Title of paper: **Micro-credit, risk coping and incidence of rural-to-urban migration**

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Abstract:
The focus of this paper is on the rural poor of south Asia and their struggle to cope with the seasonal risk of unemployment and the ensuing income risks. In the absence of formal credit or insurance markets the rural poor typically resort to, among other options, the following informal strategies to cope with seasonal income risks: (i) seasonal rural-to-urban migration, and (ii) mutual (ex-post) transfers between families of friends and relatives. Access to credit through a microfinance institution could also provide a competing source of insurance. The question raised in this paper is how the access to credit may affect the more traditional/time honoured means of risk coping, such as seasonal migration. Given that credit, i.e., a credit-financed activity, is potentially a substitute for seasonal migration, it is reasonable to argue that easy access to credit (or high return on credit) will lower the incidence of migration. However, there also exists a potential complementarity between the two activities (if implemented jointly) in terms of gains due to diversification of income risks. That is, given that income from migration is not typically subject to the same shocks as income generated by a credit-financed activity, a joint adoption of both activities creates opportunities for diversification of risk in the family incomes portfolio. If the diversification gains are *large enough* then the adoption of both activities jointly will be preferred to adopting either of the activities individually. In that event, introduction of microfinance in rural societies may result in raising the incidence of migration.

The joint adoption case for rural households is modelled using a choice theoretic framework, and exact conditions are derived for when joint adoption is preferable to adoption of a single project. The model of joint adoption is estimated by applying a *Bivariate Probit* regression model on a single cross-section of household survey data from rural Bangladesh. Our preliminary results show that indeed the probability of participation in migration by household members is positively related to the probability of the household being a credit recipient.

Key-words: Development, South Asia, Poverty, Microfinance, Rural labour markets, Rural-to-urban migration, Risk-coping strategies

JEL classification: D1, D81, J43, J61, O1, Q12, R23

1. Introduction

The primary focus of this paper is on the rural poor of south Asia – mainly the *landless* or *near landless* peasant households – and their struggle to cope with the seasonal employment/income risks. The income risk has its origin in the following. Working members of peasant households typically face the risk of partial/full unemployment during the agricultural slack season due to low levels of activity/labour demand, and from this follows seasonal income risks. The associated consumption risks call for seasonal consumption smoothing or insurance. In the absence of either formal credit or insurance markets, these households typically resort to various informal (self-insurance) strategies. An obvious self-insurance strategy is to build up savings during the peak seasons which are to be drawn down in the slack seasons if/when income falls short of consumption needs. However, such intertemporal risk-pooling typically does not work well since incomes across seasons often tend to be correlated. Other strategies of consumption smoothing for the rural poor, as cited in the literature, are:

(i) A mutual insurance scheme among members of the same family, or between families of relatives and friends, implemented through ex-post transfers, (see, for example, Rosensweig (1988)).

(ii) Diversification of household incomes portfolio – an ex-ante measure – via, among other means, participation in *seasonal rural-to-urban* (or rural-to-rural) *migration*, (see among others, Stark (1978) and Stark and Levhari (1982)).

Participation in seasonal migration usually entails the following. A participating household sends some of its working members to seek informal urban jobs during the slack season while the remaining members pursue rural employment. Further, the migrant members are expected to return home to participate in the peak season labour market. This allows for diversification of slack income to the extent that the incomes from rural and urban sources are not fully correlated.

Ex-post transfers between relatives are a widely practiced custom in south Asia, but for it to function as an insurance provider, the parties/families involved in the exchange must have incomes that do not co-vary. This essentially requires that the parties either live far apart, or have highly different sources of income, (see Stark and Rosensweig (1989)). Among the alternative ex-ante diversification measures, evidence in the literature indicate that seasonal migration is by and large the preferred instruments of income diversification among the very poor, (see, for example (Rogally (2002)). Seasonal migration owes its popularity to its relatively low financing costs/capital requirement compared to alternatives such as the various *self-employment projects*, e.g., petty trading, fish culture, poultry rearing, and the like, (which typically have higher start-up costs). However, the recent introduction of collateral-free credit for the rural poor via the various microfinance institutions could provide the means of financing the alternative self-employment projects mentioned above. Microfinance institutions thus create an opportunity for the diversification of family incomes portfolio, and hence an alternative/competing source risk-coping, i.e., an alternative to seasonal migration. The question raised in this paper is <u>how the proliferation of micro-credit institutions affects the more traditional means of risk-coping, namely, seasonal migration</u>.

Micro-credit institutions typically target poor/landless households by offering them *group-based* credit for small–scale "*rural investment activities*". Given that a credit-financed activity is a potential *substitute* for seasonal migration, it is reasonable to argue that easy access to credit will lower the incidence of migration. However, there also exists a potential *complementarity* between *rural investment* and *migration* (if the two activities are implemented jointly by the same household) in terms of gains due to additional diversification of income risks. That is, given that incomes generated by migration (- urban sources -) and rural investment financed by micro-credit (- rural sources -) are *not* likely to be subject to *common shocks*, a joint adoption of both activities creates opportunities for diversification of risk in the family incomes portfolio. If the diversification gains are *large enough* then the joint adoption will be the preferred to adopting either of the activities individually. This gives rise to the possibility that *the spread of microfinance in rural societies may indeed lead to a higher incidence of migration*, and *vice versa*, (that is, the probability of participation in micro-credit also increases if the household has migrant workers in the family).

The possibility that participation in migration may promote household adoption of risky investment was first suggested by Stark (1978) and Stark and Levhari (1982). We present below the Stark *el al*. argument it its appropriate context. A common feature of most developing economies, (especially of the rural sector), is that there exists an abundance of investment opportunities with high potential returns that are never exploited. The reason typically is that rural entrepreneurs lack access to formal capital markets, and in the absence of either capital or insurance markets, the entrepreneurs are simply unable to cope with subjective/perceived risks that investment activities entail. Given that the *spreading of risks*, under these circumstances, would be the best way of *reducing risk*, an ideal strategy for a rural household would be 'a portfolio "investment" in urban earnings activity - namely, migration of a family member -' jointly with rural investment.[1] While Stark provides a mathematical proof of the claim – that migration is an "optimal" strategy –, (Stark (1978)), in our opinion, the analytical model he develops is highly *general* and lacks sufficient *structures* for it to yield meaningful testable hypotheses. Further, the basic proposition here, to the best of our knowledge, has not been modelled or studied elsewhere. This apparent oversight in the literature provides the main motivation for this paper. Additionally, we argue that both the "incidence of seasonal migration" as a behavioural phenomenon and "microfinance" as an antipoverty policy are two leading issues in poverty research. We believe that a study on the interaction between migration and microfinance will contribute to the understanding of the dynamics of rural poverty, and will have clear implications for poverty policies. In what follows, we develop a framework for analyzing both theoretically and empirically the joint investment phenomenon and explore its implications. We give below a brief summary of the modelling technique and the empirical methodology, followed by a plan for the rest of the paper.

Using rural households as the decision making unit, the case of joint adoption is modelled in this paper utilizing an intertemporal, (*albeit*, a two-period), choice theoretic framework. Assuming that poor households perceive both *migration* and *rural investment* as risky activities, exact (marginal) conditions are derived for the case where joint adoption is preferable to adoption of a single activity. The empirical adaptation of the model is designed to capture the potential *complementarity* between the two activities in the joint adoption case. The methodology proposed here is a *Bivariate Probit regression model*. According to this, a test for complementarity would amount to testing if the ***probability*** that a household participates in seasonal migration ***increases*** in the event the household is also a recipient of micro-credit. Our preliminary estimation using a single cross-section of household survey data from rural Bangladesh lends clear support to the complementarity hypothesis. The rest of the essay is organized as follows. In section two, we model the investment decision of a representative farm family. We subsequently proceed to find a suitable empirical adaptation of the model, i.e., a regression model that captures the testable implications embedded in the theoretical analysis. In section three, the data and the empirical methodology are presented.

[1] The quote comes from Stark and Levhari (1982), page ??

This is followed by the discussion of results. Section four contains the concluding remarks and caveats.

2. The Model

We consider a representative peasant household that owns virtually no assets other than its labour power[2].The prevailing agricultural labour market is seasonal, meaning that the labour market is *tight* during the *peak season* – (*peak season* is defined as the duration of harvesting and harvest related activities and planting/replanting of new crop) - followed by a period of relative inactivity, (called the *slack*- or *off-season*), during which demand for labour is particularly low. A typical household will earn its livelihood primarily through selling its labour power during the peak season. Additional income could be earned through pursuing various odd jobs during the slack season. Labour income from the peak season alone will normally fall far short of the minimum consumption needs of a farm household over the length of a crop cycle. The high incidence of off-season joblessness is therefore a main contributing factor to rural poverty. There exists however a wide range of potential investment/self-employment opportunities during the off-season that a poor household could engage in. For example, household members could become off-season traders (engaging in petty trading in the local market), or pursue home entrepreneurship, such as poultry farming, livestock rearing and the like. These activities will require moderate amount of start-up capital, and returns are risky. In the absence of micro-credit institutions, few peasant households will have access to alternative capital and/or have the ability to bear risk in order to make adoption of such investments worthwhile. To summarize the above, the problem facing a farm household contemplating rural investment/innovation is twofold: access to capital and managing (coping with) the risk. While the introduction micro-credit may mitigate the first of the problems, this does not necessarily resolve the issue of risk. Below, we propose to model the claim that farm households may resolve the issue of risk by adopting a scheme of joint undertaking, namely, participation in migration and rural investment funded through micro-credit. For concreteness, we assume that farm households have a two-period decision horizon: a peak season followed by a slack season. All (working) members of the household will seek work as agricultural labourers in the peak season. In the slack season, some household members will contemplate (seasonal) migration, while the remaining members will

[2] The very poor in south Asia are often defined as those belonging to households that are functionally landless. That is, these households own their homestead land but not sufficient land for cultivation. We could assume, with no loss of generality, that our representative household is functionally landless.

become entrepreneurs. The model is developed in three stages. We develop first a benchmark scenario where households do not engage in either migration or rural investment[3]. The model is extended by considering first the possibility of only rural investment. Here, we will derive the *marginal* conditions (in terms of *minimum required rate of return*) such that undertaking rural investment is worthwhile. We introduce finally the possibility for off-season migration jointly with rural investment.

2.1. The benchmark

Recall from above that our representative household is assumed to have a two period/season decision horizon. For simplicity, the benchmark case abstracts from uncertainty. All household members sell their labour effort in the *peak season* to earn a constant sum, *W*. Additionally, the household pursues all available odd/casual employment in the local area during the *slack season* and earns an amount *F*, also a constant.

Peak season :	*Labour income = W (constant)* $Consumption = c_1$
Slack season :	*Income (from casual employment) = F* $Consumption = c_2 = (W - c_1) + F$

The household utility function is defined as separable over the two periods and is a function of consumption in each period. The following maximization problem is solved:

$$\underset{\{c_1, c_2\}}{Max}\ .\ u^1(c_1) + \delta u^2(c_2),\ \delta > 0,$$
$$subject\ to \quad c_2 = (W - c_1) + F$$

The following first order condition is obtained:

$$\Rightarrow \quad \frac{u^{1'}(c_1^*)}{u^{2'}(c_2^*)} = \delta \tag{1}$$

[3] The terms entrepreneurship, off-season investment and rural innovation are used interchangeably from here onward.

Here, u^1 and u^2 are utilities for peak and slack seasons respectively, and δ is defined as the time rate of discount (or, the rate of impatience).

For purposes of illustration, we solve explicitly for c_1 and c_2 by assuming that farm households have a negative exponential utility defined over consumption (of the following type):

$$u^1(c_1) = -e^{-\phi c_1} \quad and \quad u^2(c_2) = -e^{-\phi c_2}$$

If c_1 and c_2 are stochastic, then ϕ (a positive constant) is defined as the *coefficient of absolute risk aversion*. Applying the above first order condition on these utility functions, and using the consumption constraint, $c_2 = (W - c_1) + F$, we get,

$$c_1^* = \frac{W+F}{2} - \frac{\log\delta}{2\phi}$$
$$c_2^* = \frac{W+F}{2} + \frac{\log\delta}{2\phi} \qquad \text{and} \quad u^1(c_1^*) + \delta.u^2(c_2^*) = U^*$$

We define U^* as the maximized utility for the benchmark case. This solution has an easy interpretation. Since future utility is discounted, the optimal allocation of consumption between the two periods is uneven: higher consumption is allocated to the first period, (note that $\log\delta$ is negative). We introduce now risk in the model by allowing the household to contemplate investment activities (in the off-season) with uncertain returns. For the purpose of illustration, we assume that the household obtains a loan from the local micro-credit institution and (say) opens up a "poultry farm" in the homestead. The scale of undertaking (i.e., the size of farm) is not a decision variable in the model. It is thought to be just large enough to fully employ all (working) family members in the slack period. The latter assumption imply that the loan-size is flexible, that is, the household can take up as much loan as necessary to achieve the desired farm-size[4]. Below, we proceed to derive the critical/marginal conditions in terms of the *required* minimum rate of return on

[4] This assumption is certainly not in conformity with the normal lending practice of micro-credit institutions. Loans under these schemes are rationed – only a small, fixed-size loan is given to the first time borrowers. Our model is meant to be largely illustrative and not intended to capture the *exact mechanics* of the banking practice of these institutions.

entrepreneurship ("poultry-farming") that leaves the household indifferent between adopting and not adopting off-season entrepreneurship.

2.1. Household decision on entrepreneurship

Assumptions:

Peak period income : W

Total net return (net of all costs) on investment (slack period) : $\widetilde{R}_1$

Further, $\widetilde{R}_1 = \mu_1 + \widetilde{\varepsilon}_1, \quad \widetilde{\varepsilon}_1 : N(0, \sigma_1^2).$

That is, the net return on investment is defined to be stochastic (risky) and the (additive) risk term is normally distributed with zero mean and a constant variance. Assuming that the household maximizes expected utility in the face of uncertainly, following expression for expected utility is obtained:

$$E\{\ u^1(c_1) + \delta.u^2(c_2)\ \} = u^1(c_1) + \delta.u^2(c_2^{CE}),$$

where c_2^{CE} is the "certainty equivalent" consumption for the slack season. (Note that the decisions are made in the peak/first period). Further, with the assumption of negative exponential utility, we obtain:

$$c_2^{CE} = E\widetilde{c}_2 - \frac{1}{2}\phi\sigma_1^2 = (W - c_1) + \mu_1 - \frac{1}{2}\phi\sigma_1^2$$

The maximization problem is given as follows:

$$\underset{c_1}{\text{Max}}\{\ u^1(c_1) + \delta.u^2(c_2^{CE})\ \} \quad \text{subject to} \quad u^1(c_1) + \delta.u^2(c_2^{CE}) \geq U^*$$

The constraint implies that the total household utility in the event that investment in entrepreneurship is made must be at least as large as the utility under the benchmark case. Assuming that the constraint holds with equality, it follows trivially that the optimal consumption allocation for the above problem, $(\hat{c}_1, \hat{c}_2^{CE})$, is identical to that for the benchmark case. That is,

$$\hat{c}_1 = c_1^* \text{ and } \hat{c}_2^{CE} = c_2^*.$$

From the second equality above, we get,

$$(\hat{c}_2^{CE} =) W - \hat{c}_1 + \mu_1 - \tfrac{1}{2}\phi\sigma_1^2 = W - (\tfrac{W+F}{2} - \tfrac{\log\delta}{2\phi}) + \mu_1 - \tfrac{1}{2}\phi\sigma_1^2 = \tfrac{W+F}{2} + \tfrac{\log\delta}{2\phi} (= c_2^*)$$

$$\Rightarrow \qquad \mu_1 - F = \tfrac{1}{2}\phi\sigma_1^2 \qquad (2)$$

Equation (2) has the following interpretation. For entrepreneurship to be worthwhile, the expected net total return from this (μ_1) must exceed the slack season income, *F*, (under the benchmark scenario), by at least $\frac{1}{2}\phi\sigma_1^2$, that is, the relevant *risk premium*. We define this required minimum rate of return as the *critical rate* of return on entrepreneurship, CR_E :

$$CR_E = F + \tfrac{1}{2}\phi\sigma_1^2$$

We introduce now the possibility of an addition slack season investment opportunity, namely, participation in seasonal/temporary migration. Our aim is to show that the *critical rate* of return on joint investment (defined as CR_{JI}) (i.e., the required minimum rate of return that makes joint investment worthwhile) is *lower* than the corresponding critical rate of return on entrepreneurship, CR_E. This will make joint investment a more likely outcome than a single investment (i.e., entrepreneurship).

2.3. The case of joint investment

The entire household is assumed to participate in the peak season labour market, just as before. In the slack season, the household has the option of dividing up the total family labour between migration activities and rural entrepreneurship. Slack season migration takes the form of family members travelling to urban centres to seek casual employment, and returning home before the peak season labour market opens up. Recall that $\widetilde{R}_1$ is defined as the net return from entrepreneurship when all family members participate in this activity. We assume here that net return varies *linearly* with the proportion of total family labour that participates, that is, if a proportion α of family labour participates then net return (on entrepreneurship) will be $\alpha\widetilde{R}_1$[5]. Net return from migration, $(1-\alpha)\widetilde{R}_2$, is the wage income of the remaining family members (as migrants) net of all migration costs. (Note that $\widetilde{R}_2$ denotes net migration income when all family members become off-season migrants). The above assumptions are summarized below.

$$\text{Peak period income}: \quad W$$
$$\text{Total net return from joint investment (in slack period)}: \alpha\widetilde{R}_1 + (1-\alpha)\widetilde{R}_2$$
$$\widetilde{R}_2 = \mu_2 + \widetilde{\varepsilon}_2, \quad \widetilde{\varepsilon}_2 : N(0, \sigma_2^2)$$
$$\widetilde{c}_2 = (W - c_1) + \alpha\widetilde{R}_1 + (1-\alpha)\widetilde{R}_2$$
$$E\widetilde{c}_2 = (W - c_1) + \alpha\mu_1 + (1-\alpha)\mu_2$$

The certainty equivalent consumption for the slack season is given by:

$$c_2^{CE} = E\widetilde{c}_2 - \tfrac{1}{2}\phi\sigma^2$$
$$\sigma^2 = \text{Variance}\ (\widetilde{c}_2) = \alpha^2\sigma_1^2 + (1-\alpha)^2\sigma_2^2 + 2.\alpha(1-\alpha)\sigma_{12}$$
$$\sigma_{12} = \text{Covariance between the two returns.}$$

The problem the household faces here is a two-fold optimization problem: to *allocate* the available *family labour* between the two investments (the portfolio allocation decision) and to choose *consumption* in the two periods. The optimization problem is given as follows:

$$\underset{c_1, \alpha}{\text{Max}} \{ \ u^1(c_1) + \delta.u^2(c_2^{CE}) \ \} \quad \text{subject to} \quad u^1(c_1) + \delta.u^2(c_2^{CE}) \geq U^*$$

The appropriate Lagrange function is given by:

$$Max.L = \underset{\{c_1, \alpha, \lambda\}}{Max} \left[\{u^1(c_1) + \delta u^2(c_2^{CE})\} + \lambda\{u^1(c_1) + \delta u^2(c_2^{CE}) - U^*\} \right]$$

[5] This assumption essentially implies that there are no economies of scale in entrepreneurship. This is invoked for simplicity.

The first order conditions are given by:

$$c_1: \quad u^{1}{}'(c_1) - \delta u^{2}{}'(c_2^{CE}) + \lambda \left(u^{1}{}'(c_1) - \delta u^{2}{}'(c_2^{CE}) \right) = 0$$

$$\lambda: \quad u^{1}(c_1) + \delta u^{2}(c_2^{CE}) - U^* = 0$$

$$\alpha: \quad \alpha^{**} = \frac{(\mu_1 - \mu_2) + \phi(\sigma_2^2 - \sigma_{12})}{\phi(\sigma_1^2 + \sigma_2^2 - 2\sigma_{12})} \tag{3}$$

Given that the constraint holds with equality, λ>0. The above first order conditions then give:

$$u^{1}{}'(c_1) - \delta u^{2}{}'(c_2^{CE}) = 0 \;\Rightarrow\; \left(u^{1}{}'(c_1) \big/ u^{2}{}'(c_2^{CE})\right) = \delta$$

Note that the equation above is identical as (1). Then the optimal allocation of consumption in the present case will be identical as to that of the benchmark case (as well as the single investment case). Denoting the solution as ($c_1^{**}, c_2^{CE**}, \alpha^{**}$), and equating the slack season consumption in the benchmark case with the corresponding consumption in the joint investment case, we get,

$$c_2^{CE**} = c_2^{*}$$

$$\Rightarrow W - c_1^{**} + (\alpha\mu_1 + (1-\alpha)\mu_2) - \tfrac{1}{2}\phi\sigma^2 = \frac{W+F}{2} + \frac{\log\delta}{2\phi}$$

$$\Rightarrow W - \left(\frac{W+F}{2} - \frac{\log\delta}{2\phi}\right) + (\alpha\mu_1 + (1-\alpha)\mu_2) - \tfrac{1}{2}\phi\sigma^2 = \frac{W+F}{2} + \frac{\log\delta}{2\phi}$$

$$\Rightarrow \quad (\alpha\mu_1 + (1-\alpha)\mu_2) - F = \tfrac{1}{2}\phi\sigma^2 \tag{4}$$

Optimal investment rule in (4) has a straightforward interpretation. For the joint investment to be worthwhile, its expected return must exceed the alternative certain return, *F*, (i.e., the slack season income in the benchmark case) by an amount at least equal to the associated risk premium. The critical return on joint investment, CR_{JI}, is given by:

$$CR_{JI} = F + \tfrac{1}{2}\phi\sigma^2$$

That is, if the expected rate of return on joint investment is higher than the critical rate, CR_{JI}, then the joint investment would be the *preferred option*.

Note that the optimal solution for α, given by (3), does not depend on the intertemporal allocation of consumption. The solution to α comes out of the following:

$$\frac{\partial}{\partial\alpha}(c_2^{CE} = E\tilde{c}_2 - \tfrac{1}{2}\phi\sigma^2) = 0$$

The above partial derivative further implies that α is chosen so as to minimize the portfolio variance (for a given rate of expected portfolio return). According to (3), the optimal proportion of family labour that is engaged in entrepreneurship will *ceteris paribus* vary positively with the rate of return differential between the two investments, $(\mu_1 - \mu_2)$, positively with the variance of return from migration, σ_2^2, and negatively with the variance of return on entrepreneurship, σ_2^2. The relationship between α and the covariance term σ_{12} is ambiguous.

***2.4. How does rural innovation facilitate migration*?**

In order to show why investment in entrepreneurship facilitates participation in migration, we compare the optimality conditions in (2) and (4). In order to make the two conditions comparable we first make the following assumptions:

$$\mu_1 = \mu_2,\ \ \sigma_1^2 = \sigma_2^2 \ \text{ and } \ \sigma_{12} = 0. \text{Then from (3)}, \ \ \alpha = \tfrac{1}{2}$$

Given the above, the portfolio variance or the variance of the joint return, σ^2, will take on the following value:

$$\sigma^2 = \alpha^2\sigma_1^2 + (1-\alpha)^2\sigma_2^2 + 2\alpha(1-\alpha)\sigma_{12} = \tfrac{1}{2}\sigma_1^2.$$

The equation above shows that the portfolio variance under joint investment is half the variance of the individual investment. It follows that the risk premium under joint investment will also be half that of the individual investments. That is,

$$\underbrace{\tfrac{1}{2}\phi\sigma^2 = \tfrac{1}{4}\phi\sigma_1^2}_{\text{risk premium in joint invetment}} \quad < \quad \underbrace{\tfrac{1}{2}\phi\sigma_1^2}_{\text{risk premium in entrepreneurship}}$$

This is an illustration of what we call benefits from diversification. The above inequality along with equations (2) and (4) imply in turn that the *critical rate of return* in the joint investment case is *lower* than that of any of the two investments separately:

$$CR_{JI} = F + \frac{1}{2}\phi\sigma^2 = F + \frac{1}{4}\phi\sigma_1^2 < F + \frac{1}{2}\phi\sigma_1^2 = CR_E$$

If we assume instead that the covariance need not be zero, it can then be shown (by leaving the other assumptions unchanged) that the only instance where there is no diversification benefit is where the correlation coefficient between the two returns is unity. To verify this, we look as the following definition:

$$\text{Correlation coefficient} \equiv \rho(\widetilde{R}_1, \widetilde{R}_2) = \tfrac{\sigma_{12}}{\sigma_1 \sigma_2} = 1 \Rightarrow \sigma_{12} = \sigma_1 \sigma_2 .$$

If we substitute $\sigma_{12} = \sigma_1 \sigma_2$ in the risk premium calculation above, we find that the risk premium for the joint project is equal to that for entrepreneurship. In that case, the household would be indifferent in terms of adoption decision between the joint investment and a single investment.

The query we set off to investigate was if the family's adoption of risky investment would facilitate participation in migration (by family members). The intuition is that given that income of migrants from *urban sources* (which is also risky) is likely to be uncorrelated with income generated from entrepreneurship (a *rural activity*), possibilities exist for gains from risk diversification when households engage in both activities simultaneously. In order to establish this intuition, we develop an illustrative model that draws on the theory of portfolio management. By treating off-season migration and entrepreneurship as competing investment projects, we produce an example where the household is better off by investing in both projects simultaneously, (i.e., forming a portfolio of the two projects), than investing in any one of the two projects alone. The reason simply is that the portfolio risk is lower than the individual project risk (as shown in the example).

(*For readers*: *The paper requires substantial revision/rewriting from this point onward*)

2.5. Empirical implementation

The main hypothesis we wish to test is to what extent a given household's investment in risky activities may explain its propensity to participate in migration. That the decision to engage in rural entrepreneurship may promote migration within a given household is captured in equations (2) and (4). Equation (3) on the other hand captures the relative proportions of household labour that are allocated to the alternative investments. In fact, the relationship in (3) could be a useful point of departure in terms of forming an empirical model. Note that α^{**} in (3) represents the optimal proportion of family labour employed in entrepreneurship. This could alternatively be viewed as the size of investment, since, by definition, α is proportional to the size of the undertaking. For the purpose of estimation, we give α yet another interpretation, namely, α could be viewed as the *probability* of investing in entrepreneurship.

It is reasonable to argue that factors that affect the size of investment will also affect the probability of adoption of that investment. We reinterpret (3) as follows.

The *probability of investing in entrepreneurship* (a proxy for α) is *larger* (with other things being the same)

i) *larger* is the *expected return* on entrepreneurship, μ_1, (or smaller is the return to migration activities, μ_2),

ii) *smaller* is the *variance* of own return, σ_1^2 (or larger the variance of returns from migration, σ_2^2),

and equivalently for the *probability of participation in migration*.

Note that the specification above (following equation (3)) allows for only two risky investments in the household portfolio. The framework can be easily extended to include other investment objects for purposes of estimation. Further, we could allow these additional investments to be either substitutes or complements to investment in entrepreneurship. Note however that (3) does not capture the main hypothesis that we wish to test, namely that joint investment potentially reduces total portfolio variance, thus making both investments more viable. One way of incorporating this explicitly is to add the following (hypothesis) to the empirical model above:

The *probability of participation in migration is higher*

iii) if the household also engages itself in rural investment.

The estimating model we propose below is geared towards capturing/testing the above three main hypotheses.

Econometric technique

We apply a *Bivariate Probit* model to estimate the relationship spelled out above. The two household decision variables, participation in seasonal migration (*Migrate*) and loan-financed investment (*Invest*), are defined to have *binary* outcomes. Households either invest (*Invest*=1) or do not (*Invest*=0), and similarly for participation in migration, i.e., *Migrate*=1 or *Migrate*=0. The estimating model is specified as follows:

$$\boldsymbol{Invest^*} = \beta_1' x_1 + \varepsilon_1, \quad \boldsymbol{Invest} = 1 \quad \boldsymbol{if} \quad \boldsymbol{Invest^*} > 0, \quad 0 \quad \boldsymbol{otherwise}, \qquad (5)$$

$$\boldsymbol{Migrate^*} = \beta_2' x_2 + \varepsilon_2, \quad \boldsymbol{Migrate} = 1 \quad \boldsymbol{if} \quad \boldsymbol{Migrate^*} > 0, \quad 0 \quad \boldsymbol{otherwise}, \qquad (6)$$

$$E[\varepsilon_1] = E[\varepsilon_2] = 0,$$

$$Var[\varepsilon_1] = Var[\varepsilon_2] = 1, \qquad Cov[\varepsilon_1, \varepsilon_2] = \rho.$$

The probability that the households engage in both entrepreneurship (*Invest*=1) and participates in migration (*Migrate*=1) is given by a bivariate normal distribution. The x's are the explanatory variables proxying for the rates of return on the two investment projects and their variances/covariances, etc., as specified in equation (3). Equations (5) and (6) form the empirical counterpart to equation (3). Under the null hypothesis that ρ=0, the model above collapses to two univariate Probit model implying that the two investment decisions are independent. By implication, the alternative hypothesis, ρ>0, stands for the claim that two investment are complementary to each other. The model is estimated (as a standard method) by Maximum Likelihood technique using statistical package Stata, version 8.

3. Data and choice of variables

Our data set is based on a household survey conducted in 1994 in two groups of villages (each group belonging to a distinct region) in Bangladesh by the Institute of Development Studies (IDS), University of Sussex in England. The first group of villages are located in the Chandina *thana* of Comilla district and the second group of villages are from the Madhupur *thana* of Tangail district[6]. The survey covered 5062 households of which 2495 were from Chandina. Note that the two regions represented here are geographically distinct (about 250 kilometers apart) and have markedly different socio-economic characteristics. For the present purpose, we exclude from the sample two villages from *Chandina* that do not have any functioning credit program. This leaves us with a sample of 3422 households from six villages. Further discussion on data, summary statistics of data, etc. are omitted in the present (preliminary) version due to time constraint.

The two binary decision variables (or) independent variables of the model are measured/proxied for the purpose of estimation as follows.

[6] A *thana* is an administrative unit consisting of several villages. The word *thana* literally means "police station".

Variable “Invest”, defined as rural investment undertaken by households using institutional credit, is proxied by

$$Invest = \begin{cases} 1, \text{ if the household had ever taken an institutional loan} \\ 0, \text{ otherwise.} \end{cases}$$

Note that microfinance institutions advance loans to those families who are functionally landless (with some exceptions) and who have submitted loan applications with a viable investment project. The utilization of the loan is also closely monitored.

The variable “Migrate” is proxied by the following:

$$Migrate = \begin{cases} 1, \text{ if the household has at least one member who is a temporary or} \\ \quad \text{a permanent migrant} \\ 0, \text{ otherwise.} \end{cases}$$

The above definition of “Migrate” appears to violate the assumption (of the theoretical model) that our focus is exclusively on seasonal migration. That is, given that permanent migrants live and work away from home all year round, it is unlikely that they with repatriate much of their income/savings to their rural home. As such, the family income diversification function of migration will be lost. It would therefore be advisable that permanent migrants should not be included in the definition. However, the permanent migrants in *our sample* are *qualitatively* very similar to temporary/seasonal migrants in that majority have strong ties with their rural home, for example, most of the adult male (permanent) migrants have their wife and children living in the rural home.

As to the choice of the main independent variables for the regression model, (namely, *returns* to competing investments, μ_1 and μ_2, *variances* of returns, σ_1^2 and σ_2^2, the covariance, σ_{12}), we do not have direct measures for all of these. As such, we rely on a wide range of *proxies* that directly or indirectly represent (or influence) these variables. Some of these proxies are household-specific, others are region specific. We give below a list (as well as definition) of all the variables in the regression model.
Independent variables are listed in Table 1 below.

Table 1

Variable name	**Variable definition**	***Aprioi sign (Dependent Var.: Migrate)***	***Apriori sign (Dependent var.: Invest)***
Explanatory variables for both equations			
HEADEDU (DUMMY)	Education level of household head = 1, if 10 years of school (secondary) or more = 0, otherwise	+/-	+/-
HEADSEX (DUMMY)	Sex of household head =1, if female =0, if male	-	+
IRRIGATION (DUMMY)	Access to irrigated land =1, if household has access to irrigated land for cultivation = 0, otherwise	-	+/-
REGION (DUMMY)	=1, if the household is from *Chandina* =0, if the household is from *Modhupur*	+	+
MALES	Number of adult males (over age 14) in the household	+	-
FEMALES	Number of adult females (over age 14) in the household	+/-	+
CROPLAND	Total amount of cropland owned	-	-
FAMILYSIZE	Total family members	+	+
POND (DUMMY)	=1, if the household owns fish pond, =0, if not.	-	-
NO_H	Number of households in the compound	+/-	+/-
RELIGION	=1, if muslim household = 0, if hindu household	-/+	-

The rationale for the choice of the variables will be presented together with the regression results below.

Results

Table 2

Bivariate Probit regression Number of observations =1994 Wald $\chi^2(22) = 544.25$		Figures in parentheses are Z-values * indicates significance at 90% ** indicates significance at 95% *** indicates significance at 99%
Variables	COEFFICIENT EQUATION: ***Migrate***	COEFFICIENT EQUATION: ***Invest***
HEADEDU (DUMMY)	0.2146** (2.09)	-0.0576 (-0.67)
HEADSEX (DUMMY)	-0.078 (-0.38)	-0.4722*** (-3.02)
CROPLAND	-0.0035*** (-4.65)	-0.0034*** (-5.69)
IRRIGATION (DUMMY)	-0.0796 (-0.8)	-0.1133 (-1.56)
REGION (DUMMY)	1.55*** (10.68)	-0.5927*** (-4.29)
MALES	0.298*** (5.44)	-0.1878*** (-3.98)
FEMALES	0.1966*** (2.86)	-0.0195 (-0.34)
FAMILY SIZE	-0.0874*** (-3.14)	0.1667*** (7.42)
POND (DUMMY)	-0.1989 (-1.56)	-0.2273** (-2.04)
NO_H	0.0011 (0.15)	-0.0225*** (-2.98)
RELIGION	0.9479*** (5.39)	0.0929 (0.51)

Estimate of $\boldsymbol{\rho}$ (rho) = 0.116

Likelihood-ratio test for ρ=0:

$\chi^2(1)$=4.234, Prob ($\chi^2(1) > 4.234$) = 0.0396

3.1. Discussion of results

Note that in line with theoretical model in equation (3), the list of explanatory variables in both of the Probit equations is identical. The list of included explanatory variables, at this stage, is quite short – we are still in the process of finding additional relevant variables – but care is taken in choosing variables that are fully exogenous/predetermined in order to avoid the problem of simultaneity, (i.e., endogenous variables on the right-hand side). Further, the results reported in Table 2 are obtained using a sample that excludes the poorest 25% and the richest 15% of the households. (The rational for this is not discussed in this version due to time constraint). Below we explain first the rationale for choice of variables along with the expected signs of the effects (i.e., the sign of coefficients) followed by discussions of the actual estimates.

HEADEDU (DUMMY)

A household with a well-educated/well-informed head is expected to be a better decision maker in terms of choice and execution of investment projects. Such a household is likely to have relatively lower perceived risks and/or higher expected returns and therefore more inclined to *invest* in entrepreneurship. However, an educated household head also imply a "resourceful" household. These households may simply not qualify for institutional loans. The relevant coefficient is insignificant which is in line with our prediction.

An educated household head could also have a positive impact on *migration*, in that, he/she is likely to be better informed about alternative opportunities. However, in line with the argument above, these households are likely to have a well diversified incomes portfolio, and therefore are less likely to need additional diversification through migration. The relevant coefficient is positive and significant.

HEADSEX (DUMMY)

The female household heads are typically widows or divorcees, - often older women - who are typically resource poor in terms of both assets/capital and labour, (that is, these households are less likely to have adult males). These households will also have difficulty in finding partners (i.e., forming groups) in order to apply for group-loans. While micro-credit institutions are supposed to be specially supportive of poor female borrowers, a separate regression model with the same data set - results not reported here - reveals that probability of borrowing from micro-credit institutions is negatively affected by the fact that a given household has a female head. A negative coefficient obtained in the present regression corroborates our earlier results.

A female-headed household will also have difficulty to participate in migration because of high opportunity costs. Note that these households will almost certainly have no adult male – that is why these are called female-headed - where males are the typical migrants. The estimated coefficient is insignificant.

CROPLAND

Ownership of (large amount of) cropland is an important source of insurance against income shock in rural economies. Further, large land-owners are also expected to have other assets and hence a diversified incomes portfolio. On the other hand, these households, having large risk-bearing ability, may indeed wish to invest in (additional) rural entrepreneurship. However ownership of land will probably disqualify them from applying for institutional loans[7]. The relevant coefficient is negative and significant in line with our prediction.

The insurance function of land-ownership implies that participation in migration may not be a priority for these households. The relevant coefficient for the migration equation is negative and significant.

IRRIGATION (DUMMY)

This measures a household's access to irrigated land. Note that access to irrigated land in Bangladesh allows farmers to grow crops in periods that are traditionally considered off-season. Thus, this variable is thought to indicate the extent to which a household has access to off-season employment/income generating activities. Access to irrigated land is therefore a source of insurance against seasonal income risks. This is likely to lower the need for additional insurance via migration.

[7] Our sample reveals that while the probability of receiving institutional credit declines with increasing landholding, large landholders are by no means excluded by the lenders.

The same argument also applies in the case of rural investment. The estimated coefficients for both the equations are insignificant.

REGION

This (dummy) variable is constructed to capture regional differences in the probability of participation in either migration or rural investment (borrowing) that are not explained by the individual/family specific explanatory variables. The estimates show that belonging to *Chandina* region significantly raises the average probability of migration. This difference could be a measure for factors not captured explicitly in the model, such as climatic differences in the two regions (e.g., Chandina is more prone to seasonal flooding compared to Modhupur), or differences in economic infrastructure, e.g., transportation network, extent of electrification, etc. Chandina is at a relative disadvantage in terms of various economic infrastructure, and therefore, Chandina-households are in a greater need to participate in migration to achieve income diversification. The estimated positive coefficient in the migration equation agrees with the above conjecture.

In the investment equation, Chandina has a negatively significant coefficient reflecting the fact that microfinance activities are more widespread and have a much longer history in Modhupur compared to Chandina.

MALES

Large number of males in the household certainly facilitates entrepreneurship (*investment*). Working men – agricultural workers - generally have a low opportunity cost of time during the slack season and as such could be "profitably" employed in family businesses. However, having many male members will also increase the possibility of alternative income sources (and income diversification), and accordingly, discourage investment in entrepreneurship (as a source of diversification). Expected net effect is therefore ambiguous.

As far as *migration* is concerned, a large number of male members can definitely facilitate participation in migration. The estimated coefficient for the investment equation is negatively significant whereas the same coefficient in migration equation is positive and strongly significant. These are in accord with our apriori intuition.

FEMALES

Having many females over age 14, does not appear to be advantageous for entrepreneurship, apriori, since women in general do not participate in outdoor activities, such as *petty trading*. However, if investment activities are driven from within the home, then female members are a definite advantage.

Many adult females in the family do not in general encourage migration, however, the recent proliferation of urban based garment industry (which exclusively employs young women) implies that variable "FEMALE" could indeed have a positive effect on the probability of migration. The results show that the variable has a positive and significant coefficient in the migration equation but an insignificant coefficient in the investment equation.

RELIGION

This represents the religious denomination of the household. There are two categories here: *hindu* and *muslim*. Being a member of the religious minority (just over 8% in this sample), the hindu households are expected to have relatively stronger communal bonds (as opposed to their muslim counterpart), that is, they are likely to form close networks of families and be highly supportive of each other. Indeed, being a member of the hindu community in itself gives access to a source of insurance against income risks. Migration by a member of a hindu family implies that the migrating individual loses the protection and support of the (rural) community network, which simply increases the opportunity cost of migration. This may discourage migration.

In terms of participation in borrowing, being a member of the hindu community could indeed be an advantage in that it would be easier to form groups (in order to seek group credit) from within the family network. While the coefficient in migration equation is strongly negative the same for the investment equation is insignificant.

POND (DUMMY)

Ownership of pond could be complementary to rural entrepreneurship in that it facilitates investment fish farming. However a pond-owner is not likely to be a landless poor and may therefore not qualify for institutional credit.

As to the migration equation, potential income from pond (through fish farming, etc.) provides income diversification and may therefore dampen the need for migration. One may on the other hand argue that pond ownership (fish farming) is complementary to migration in terms of gains from diversification. This could encourage migration (i.e., if the latter effect is dominant). The estimated coefficient for POND is negative (and significant) in the investment equation, and insignificant for the migration equation.

FAMILY SIZE

The argument that there is a strong insurance motive for having large families among poor rural households could well be applied in the present case. Large families imply larger number of working members in the household. This could provide some insurance against low season income risk if two or more family members choose to pursue alternative employment/income opportunities (with less than fully correlated risks). Large families may, on the other hand, imply lower opportunity cost of migration, and therefore encourage migration.

Having a large family may also facilitate adoption of investment projects, in that large families will enjoy a cost advantage in running/operating such undertaking. The estimated coefficient is positive and significant in the investment equation, but the comparable coefficient in the migration equation is insignificant.

NO_H

This variable stands for the number of houses/families that share a *compound*. The families within a compound will typically have close ties, and therefore belonging to a large compound is itself a source of insurance. Belonging to a large network of families may facilitate securing a loan and thus encourage rural investment. It can also encourage migration by lowering its opportunity costs. The estimated coefficient is insignificant in the migration equation but negatively significant in the investment equation.

The complementarity hypothesis (ρ=0 vs. ρ>0)

The null hypothesis is rejected at the 95% level in favour of the alternative hypothesis that ρ>0. This implies that there are unobserved factors (i.e., factors not included in the list of explanatory variables) that lie behind the positive correlation between the two decision variables. This in consistent with our complementarity hypothesis.

4. Some concluding remarks

The results, on the whole, appear to lend strong support to our main hypothesis that participation in borrowing (risky investment) facilitates participation in migration via benefits from risk diversification. However, we find that the complementarity hypothesis is supported in the data only if we exclude the poorest 25% (those earning under $100 per capita) from the sample. This may be indicative of the fact that the very poor are unable to exploit the gains from diversification in the same manner as their relatively better off counterparts. (INCOMPLETE).

(*This part is to be expanded to include additional discussion of results and policy recommendations*).

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