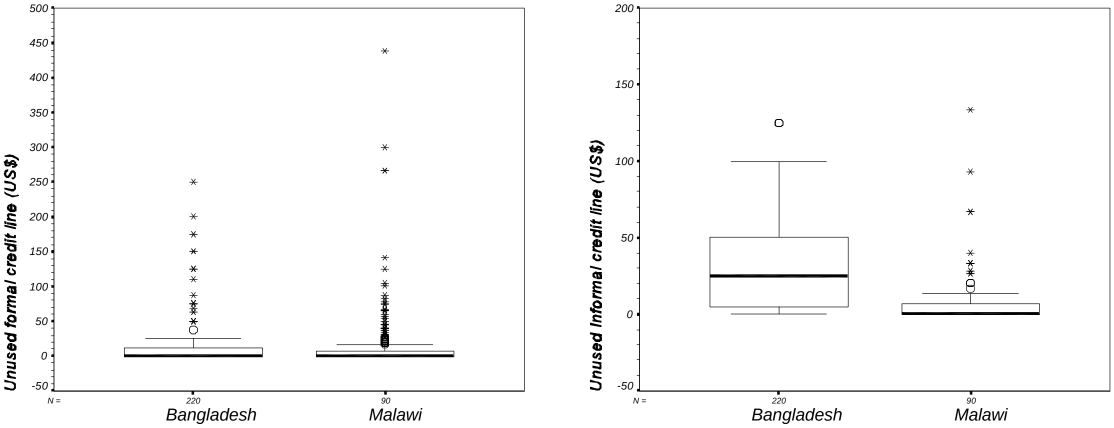
Per capita 1995 GNP for Bangladesh and Malawi are, respectively, $240 and $170 (World Tables 1997).

Figure 2—Distribution of unused formal and informal credit lines in Bangladesh and Malawi: Box plot diagrams

All respondents



Formal sector borrowers only**



Unused credit lines (US$). All respondents	Bangladesh		Malawi	
	Formal	Informal	Formal	Informal
Mean	52	22	3	3
Median	0	5	0	1
Standard deviation	111	130	16	9
Minimum	0	0	0	0
Maximum	1,163	2,500	438	267

Source: Bangladesh: IFPRI, Rural Finance and Food Security Survey, 1994; Malawi: IFPRI/Bunda, Rural Finance survey, 1995.

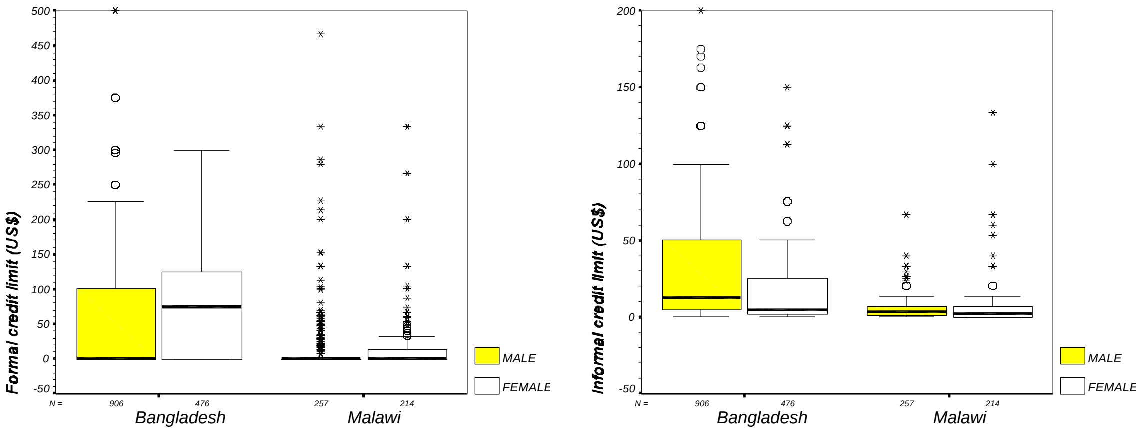
Notes: * Box plot diagrams are interpreted as follow: For each box, 50 percent of cases have values within the box and the solid horizontal line inside is the median. The length of the box is the interquartile range and the lower boundary (resp upper boundary) of the box is the 25th (resp 75th) percentile. Finally, the circles are outliers and the stars are extreme values.

** For Bangladesh, the informal credit limit figures do not include the ones for formal sector borrowers who had no informal loan transaction.

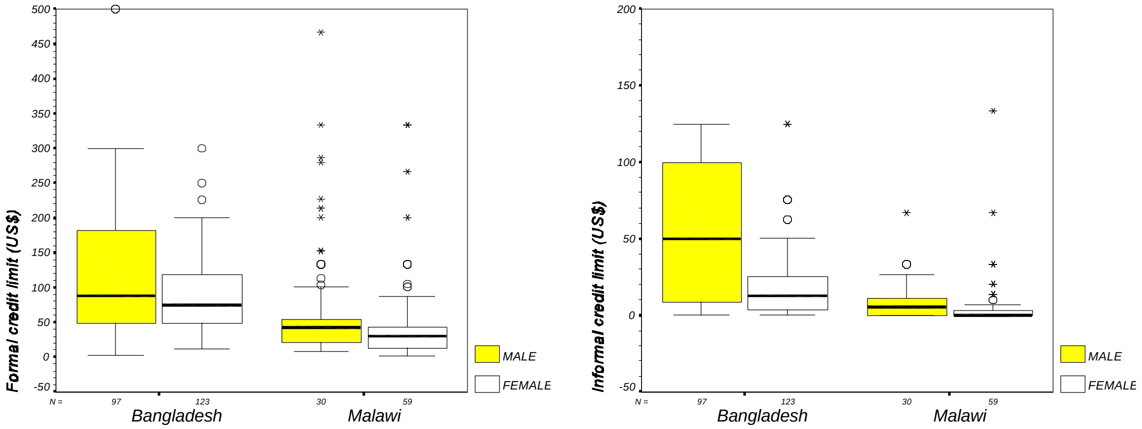
Per capita 1995 GNP for Bangladesh and Malawi are, respectively, $240 and $170 (World Tables 1997).

Figure 3—Distribution of formal and informal credit limits in Bangladesh and Malawi: Box plot diagrams by gender of respondents

All respondents



Formal sector borrowers only**



	Bangladesh				Malawi			
Credit limits (US$)	Formal		Informal		Formal		Informal	
All respondents	Male	Female	Male	Female	Male	Female	Male	Female
Mean	71	71	53	11	10	12	7	6
Median	0	75	13	5	0	0	3	2
Standard deviation	139	59	174	22	36	29	15	31
Minimum	0	0	0	0	0	0	0	0
Maximum	1,250	300	2,500	150	667	333	500	800

Source: Bangladesh: IFPRI, Rural Finance and Food Security Survey, 1994; Malawi: IFPRI/Bunda, Rural Finance survey, 1995.

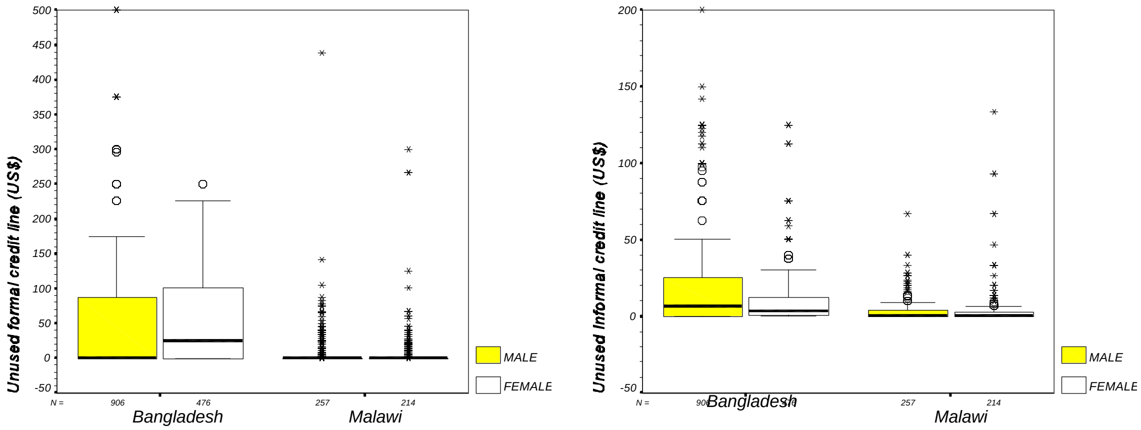
Notes: * Box plot diagrams are interpreted as follow: For each box, 50 percent of cases have values within the box and the solid horizontal line inside is the median. The length of the box is the interquartile range and the lower boundary (resp upper boundary) of the box is the 25th (resp 75th) percentile. Finally, the circles are outliers and the stars are extreme values.

** For Bangladesh, the informal credit limit figures do not include the ones for formal sector borrowers who had no informal loan transaction.

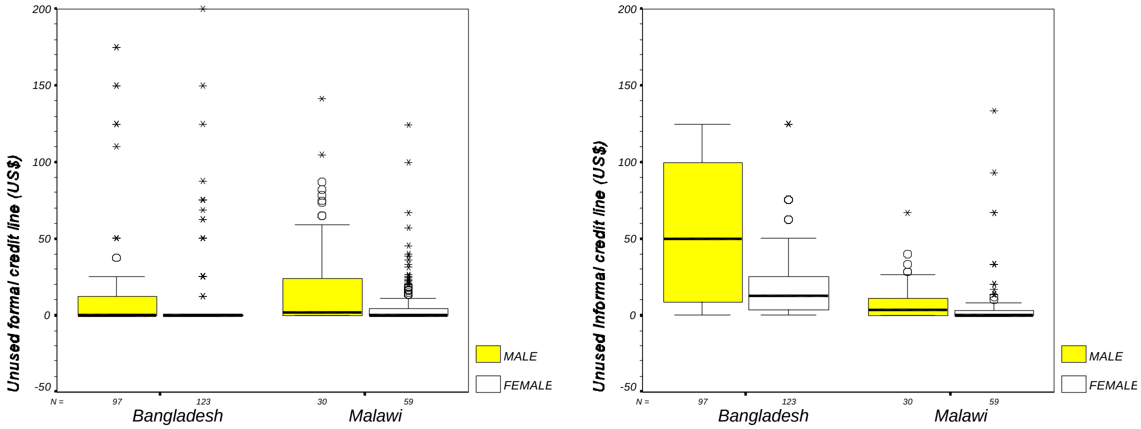
Per capita 1995 GNP for Bangladesh and Malawi are, respectively, $240 and $170 (World Tables 1997).

Figure 4—Distribution of unused formal and informal credit lines in Bangladesh and Malawi: Box plot diagrams by gender of respondents

All respondents



Formal sector borrowers only**



Unused credit lines (US$). All respondents	Bangladesh				Malawi			
	Formal		Informal		Formal		Informal	
	Male	Female	Male	Female	Male	Female	Male	Femal
Mean	58	43	29	7	4	3	3	3
Median	0	25	6	4	0	0	1	0
Standard deviation	130	60	159	21	17	16	6	12
Minimum	0	0	0	0	0	0	0	0
Maximum	1,163	250	2,500	125	438	300	67	267

Source: Bangladesh: IFPRI, Rural Finance and Food Security Survey, 1994; Malawi: IFPRI/Bunda, Rural Finance survey, 1995.

Notes: * Box plot diagrams are interpreted as follow: For each box, 50 percent of cases have values within the box and the solid horizontal line inside is the median. The length of the box is the interquartile range and the lower boundary (resp upper boundary) of the box is the 25th (resp 75th) percentile. Finally, the circles are outliers and the stars are extreme values.

** For Bangladesh, the informal credit limit figures do not include the ones for formal sector borrowers who had no informal loan transaction.

Per capita 1995 GNP for Bangladesh and Malawi are, respectively, $240 and $170 (World Tables 1997).

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