

# **Credit Constraints and Poverty Dynamics: Theory, Evidence, and Field Survey Strategy**

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## **Introduction**

People in developing countries, especially the poor, face a wide variety of risks in their daily life. Accidents, sickness, or sudden death can disable the household head or her family. Existence of tropical infectious diseases enhances health risks significantly. For farmers, agricultural production involves many risks such as a variety of price and yield risks. Though the forms and severity of the risks for farmers vary with farming systems and with environmental conditions, agricultural risks appear to be prevalent especially for small-scale, poor farmers in the semi-arid tropical areas of developing

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countries. For typical LDC farm households, the effects of idiosyncratic risks and village level risks can be distinguished. These risks or uncertainties make farmers' incomes unstable over time. Even for households in urban, industrial or commercial sector, income fluctuates over time. There are various contractual and physical risks in the handling of products, intermediate goods and employees. Debt crisis or currency crisis due to inappropriate government policies will create hyper-inflation and widespread unemployment. As a result, a household's real income becomes unstable.

However, maintaining stable consumption above the subsistence level is essential for keeping households' standard of living over time. Poverty occurs when a household's per-capita consumption level falls below a properly defined poverty line. Hence, the central behavioral problem of LDC households becomes a reconciliation of income fluctuation and consumption smoothing. This problem can be theoretically captured as the problem of intertemporal consumption smoothing under a stochastic income process. Extending the framework of the Life-Cycle Permanent Income Hypothesis [LC-PIH], the recent micro-development literature examines the role of idiosyncratic risks and village-level aggregate risks in determining nature of poverty. These studies address the effectiveness of formal and informal risk mitigating or coping mechanisms of LDC households (Alderman and Paxson

[1992], Besley [1995], Deaton [1990] [1991] [1997], Dercon ed, [2005], Fafchamps [2003], Morduch [1994] [1995], Paxson [1992] [1993], Townsend [1994] [1995], Udry [1994]).

On one hand, risk management strategies can be defined as activities for reducing income instabilities before the resolution of uncertainties in order to smooth income. Farmers have traditionally managed agricultural production risks by crop diversification, inter-cropping, flexible production investments, the use of low-risk technologies, and special contracts such as share-cropping. Even in commercial and industrial sectors, ethnicity or kinship-based long-term business relationships are often formed, in order to alleviate various contractual risks.

On the other hand, risk-coping strategies are defined as ex post strategies to reduce consumption fluctuations, provided income fluctuations due to these ex-post risks (Alderman and Paxson [1992]). In general, the existing literature identified the following different ways of risk-coping mechanisms. First, households can reduce consumption expenditure by cutting back, for example, luxury consumption but maintaining total calorie intakes (Frankenberg, Thomas, and Beegle [1999]). Second, households can use credit to smooth consumption by reallocating future resources to today's consumption (Glewwe and Hall [1998]). Third, households can accumulate financial and

physical assets as a precautionary device against unexpected income shortfalls (Rosenzweig and Wolpin [1993], Fafchamps, Czukas and Udry [1998]). Fourth, additional adult or child labor incomes through labor market participation are often used as a risk-coping device (Jacoby and Skoufious [1997], Sawada and Lokshin [1999]). In other words, returns to human capital can be used as an income insurance device. Finally, informal transfers in need can act as an effective coping device (Dercon [2005], Fafchamps [2003], Townsend [1994], Udry [1994]).

Among different risk-coping strategies potentially available for households in developing countries, we will focus on the role of credit in reducing downside welfare risks. Facing a negative income shock, households with access to credit such as those with assets suitable as collateral may absorb shocks by obtaining loans for consumption purposes. By doing so, households can use credit to smooth consumption by reallocating future resources to today's consumption (Glewwe and Hall [1998]). The lack of consumption insurance can be compensated by the access to credit market (Besley [1995], Eswaran and Kotwal [1989]). Use of credit for consumption is the basic logic of the LC-PIH interpretation of household consumption smoothing.

However, there is evidence that poor households have only a limited

access to credit markets and are constrained from borrowing for a variety of reasons (Bhalla [1979] [1980], Morduch [1990], Pender [1996]). This can be due to the high information cost and lack of assets for collateral (Carter [1988], Stiglitz and Weiss [1981]) or policy-induced financial repression (McKinnon [1973]). In either case, the existence of credit constraints has important negative impact on risk-coping abilities of these poor households.

In this paper, we review the role of credit constraints in generating transient poverty. We review the theoretical framework as well as existing empirical studies. By doing so, we elaborate an appropriate strategy to design questionnaires and field surveys. The rest of this article is organized as follows: In Section I, we will formally show the nexus between binding credit constraints and transient poverty. Section II summarizes existing empirical studies on credit constraints so that we can elaborate field survey strategies. In Section III, we will review emerging innovative programs to provide credits to the poor, a.k.a., microfinance, briefly, which will be followed by the concluding section..

## **I Transient Poverty and Credit Constraints**

Recent studies on poverty emphasize the importance of two dynamic concepts of poverty, i.e., chronic poverty and transient poverty. Chronic

poverty is a state where a household's consumption is constantly below the poverty line. Transient poverty is a situation where a household's average income [consumption] is above the poverty line, but the household is confronting possibilities of falling below the poverty line temporary. The latter situation is sometime called stochastic poverty. By following Morduch [1994], we can formally define transient poverty as follows:

*Definition (Morduch[1994]): Let  $Y^P$ ,  $C_t$ , and  $z$  represent a household's permanent income, a household's current consumption level at time  $t$ , and poverty line, respectively. Then, transient poverty is defined as a situation where  $C_t < z < Y^P$*

As Lipton and Ravallion [1995: section 5] summarizes, the distinction between transient poverty and chronic poverty is essential when we examine poverty. On one hand, when chronic poverty is dominant, continuous long-term policy interventions are necessary. For example, the government should provide agricultural research & extension services, land reform programs, price support policies, and income re-distribution programs. On the other hand, when transient poverty is prevalent, insurance provision policies are required. Such policies include micro-credit programs, crop insurance schemes,

employment guarantee schemes, and price stabilization policies.

Moreover, evidence show that transient poverty is serious in reality. For example, 70% of the ICRISAT surveyed households in South India are under transient poverty, while only 20% of households are chronically poor (Walker and Ryan [1990: 93-97]). The IFPRI surveyed households in Pakistan are under transient poverty (Adams and He [1995]). Moreover, as is shown in Table 1, an analysis of 39,000 households in poor Chinese provinces, such as Guangxi, Guizhou, and Yunnan provinces, found that about 50% of poverty can be explained by transient poverty (Jalan and Ravallion [1998b]).

**Table 1 Decomposition of Observed Poverty in China**

<b>Province</b>	<b>Observed poverty in squared poverty measures=P[2]</b>	<b>% of observed poverty which is transient</b>
Guangdong	0.14	84.21
Guangxi	1.79	56.63
Guizhou	2.85	42.80
Yunnan	1.16	48.97
<b>All 4 Provinces</b>	<b>1.43</b>	<b>49.39</b>

Source: Jalan and Ravallaion [1998b] Table 1.

According to the above definition of transient poverty, it happens when the basic LC-PIH is violated. To verify this argument, let us set up a benchmark intertemporal consumption decision model under perfect foresight and perfect credit availability. The final result we obtain is well-known as the Life-Cycle Permanent Income Hypothesis [LC-PIH] of consumption. An infinitely-lived representative consumer is supposed to maximize the discounted sum of intertemporal utility, given an intertemporal budget constraint:

$$\begin{aligned}
 (1) \quad & \underset{\{C_t\}}{\text{Max}} \quad \sum_{t=0}^{\infty} \left( \frac{1}{1+\delta} \right)^t U(C_t) \\
 & \text{s.t.} \quad \sum_{t=0}^{\infty} \left( \frac{1}{1+r} \right)^t C_t = \sum_{t=0}^{\infty} \left( \frac{1}{1+r} \right)^t y_t + (1+r)A_t,
 \end{aligned}$$

where  $U(\cdot)$  is an instantaneous concave utility function of consumption  $C$ ;  $y$  and  $A$  are exogenously given income and net physical or financial asset, respectively; and  $r$  and  $\delta$  represent time-invariant exogenous interest rate and discount rate, respectively. From the first-order conditions of the problem (1), we can derive a familiar consumption Euler equation:



$$(2) \quad U'(C_t) = \left( \frac{1+r}{1+\delta} \right) U'(C_{t+1}).$$

Suppose there is no consumption-tilting, i.e.,  $r = \delta$ , then we immediately obtain that  $C_t = C_{t+j}$ . Combining this result with the intertemporal budget constraint in the problem (1), we can obtain an analytical solution for the optimal consumption level:

$$(3) \quad C_t = \left( \frac{r}{1+r} \right) \left[ (1+r)A_t + \sum_{t=0}^{\infty} \left( \frac{1}{1+r} \right)^t y_t \right].$$

This equation (3) says that the optimal level of consumption is the annuity value of total wealth in the squared brackets, where the total wealth is composed of initial net physical and/or financial assets and human assets defined as the discounted sum of future incomes. This consumption function is known as the life-cycle permanent income hypothesis [LC-PIH]. The annuity value of total wealth is called permanent income:

$$(4) \quad Y^P \equiv \left( \frac{r}{1+r} \right) \left[ (1+r)A_t + \sum_{t=0}^{\infty} \left( \frac{1}{1+r} \right)^t y_t \right].$$

Since the LC-PIH tells that  $C_t = Y^P$ , it is obvious that transient poverty, a situation where  $C_t < z < Y^P$ , happens when the LC-PIH is violated. There are two cases of deviations from the basic LC-PIH, i.e., the case of binding credit constraint and the case of positive precautionary saving. In the following, we will exclusively focus on credit constraints. Credit constraint is defined as the inability of certain households to borrow against future income, perhaps because lenders believe they are unlikely to repay their loans. Formally, credit constraint can be represented as the following equation:  $A_t + y_t \geq C_t$ . When the credit constraint is binding, we have:

$$(5) \quad A_t + y_t = C_t$$

Suppose a case where a household is affected by a series of successive bad shocks to its income  $y$ , a finding which is reported in several developing countries (Alderman [1996]). In this case, flow income,  $y$ , will continue to be very low and, accordingly, the household's asset level,  $A$ , will become null. In addition, if the credit constraint is binding, i.e., households are denied access to credit, the equation (5) should be satisfied. Yet, in this case, obviously consumption level of the household is forced to be minimal according to equation (5). Hence, in the model of (1) with the additional constraint (5), we

can show that the case where  $C_t < z < Y^P$  can occur. In sum, transient poverty may arise under binding credit constraints.

What is worse, such situation can occur even when a household undertakes fully-optimal decision (Deaton [1990]). Interestingly, Deaton [1990] shows that, in the presence of credit constraints, the time path of consumption is characterized by infrequent but dramatic drops in consumption that he compares to the famines. The rest of time, consumption is fairly smooth in spite of large fluctuations in income. Deaton [1990] demonstrates that asset accumulation can drastically reduce fluctuations in consumption but cannot fully prevent famines. He also shows that famines only arise when households are affected by a series of successive bad shocks, a finding which is reported in several developing countries (Alderman [1996]).

## **II Credit Constraints: Theory, Empirical Framework and Survey Strategy**

There are a lot of empirical studies which found the existence of serious borrowing constraints in various developing countries, especially for poor households. For example, Bhalla [1979] [1980] finds evidence of a high correlation between income and consumption for poor households in India,

which implies binding credit constraints. Morduch [1990] applied that Zeldes [1989]’s framework to the Indian data set and found that the presence of a credit constraint cannot be rejected among poor and middle-income farmers. Only among wealthy households, credit constraint hypothesis cannot be rejected. Pender [1996] also found that in India poor households have only a limited access to credit market and are constrained from borrowing.

## **II. 1 Theoretical Framework of Credit Constraints**

In order to formalize the role of credit availability in consumption smoothing, we follow Zeldes [1989] and extend the model of optimal consumer behavior under uncertain income and possible credit constraints of equation (5). As before, we suppose a household decision maker has a concave instantaneous utility,  $U(\bullet)$ , of the household consumption,  $C_t$ . The household decision is then to choose  $C_t$  that maximizes the conditional expectation of discounted lifetime utility with a subjective discount rate,  $\delta$ , subject to possible credit constraints as well as intertemporal budget constraints. When income,  $y$ , is stochastic, analytical solutions to this problem cannot generally be derived (Zeldes [1989]). However, we can derive a set of first-order necessary conditions by forming a value function and Bellman equation to obtain an

optimum solution. Let  $\lambda$  represent the Lagrange multiplier associated with credit constraint  $A+y-C \geq 0$  where  $A$  is the household net asset. Combining the envelope condition derived from the first-order conditions, we obtain a consumption Euler equation, which is augmented by the possibility of a binding credit constraint:

$$(6) \quad \begin{aligned} U'(C_t) &= E_t \left[ \left( \frac{1+r}{1+\delta} \right) U'(C_{t+1}) \right] + \lambda_t, \\ A_t + y_t - C_t &\geq 0 \text{ if } \lambda_t = 0, \\ A_t + y_t - C_t &= 0 \text{ if } \lambda_t > 0, \end{aligned}$$

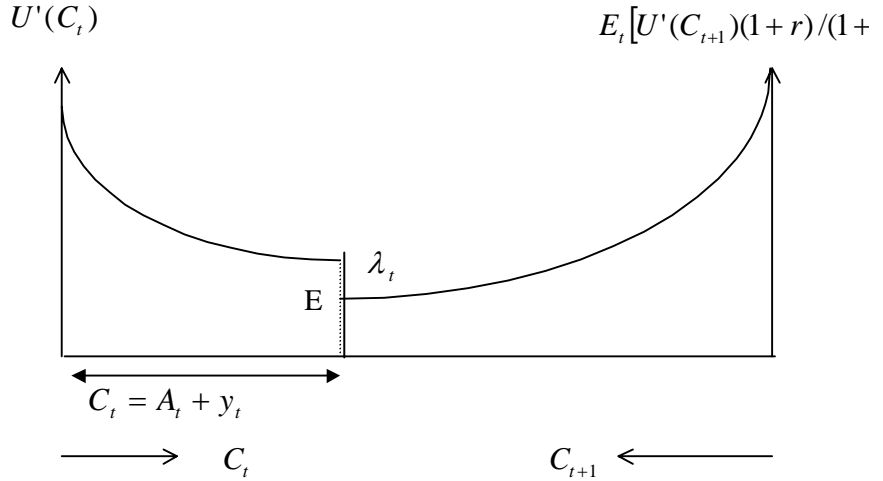
where that  $r$  and  $y$  represent the interest rate and stochastic household income, respectively. Note that this augmented Euler equation (6) was first derived by Zeldes [1989]. As can be seen in Figure 1, we can interpret the Lagrange multiplier,  $\lambda$ , as an indicator of negative welfare effects generated by binding credit constraints.\*<sup>1</sup> It is straightforward to show that given other variables, an increase in the current income of a credit-constrained household leads the

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\*<sup>1</sup> This term,  $\lambda$ , is equal to the increase in expected lifetime utility that would result if the current constraint were relaxed by one unit. Because the household is constrained from borrowing more, but not from saving more,  $\lambda$  enters with a positive sign.

marginal utility of current consumption to fall, causing the Lagrange multiplier to decline. Hence, theoretically, Lagrange multiplier  $\lambda$  should be a negative function of the current income,  $y$ , as can be verified in Figure 1 (Zeldes [1989]).

**Figure 1:**  
**Consumption smoothing under binding credit constraints**



## II.2 Empirical Framework for Credit Constraints

The aim of our econometric framework is to test the implications of the augmented Euler equation (6). Following Zeldes [1989], suppose that

households form the rational expectation and that utility is described by the constant relative risk aversion (CRRA) utility function, i.e.,  $U(C_t) = C_t^{1-\gamma} (1-\gamma)^{-1} \exp(\theta_t)$ , in which  $\theta$  represents the household size and tastes. Then, equation (6) becomes:

$$(7) \quad \ln C_{it+1} - \ln C_{it} = \frac{1}{\gamma} [(\theta_{it+1} - \theta_{it}) + \log(1 + \lambda_{it}') - \log(1 + e_{it+1}) + \log(1 + r) - \log(1 + \delta)],$$

where  $i$  is the household index and  $e$  denotes the household's expectation error with  $E(e_{it+1}|I_t)$  where  $I_t$  is the information set available at time  $t$ . The left-hand side variable indicates the consumption growth rate. Note that the Lagrange multiplier is normalized by the future marginal utility of consumption:

$$(8) \quad \lambda_{it}' \equiv \frac{\lambda_{it}}{E_t \left[ C_{it+1}^{-\gamma} \exp(\theta_{it+1}) \left( \frac{1+r}{1+\delta} \right) \right]}.$$

Then, the estimable equation becomes:

$$(9) \quad \ln C_{it+1} - \ln C_{it} = X_{it} \beta + \frac{1}{\gamma} [\log(1 + \lambda_{it}')] + v_{it},$$

where  $X$  includes the determinants of household tastes, and  $v_{it}$  indicates a stochastic error term including an expectation error.<sup>\*2</sup> To control for the changes in preferences and household characteristics, such items as household size, age of the respondent, and age squared were included (Zeldes [1989]).

Let  $C^*$  represent the optimal consumption in the absence of a current credit constraint.  $C^* = C$  if the credit constraint is not binding, while  $C^* > C$  if the credit constraint is binding. Then, define the gap between the optimal consumption under the perfect credit accessibility and cash in hand without credit constraints. In other words, we define the gap,  $H$ , such that  $H = C^* - C$ . Further, following Hayashi [1985] and Jappelli [1990], we assume that the conditional expectation of desired consumption,  $C^*$ , can be approximated by a quadratic function of current variables. Hence, the reduced form of the optimal consumption  $C^*$  can be expressed as a linear function of observables, such as current income, wealth, age, and demographic characteristics, as well as the quadratic terms of some of these variables. The maximum amount of

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<sup>\*2</sup> Note that taking a second-order Taylor expansion of  $\log(1+e)$  around  $e=0$ , we obtain  $\log(1+e) \approx e - (1/2)e^2$ .

We assume that the squared expectation error is captured by various characteristics of households and their heads.



borrowing is also assumed to be a linear function of the same variables.

Accordingly, we have a reduced-form equation:

$$(10) \quad H_{it} = W_{it} \beta_W + \varepsilon_{it} ,$$

where  $W$  includes the assets, income, and determinants of optimal consumption and maximum loan values and  $\varepsilon$  is an error term which captures unobserved elements and measurement error.\*<sup>3</sup>

From equations (7) and (10), we can derive the following econometric model of the augmented Euler equation with endogenous credit constraints:

$$(11) \quad \ln C_{it+1} - \ln C_{it} = X_{it} \beta + \lambda_{it}' + v_{it} ,$$

$$\lambda_{it}' > 0 \text{ if } H_{it} \geq 0,$$

$$\lambda_{it}' = 0 \text{ if } H_{it} < 0,$$

$$H_{it} = W_{it} \beta_W + \varepsilon_{it} .$$

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\*<sup>3</sup> Here, two factors determine whether the constraint is binding (Jappelli [1990]). First, it depends on the demand for credit, which is represented by the difference between the cash in hand and consumption. The second factor is how many financial intermediaries are willing to supply credit to this individual, which is denoted by  $z$ .

The conventional empirical approach to estimate equation (11), e.g., Zeldes [1989] and Morduch [1990], ignores the endogeneity of the Lagrange multiplier and splits the sample into those likely to be credit-constrained, i.e.,  $\lambda_t > 0$ , and those unlikely to be credit-constrained, i.e.,  $\lambda_t = 0$ , exogenously by using observable household characteristics. Zeldes [1989] splits the sample on the basis of a wealth-to-income ratio.\*<sup>4</sup> Credit availability may depend on the amount of land due to collateral requirements and standard information-economics reasons. Facing an informational asymmetry between lenders and borrowers, lenders may select borrowers depending on the amount of their land holdings (Carter [1988]). Hence, one plausible way is to split groups by the land cultivated: none, small-scale, medium-scale and large scale (Morduch [1990]).

This exogenous split approach, however, has two problems (Garcia, Lusardi, and Ng [1997: 158], Hu and Schinantarelli [1998: 466-467]). First, it is unlikely that a single variable, such as an income-to-wealth ratio, would serve as a sufficient statistic of a consumer's ability to borrow. Usually,

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\*<sup>4</sup> For example, a household is regarded as being credit-constrained if the estimated total wealth is less than the value of two months of the average income.

lenders screen credit applicants with the use of multiple factors. Secondly, if the variables used as a criterion for splitting a sample were correlated with the unobserved factors in consumption growth, this correlation would generate a sample selection problem. Accordingly, sample selection bias should be controlled for properly by using the instrumental variable technique.

In order to overcome these two issues, an alternative approach would be to construct a qualitative response model of an endogenous credit constraint by defining an indicator variable of a credit constraint, which would be one if the credit constraint were binding and zero otherwise. Such a qualitative-response model is estimated by Jappelli [1990]. Jappelli, Pischeke, and Souleles [1998] combined this model of endogenous credit constraints with a consumption Euler equation. Accordingly, in order to estimate a system of equations (11), we can combine the endogenous credit constraint approach of Japelli [1990] with augmented Euler equation.

Let the Lagrange multiplier,  $\lambda'$ , be a linear function of variable  $Z$ , i.e.,  $\lambda' = Z\psi$  with a coefficient vector  $\psi$ . Letting superscripts  $N$  and  $C$  represent the unconstrained and constrained groups, respectively, the estimable augmented Euler equation (11) can be rewritten as follows:

$$(12) \quad \ln C_{it+1} - \ln C_{it} = X_{it} \beta_X + (1 - \delta_{it}) Z_{it} \psi_N + \delta_{it} Z_{it} \psi_C + v_{it},$$

$$(13) \quad \delta_{it} = \begin{cases} 1 & \text{if } H_{it} \geq 0 \\ 0 & \text{if } H_{it} < 0 \end{cases}$$

$$H_{it} = W_{it} \beta_W + \varepsilon_{it}.$$

Note that  $\delta_{it}$  is a dummy variable for liquidity constraints, which take one if the liquidity constraint is binding and zero otherwise.

The testable restriction of our framework is that the elements of the coefficient vector in equation (12),  $\psi_N$ , are all zero for the unconstrained group. We assume that errors follow a joint normal distribution with zero means and the following covariance matrix:

$$(13) \quad \begin{pmatrix} v_{Nit} \\ \varepsilon_{it} \end{pmatrix} \sim N \left[ \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma^2 & \sigma_{v\varepsilon} \\ \sigma_{v\varepsilon} & 1 \end{pmatrix} \right].$$

If the sign of  $H$  is observable, the model can be estimated by the type 5 Tobit model with observed regime (Amemiya [1995: 399-408]). The type 5 Tobit model considers explicitly that OLS estimation of (12) involves endogenous sample selection bias. We can estimate consistently the parameters in Euler

and credit-constrained equations by maximizing the following log-likelihood function:

$$\begin{aligned}
& l_t(\beta_X, \psi_N, \psi_C, \beta_W, \sigma, \sigma_{v\varepsilon}) \\
& = \sum_{i=1}^n (1-\delta_{it}) \ln\{f(v_{it} | H_{it} < 0) \text{Prob}(H_{it} < 0)\} + \delta_{it} \ln\{f(v_{it} | H_{it} \geq 0) \text{Prob}(H_{it} \geq 0)\} \\
(14) \quad & = \sum_{i=1}^n (1-\delta_{it}) \ln \left[ \frac{1}{\sigma} \phi \left( \frac{v_{it}}{\sigma} \right) \right] \Phi \left( \frac{-W_{it}\beta_W - \frac{\sigma_{v\varepsilon}}{\sigma^2} v_{it}}{\sqrt{1 - \frac{\sigma_{v\varepsilon}^2}{\sigma^2}}} \right) \\
& \quad + \delta_{it} \ln \left[ \frac{1}{\sigma} \phi \left( \frac{v_{it}}{\sigma} \right) \right] \left[ 1 - \Phi \left( \frac{-W_{it}\beta_W - \frac{\sigma_{v\varepsilon}}{\sigma^2} v_{it}}{\sqrt{1 - \frac{\sigma_{v\varepsilon}^2}{\sigma^2}}} \right) \right],
\end{aligned}$$

where  $\phi(\bullet)$  and  $\Phi(\bullet)$  represent the density and cumulative distribution functions, respectively, of standard normal distribution.

However, a precise measurement of credit constraint is not straightforward. A direct approach is to utilize information on the household willingness and ability to obtain credit (Jappelli [1990], Jappelli, Pischeke, and Souleles [1998]). Generally, household-level data on credit availability is not available in standard household surveys (Scott [2000]). However, even in case the indicator variable for credit constraint is not observed, we can apply the

estimation method of a switching model with unknown regimes.<sup>\*5</sup> Following a recent study by Garcia, Lusardi, and Ng [1997], we can estimate the Euler equation augmented by endogenous credit constraints as a switching regression model. We cannot observe  $H$  directly, but we can estimate the probability of being credit-constrained jointly with other parameters in Euler equations by maximizing the following log-likelihood function:

$$(15) \quad L_t(\beta_X, \psi_N, \psi_C, \beta_W, \sigma, \sigma_{vE}) = \sum_{i=1}^n \log \left\{ \left[ \frac{1}{\sigma} \phi \left( \frac{v_{it}}{\sigma} \right) \right] \Phi \left( \frac{-W_{it} \beta_W - \frac{\sigma_{vE}}{\sigma^2} v_{it}}{\sqrt{1 - \frac{\sigma_{vE}^2}{\sigma^2}}} \right) + \left[ \frac{1}{\sigma} \phi \left( \frac{v_{it}}{\sigma} \right) \right] \left[ 1 - \Phi \left( \frac{-W_{it} \beta_W - \frac{\sigma_{vE}}{\sigma^2} v_{it}}{\sqrt{1 - \frac{\sigma_{vE}^2}{\sigma^2}}} \right) \right] \right\},$$

where  $\phi(\bullet)$  and  $\Phi(\bullet)$  represent the density and cumulative distribution functions, respectively, of standard normal distribution.

In either model (14) or (15), the testable restriction derived from the theoretical result of the augmented Euler equation (6) is that the elements of the coefficient vector,  $\psi_N$ , are all zero for the non-constrained group, while the elements of the coefficient vector,  $\psi_C$ , are all non-zero.

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<sup>\*5</sup> See Dickens and Lang [1985] for an application for the dual labor-market theory.

We can also estimate the augmented Euler equation with unobserved regimes by letting the parameter vector  $\beta_X$  differ depending on the regime. In this case, we have the following econometric model:

$$(16) \quad \ln C_{it+1} - \ln C_{it} = X_{it} \beta_N + Z_{it} \psi_N + v_{Nit} \text{ if } H_{it} < 0,$$

$$(17) \quad \ln C_{it+1} - \ln C_{it} = X_{it} \beta_C + Z_{it} \psi_C + v_{Cit} \text{ if } H_{it} \geq 0,$$

$$(18) \quad H_{it} = W_{it} \beta_W + \varepsilon_{it}.$$

Again, the testable restriction of our framework is that the elements of the coefficient vector in equation (16),  $\psi_N$ , are all zero for the unconstrained group. We assume that errors follow a joint normal distribution with zero means and the following covariance matrix:

$$(19) \quad \begin{pmatrix} v_{Nit} \\ v_{Cit} \\ \varepsilon_{it} \end{pmatrix} \sim N \left[ \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_N^2 & \sigma_{NC} & \sigma_{N\varepsilon} \\ \sigma_{CN} & \sigma_C^2 & \sigma_{C\varepsilon} \\ \sigma_{\varepsilon N} & \sigma_{\varepsilon C} & \sigma_\varepsilon^2 \end{pmatrix} \right].$$

For identification, we assume that  $\sigma_\varepsilon^2 = 1$ . We cannot observe  $H$  directly, but we can estimate the probability of being credit-constrained jointly with other parameters in Euler equations by maximizing the following log-likelihood

function:

$$\begin{aligned}
 & L_1(\beta_N, \beta_C, \psi_N, \psi_C, \beta_W, \sigma_N, \sigma_C, \sigma_{N\epsilon}, \sigma_{C\epsilon}) \\
 (20) \quad & = \sum_{i=1}^n \log \left\{ \left[ \frac{1}{\sigma_N} \phi \left( \frac{v_{Nit}}{\sigma_N} \right) \right] \Phi \left( \frac{-W_{it}\beta_W - \frac{\sigma_{N\epsilon}}{\sigma_N^2} v_{Nit}}{\sqrt{1 - \frac{\sigma_{N\epsilon}^2}{\sigma_N^2}}} \right) + \left[ \frac{1}{\sigma_C} \phi \left( \frac{v_{Cit}}{\sigma_C} \right) \right] \left[ 1 - \Phi \left( \frac{-W_{it}\beta_W - \frac{\sigma_{C\epsilon}}{\sigma_C^2} v_{Cit}}{\sqrt{1 - \frac{\sigma_{C\epsilon}^2}{\sigma_C^2}}} \right) \right] \right\},
 \end{aligned}$$

where  $\phi(\bullet)$  and  $\Phi(\bullet)$  represent the density and cumulative distribution functions, respectively, of standard normal distribution.

### II.3 Studies to Estimate the Extent of Credit Constraints

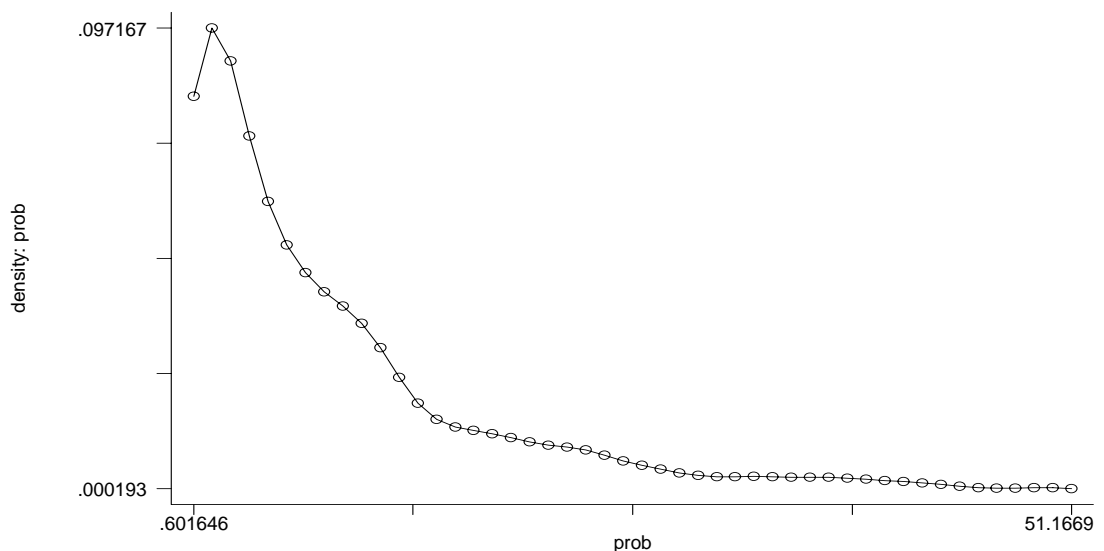
Regardless of data availability to identify the credit constraints directly, we can estimate parameters in the credit constraint equation. We can employ the estimated coefficients to compute the probability of binding credit constraints,  $1 - \Phi(-W_{it}\hat{\beta}_W)$ , by using the estimated parameter vector,  $\hat{\beta}_W$ .

With Japanese household panel data for 1993-1999, Sawada, Ii and Nawata [2003] estimated the augmented Euler equation by using Type 5 Tobit model. In 1993, credit constraints are directly observable from the data set so that we can employ the likelihood function (14). A kernel density function for probability of binding credit constraints in this case is presented by Figure 2.



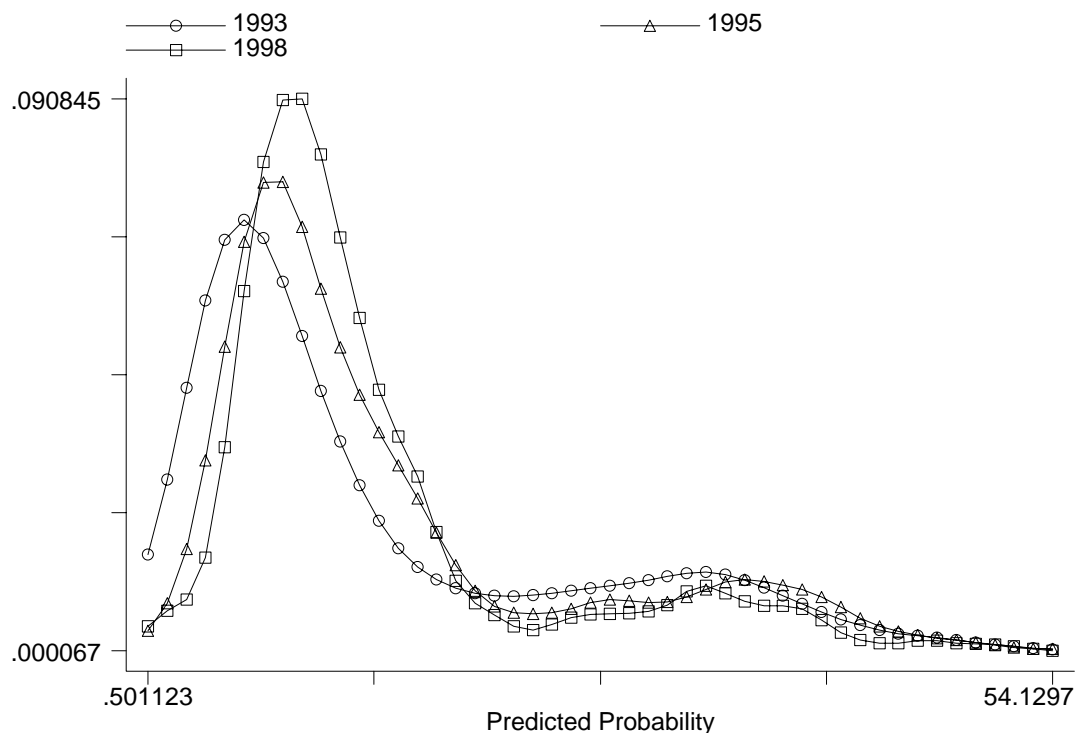
From 1994, constraints are not observable, hence we employ the likelihood function (15) or (20). Yet in this case, the likelihood function is not concave in the parameters to be estimated. Accordingly, the nonlinearity of the likelihood function made convergence difficult. However, they achieved interior solutions by taking the estimated parameters of the Zeldes [1989] type model as the initial values.\*<sup>6</sup> Figures 2 and 3 summarize estimated kernel distribution function of probability of binding credit constraints.

**Figure 2: Probability of Binding Credit Constraints in Japan (1993)**



\*<sup>6</sup> Initially, we set auxiliary parameters,  $(\sigma_N, \sigma_C, \sigma_{N\delta}, \sigma_{C\delta})$ , to be  $(1, 1, 0, 0)$ . Then the estimated auxiliary parameters are employed as the initial values to re-estimate all the parameters.

**Figure 3: Probability of Binding Credit Constraints in Japan (1993, 95, 98)**



By using the framework of equation (16), (17), and (18), Kang and Sawada [2003] examined how the credit crunch in Korea in the late 1990s affected household behavior and welfare. With household panel data from 1996-1998 in Korea, Table 2 shows the descriptive statistics. The average age of household heads was 47 in 1996 and 50 in 1998. Household size remained stable at around 3.7. Income and expenditure variables are converted into real value by using provincial consumer price indices. Between the 1995-96 and

1996-97 rounds, total income and wage earnings were fairly stable. Moreover, the major components of expenditures are fairly stable in this period. The value of household assets rose by about five percent, while debt declined by 11 percent during this period.

On the other hand, with the onset of the crisis, real total income fell by 24 percent between 1997 and 1998. The major income component, wages, dropped by 26 percent and was partially offset by a 28 percent increase in debt during this period.

During the crisis, sales of assets did not increase significantly, and assets declined by a mere 2 percent, implying that such sales did not serve as an important coping device. This may indicate that households were reluctant to sell their assets to cope with the negative shock since land and stock prices declined sharply. On the other hand, private and public transfers rose by 8 and 11 percent, respectively. However, transfers constituted only 4 percent of total income, and merely 22 percent of total households received transfers. Public transfers consisted predominantly of pensions, which take 82 percent of public transfers on average, since most of the social safety net programs were not yet in place during the initial phase of the crisis, which is the period of our analysis.

With the contraction of the economy, rising unemployment, and falling income, total household expenditures dropped by 29 percent between 1997 and

1998. The largest drop of 63 percent was in the consumption of luxury items, i.e., leisure activities, dining out, and durable goods. On the other hand, food consumption fell by only 15 percent, and expenditures on health and children's education, which included extracurricular activities and additional after-school classes, fell by 20 percent. These three categories — food, health & education, and luxury goods— represented 64 percent of the total expenditure. Although the consumption of food, health services, and children's educational services fell in absolute terms during the crisis, they maintained a higher proportion of the total household budget. The share of food and health and education expenditures increased from 28 percent and 24 percent in 1997 to 31 percent and 25 percent in 1998, respectively, while that of luxury expenditures fell from 12 percent in 1997 to 6 percent in 1998. This suggests that average households were cutting back on the consumption of non-essential items to preserve funds available for food, health, and children's education.\*<sup>7</sup>

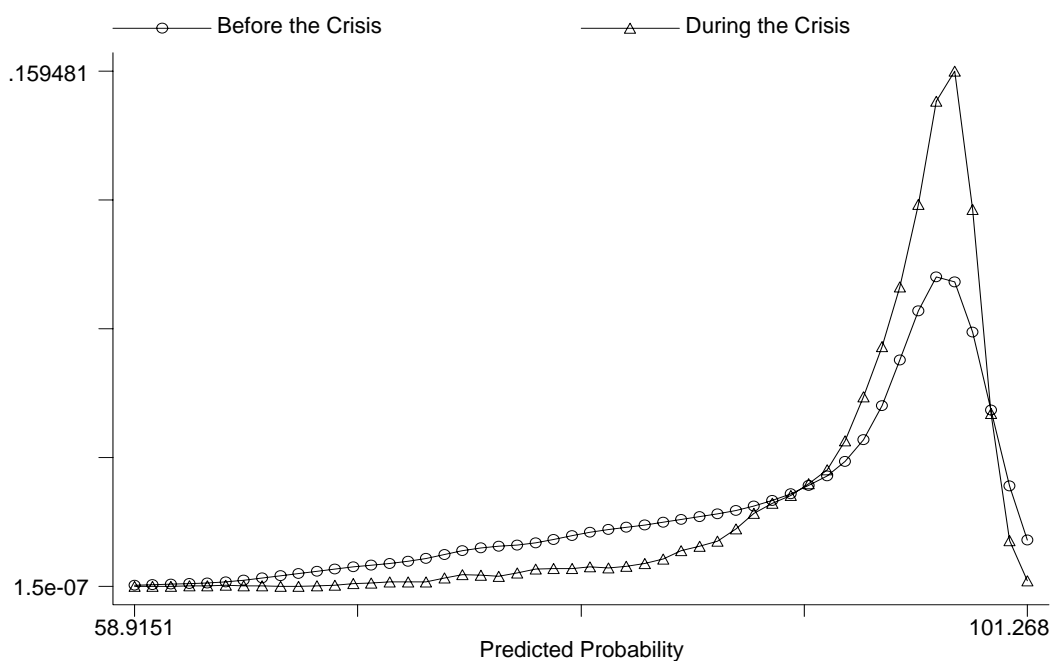
Kang and Sawada [2003] then follow a switching regression approach to estimate a consumption Euler equation, which is augmented by endogenous credit constraints. The estimated results of the likelihood function (20) suggest that the necessary condition of the life-cycle permanent income hypothesis does not hold

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<sup>7</sup> Goh, Kang, and Sawada [2001] examine the consumption reallocation pattern in Korea during the

because of binding credit constraints. As before, they compute the probability of binding credit constraints,  $1 - \Phi(-W_{it}\hat{\beta}_w)$ , by using the estimated parameter vector of the credit constraint equation,  $\hat{\beta}_w$ . Figure 4 compares the estimated kernel density function of the predicted credit-constrained probability using the switching regression results before and during the crisis. As we expected, the probability density to be credit-constrained increased during the crisis for Korean households.

**Figure 4: Probability of Binding Credit-Constrained in Korea  
Before and During the Financial Crisis**



Source: Kang and Sawada [2003]

financial crisis.

**Table 2: Changes in per capital consumption in Korea**

[unit: 10,000 Won, per year value at 1995 price]

	Aug 1996 – July 97	Aug 1997 – July 98	Rate of change (%)
	mean (std. error)	mean (std. error)	
<b><u>Consumption expenditure</u></b>			
Food expenditure	351.54 (216.26)	297.99 (177.63)	-15.2
Education & medical expenditure	304.17 (371.30)	242.21 (336.21)	-20.4
Expenditures for luxuries (cultural activities, entertainment, dining out, and durable goods)	147.25 (333.75)	53.98 (86.36)	-63.3
<b><u>Income, Asses, and Debts</u></b>			
Wage income or earnings from work	2064.81 (1734.66)	1523.41 (1264.16)	-26.2
Private transfers received	51.38 (214.14)	54.90 (209.45)	6.9
Public transfers received	19.18 (116.35)	20.99 (134.08)	9.4
Sales of assets (land, real estate, securities, and withdrawal of time deposits)	195.01 (1305.44)	203.62 (1089.94)	4.4
Total assets (savings account, shares, bonds, insurance, loan clubs, current value of house)	7681.19 (9403.04)	7533.37 (11895.05)	-1.9
Outstanding debt (formal banks, informal banks, and personal)	842.02 (2177.78)	1074.34 (5252.27)	27.6

Source: Kang and Sawada [2003]

### II.3 Field Survey Strategy

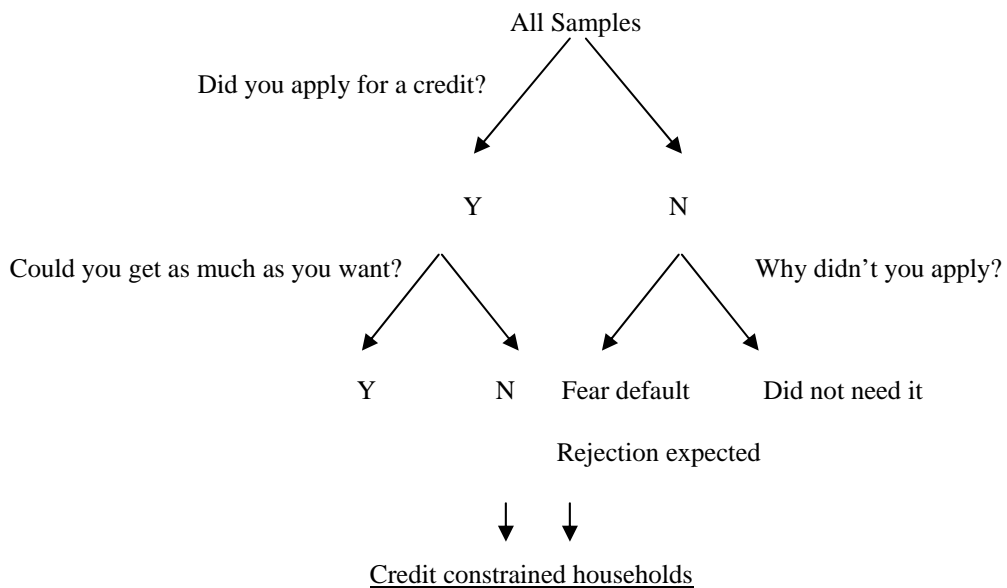
Various evidence from developing countries as well as developed countries supports the existence of liquidity constraints, especially for poor households. Especially poor landless farm households frequently cannot borrow against their future income. The liquidity constraints on households result from credit market imperfections, which may include financial repression such as interest rate restrictions imposed by government (McKinnon [1973]) or from asymmetric information between lenders and borrowers (Stiglitz and Weiss [1981], Carter [1988]).

There have been a variety of different empirical efforts to quantify the existence of liquidity constraints (Scott [2000]). For example, Bhalla [1979] [1980] finds evidence of high correlation between income and consumption for poor households in India, which implies binding liquidity constraints. Yet, a precise measurement of credit rationing is not straightforward.

The first direct approach is to utilize information on households' willingness and ability to obtain credit (Figure 4). This method is first employed by Feder et al. [1989] in the context of a developing country and subsequently extended by Bardham et al. [1996] and Baydas et al. [1992]. Jappelli [1990] used this framework for a US data set. Yet, generally,

household-level data on credit availability is not available in standard household surveys [Scott, 2000]. Accordingly, it would be reasonable to collect information on credit constraints directly in interviews by designing a credit module questionnaire carefully. Basically, a questionnaire should include questions represented by the tree diagram of Figure 5.

**Figure 5: Tree Diagram of Questions for Identifying  
Liquidity Constrained Households**





### **III Overview of the Formal or Informal Credit in LDCs**

As we have seen from the previous section, credit availability is quite important for poor households' welfare. This is simply because borrowing constraints generate transitory poverty or risks of voluntary famine (Deaton [1991]), while the availability of credit provides important device for consumption smoothing. In informal credit markets, money is lent by private agents such as pure moneylenders, crop marketers and traders, village shopkeepers, wealthier landlord, friends and relatives: Typically, high interests are favored by informal moneylenders. The policy response to high interest rates charged by moneylenders is to provide institutionalized credit with low interest rate as an alternative to the village moneylender. In fact, many governments in developing countries have placed policy priority on creation of rural credit markets and institutional credit provisions to rural areas in the 1960's and 70's. However, most of efforts to establish functioning formal credit markets have been disappointing (Hoff and Stiglitz [1993], Besley [1996]). The main characteristic of the poor performance of formal financial institutions is the high default rate of loans which were, frequently, more than 40%. Interestingly, the creation of a positive institutional alternative, e.g., rural banks and credit cooperatives, has failed to drive the traditional moneylender

out of the market. As a result, there typically exists a dual rural credit market, i.e., formal and informal credit markets, in developing countries (Hoff and Stiglitz [1993]). Moreover, government intervention has not even lowered interest rates charges by moneylenders. Hence, there may be aspects of interest rate rigidity which cannot be captured by a standard monopoly model applied to a usurious money lender. The imperfect information paradigm, an alternative view of rural credit markets, has emerged in the 1980's. This new view is better able to help us understand the workings of rural credit markets by focusing on the following three factors: screening problem, moral hazard problem, and enforcement problem. The new view holds that it is the markets' responses to these three problems, singly or in combination, that explain many of the observed features and puzzles of rural credit markets, and that they must therefore inform the policy perspective for designing specific interventions.

### **III.1 ROSCAs**

In order to solve the above-mentioned three problems from asymmetric information, collaterals are required in loan transactions in developing countries. Interestingly, even without collateral, Rotating Savings and Credit Associations (ROSCAs) can provide an important device of credit provision, avoiding the information and incentive problems (Besley [1995]).

Indeed, ROSCAs have a long history and can be found everywhere in the world, including Paluwagan in Philippines, Pasanakus in Bolivia, Djanggi in Cameroon, Chit Funds in India, Susu in Ghana and Trinidad, Ekubs in Ethiopia, Kye in Korea, Tanomoshi-Koh or Mujin in Japan, Hui in China, and Tontines in Senegal. In the usual case, a small group is formed from an office block, a neighborhood or extended-family group where enforcement costs are low because of powerful social sanctions. The group comit to putting a certain sum of money into a pot which each period is allocated to one member of the group by a system of drawing lots a random ROSCA or by bidding a bidding ROSCA. The existence of potential social sanction mechanisms solves enforcement problems effectively.

ROSCAs are distinguished from general informal credit by the following two operating rules: first, each individual in the ROSCA wins the pot once and only once. This property distinguishes ROSCAs from a pure gambling game. ROSCAs provide ways of rationing access to a pot of funds at some point in the rotation. Second, there are no demand deposits. This property distinguishes a ROSCA from an informal bank.

Suppose several individuals wish to acquire a durable good that requires a large fixed payment. In this situation, the random ROSCA, for example, lowers the cost of saving up to acquire the durable. Even if it maintained the

same saving pattern as under autarky, i.e., without ROSCA, the ROSCA gives each of its members a chance of winning the pot early by drawing lots. In fact, all but the last member of the ROSCA is better off ex post holding savings fixed.

As for empirical evidence of ROSCAs, by using household data from Taiwan between 1977 and 1991, Besley and Levenson [1996] found that ROSCA played an important role in lowering the cost of saving for purchasing durable goods such as refrigerator, TV set, .telephone, and washing machine. ROSCAs may also serve a risk-sharing function if individuals receive shocks to their health or incomes during the rotation cycle (Calomiris and Rajaraman, [1998]). This insurance role explains why ROSCAs with concurrent bidding are the dominant means of determining the sequence and pricing of allocations.

### **III.2 Micro-finance**

Recently, “micro-finance” has flourished all over the world. Micro-finance is defined as a program of providing financial services to poor households without collateral assets who have been excluded from the formal banking sector. Most micro-finance programs do not require borrowers to put up collateral, enabling various investments of potential entrepreneurs who have

been credit constrained. One of the main characteristics of such programs is joint-liability contracts which effectively make a borrower's group partners co-signers to loans, mitigating problems created by informational asymmetries between lender and borrower. Partners have incentives to monitor each other and to exclude risky borrowers from participation, promoting repayments even in the absence of collateral requirements.

In particular, Grameen Bank in Bangladesh has received a wide attention. The Grameen Bank has been initiated by Dr. Muhammed Yunus, a former economics professor at Chittagong University, to lend to the poorest people in Bangladesh. Encountering the Bangladesh famine of 1974, Dr. Yunus launched a pilot project to help forty-two poor stool makers in the village of Jobra by providing credit services. Being convinced by the success there, Prof. Yunus established a collateral-free micro-credit project for the poor, "Grameen Bank" in 1978. The bank asks borrowers to form a group consisting of five borrowers and lending to individuals occurs in sequence. In this sense, the Grameen Bank also drew on the idea of ROSCAs. The average loan size is about \$100 which will be weekly repaid over 50 weeks. No collateral is required and the nominal rate of interest is around 20%. The bank encourages women to do borrowing and, as a result, over 90% of borrowers are women. Amazingly, average repayment rates are over 97% (Morduch [1999]).

Group lending has many advantages, beginning with mitigation of problems created by adverse selection (Ghatak [1999]). The key is that group-lending schemes provide incentives for similar types to group together: First, without group-lending schemes, credit market becomes a lemon market – risky borrowers drive out the safe borrowers. Second, there is not mutually beneficial way for risky and safe types to group together. Group lending thus leads to assortative matching. All types form each group with like types. Finally, group-lending contract provides a way to charge different effective fees to risky and safe types even though all groups face exactly the same contract with exactly the same nominal charges. Ghatak [1999] and Morduch [1999] show formally how group-lending schemes provide incentives for similar types to group together by which the adverse selection problem will be mitigated. If the joint-liability payment is appropriately large, the adverse selection problem will be solved. This is because a successful risky type is more likely to have to pay  $c$  than a successful safe type. This mechanism is sometimes called “peer screening.”

If there is a collateral requirement, moral hazard problem is avoided. This is simply because lowering effort will generate a cost from losing collateral. Then, is it possible to achieve the optimal solution even without collateral? Stiglitz [1990] and Varian [1990] showed how the peer monitoring

mechanism of the joint-liability lending can reduce the moral hazard problem. They focus on the informational advantages of group lending, i.e., the fact that group members may have better information about individuals' efforts and/or abilities than does the bank. Through exploiting the ability of partners to monitor each other, even when the bank cannot do it, the group-lending contract offers a way to lower equilibrium interest rates, raise expected utility, and raise expected repayment rates. This is simply because that your partners will not allow you to implement a risky project under the joint-liability contract. These models are capturing the incentive problem.

Formally, when the legal enforcement framework is weak, it is difficult to compel repayment. Hence, group lending per se does not guarantee improved repayment incentives. Besley and Coate [1995] looks at borrower's willingness to repay, capturing the problem of enforcing repayment after some set of project returns has been realized. In their model, group lending has both positive and negative consequences for repayment rates. If one individual's project does well and the other's does badly, then this may result in one individual repaying the other's loan to avoid the penalty from the lender. However, this possibility raises the cost of repaying a loan and may lead both individuals to default where, with individual lending, one borrower would have repaid.

Yet, if social penalties available within a group, but not for the bank, are sufficiently severe, group lending will necessarily yield higher repayment rates than individual lending. Therefore, the enforcement problem will be mitigated

Wydick [1999] empirically showed that the success of group lending is derived from peer monitoring and a group's willingness to apply internal pressure on delinquent members rather than the institution's ability to harness previously existing social ties to improve loan repayment. Zeller [1998] rejects the hypothesis that groups consisting of members with homogenous risk exposure have higher repayment rates. Rather, groups exploit scope and scale economies of risk by pooling risks and by entering into information insurance contracts.

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