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Abstract:
The dominant argument in the recent literature in explaining *internal* (e.g., rural-to-urban) migration in developing countries has been one of *insurance motives*. According to this, rural households, by placing working family members in geographically dispersed labour markets, potentially achieve diversification of family income risks. In an extension to this, it is further argued that participation in migration may generate additional (external) benefits, in that it may facilitate adoption of risky investments, (e.g., adoption of modern technology in agriculture) by households, which in the absence of migration would not be feasible. The hypothesis that migration promotes rural innovation is modelled in this paper using a choice theoretic framework. This is also tested empirically using household survey data, (a single cross-section of micro-data), from rural Bangladesh. The preliminary results (based on a Logit regression on the determinants of *household acquisition of new agricultural land* (a *proxy* for risky innovation)) lend strong support to the claim that the presence of migrants in the family facilitates innovation.

Theme: Migration
Keywords: Rural-to-urban migration, Rural labour markets, Rural innovations, Insurance motives for migration
JEL classification: D1, D81, J43, J61, O1, Q12, R23

Can Rural–to-urban Migration Promote Rural Innovations? - Theory and Tests*

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1. Introduction

The dominant argument made in the recent literature in explaining *internal* migration (i.e., both rural-to-urban and rural-to-rural) in developing countries has been one of insurance motives. The insurance argument has been widely studied both theoretically and empirically by, among others, Cox and Jimenez (1992), Hoddinott (1994) and Lucas and Stark (1985). In a related claim, Stark et al., (see for example, Levhari and Stark (1982) and Katz and Stark (1986)) argue that migration is desirable because it may enable rural households to engage in certain risky investment activities, which, in the absence of migration, would be deemed infeasible. Below, we elaborate on this in the context of decision making within poor farm households.

The insurance argument is as follows. Given that income from agriculture (both labour income and/or income from production) is inherently risky and that markets for income insurance are typically missing, rural families generally seek to self-insure. One probable means of self-insurance is a scheme of *mutual insurance* among family members via migration. For a given household, an implementation of this would be to send some of its members away to seek (permanent or temporary) urban employment while the remaining members engage in rural activities (home production). Some measure of risk spreading may be achieved in this manner given that the income risks from the two sources are not fully correlated. A simple extension of this diversification argument can be made to demonstrate that participation in migration by household members may have additional *external* benefits, in that it may promote household adoption of risky investments. In order to facilitate understanding, we present first an appropriate contextual background for this idea.

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, (see Stark et al. (citations above)). 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 risks that investment activities entail. With this backdrop, we argue that there are means by which a rural household may circumvent the problem of missing capital/insurance markets. It follows from simple theory of portfolio management that if an individual saver has a portfolio consisting of at least one risky asset, then the inclusion of additional risky assets will

generally create opportunities for diversification/reduction of total (portfolio) risk. This intuition can also be extended to a portfolio of investment in physical/non-financial assets. That is, the same diversification argument could be used to explain why a farm household that shies away from investing in a risky project in the absence of migration opportunities, may find such investments *feasible* if undertaken jointly with migration, (here, participation in migration is viewed as a risky investment).

As mentioned earlier, the argument that migration may promote rural innovation was first elucidated by Stark *et al*., (see citations above). Quite surprisingly however, Stark *et al*. do not provide an exact analytical model of this claim, and, to the best of our knowledge, this has not been modelled elsewhere[1]. This apparent oversight in the literature provides the main motivation for this paper. Additionally, we believe that the joint investment phenomenon under discussion has strong implications for development policies, and as such, further insight into this is needed. To this end, we wish to develop in this paper a choice theoretic framework in order to analyse the decision problem of a representative farm household contemplating a dual/joint investment project of the type discussed above.

Before proceeding with the modelling, we wish to add a methodological note on how our approach compares with the more traditional approaches to modelling migration, due to, for example, Todaro (1969, 1976, 1980). Todaro argued that rural-to-urban migration is motivated by the expectation of positive earnings differential between destination (urban centres) and (rural) home. Our approach on the contrary will appear to focus on earnings/consumption risks and risk-avoidance as the main motive for migration. We argue below that our approach is more general than that of Todaro, and that the Todaro argument is indeed embedded in our model. We show, by assuming that farm households are risk averse, i.e., they are expected utility maximizers, (and by choosing a *special* functional form for household utility), that migration decision by households are based on comparing *certainty equivalent* earnings between home and destination, (details are given in section two). Note that certainty equivalent earnings are defined as the *risk adjusted expected value* of earnings. If we assume now that farm households are risk neutral (or that they maximize expected earnings instead of expected utility, as assumed in Todaro (1969)),

[1] Katz and Stark (1986) model a joint investment phenomenon that is quite akin to the idea presented above, however the thrust of their model deviates from the main point of contention above. In particular, in their joint investment story, while migration is assumed to be a *gamble* (risky investment), the accompanying investment in innovation *is not*. Clearly then, it *cannot* be the diversification argument that drives their model. Note that diversification lies in the heart of the argument above.

then comparing certainty equivalent earnings simply collapses to comparing expected earnings. Our approach is more general in the sense that we can compare both expected earnings/returns as well the associated variances/risks of alternative investment decisions, which Todaro approach cannot[2]. 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. This is followed by the discussion of results. Section four contains the concluding remarks and caveats.

2. The Model

We consider a representative farm household that owns a small plot of land (asset) in addition to its labour power. 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 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 cultivation of own land, (households could alternatively rent out land and earn rental income), as well as 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 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 in the off-season that a poor farm household could engage in. For example, household members could become off-season traders (engaging in petty trading in the local market), or alternatively, the household could choose to become an agro-entrepreneur, whereby it would lease-in (or purchase) additional land and engage in intensive cultivation using family/hired labour[3]. These activities will require relatively large start-up capital, and returns are risky. As such, very few farm households have sufficient access to capital

[2] Note that similar remarks have been made by Stark *et al*. (cited above) in comparing the traditional approach *a la* Todaro and the more recent approach based on the insurance argument.
[3] During periods when land lies fallow in the traditional method of cultivation (- a part of slack season -), crops can indeed be grown if one has access to water/irrigation facilities and other implements of modern agriculture.

and/or the ability to bear risk in order to make adoption of such investments worthwhile. To summarize the main point above, the problem facing a farm household contemplating rural investment/innovation is twofold: access to capital and managing (coping with) the risk. In the model below, we propose to analyse the claim that farm households may resolve the twofold problem of access to capital and risk by adopting a scheme of joint undertaking, namely, participation in migration and undertaking rural investment. 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 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[4]. 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. All household members sell their labour effort in the *peak season* to earn a fixed sum of *W*. The household is thought to lease out owned land for a fixed rent. Own cultivation of land is possible, however, given that the land (owned by poor households) is also thought to be of marginal quality, large outlay will be required in order make this worthwhile. The household is assumed not to choose such risky endeavour. The household pursues all available odd/casual employment in the local area during the *slack season* and earns a fixed income. An amount *F* (a constant) is earned in the slack season consisting of income from land-lease and odd jobs.

Peak season :	Labour income $= W$ (constant)
	Consumptio n $= c_1$
Slack season :	Income (from lease and employment) $= F$
	Consumptio n $= c_2 = (W - c_1) + F$

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

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 $c_2 = (W - c_1) + F$

The following first order condition is obtained:

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

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):

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

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,

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

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 illustrative purposes, we assume that the household pursues agro-entrepreneurship, implying that the household leases in (or buys) agricultural land (in addition to land it

owns) and engages in intensive cultivation using family labour and implements of modern technology. The scale of undertaking (i.e., entrepreneurship) is not a decision variable here, (assumed to be a constant). It is thought to be just large enough to fully employ all (working) family members in the slack period. While entrepreneurship will typically require large start capital/outlay, we ignore the problem of raising capital for the time being, and concentrate solely on the household's risk coping behaviour. We wish to derive critical/marginal conditions in terms of the *required* minimum rate of return on entrepreneurship 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 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,

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

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 $\alpha\widetilde{R}_1$. 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.

Peak period income : W

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:

$c_2^{CE} = E\widetilde{c}_2 - \frac{1}{2}\phi\sigma^2$

$\sigma^2 = \text{Variance}\ (\widetilde{c}_2) = \alpha^2\sigma_1^2 + (1-\alpha)^2\sigma_2^2 + 2.\alpha(1-\alpha)\sigma_{12}$

$\sigma_{12} = \text{Covariance between the two returns.}$

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:

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

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:

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

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,

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

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

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

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

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 feasible.

Note that the optimal solution for α is 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 migration facilitate innovation*?**

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

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

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

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

It follows given above assumptions that both investment projects are equally attractive when adopted separately, (they have the same risk premium), but the risk premium under joint investment is half that of the individual investments. That is,

$\frac{1}{2}\phi\sigma^2 = \frac{1}{4}\phi\sigma_1^2$ (risk premium in joint investment) $< \frac{1}{2}\phi\sigma_1^2$ (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:

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

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 participation in migration by the members of farm family would facilitate the family's adoption of risky investment. The intuition behind this conjecture 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 the participation in migration by poor rural households may explain households' propensity to invest in risky activities. That migration may promote risky investment 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).

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 explicitly 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 investing in entrepreneurship* is larger

iii) if the household also participate in migration activities.

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

Econometric technique

We apply the Logit model to estimate the relationship spelled out above. We define the investment in entrepreneurship (INVEST) as a binary variable. Households either invest (INVEST=1) or do not (INVEST=0). We define further,

Probability(INVEST = 1) = $F(\beta' x)$

Probability(INVEST=0) = 1- $F(\beta' x)$.

x is a vector of variables thought to influence household investment decision, β is set of parameters reflecting marginal impact of x on the probability and F is the probability distribution function. It is quite standard to use a "logistic cumulative distribution function" to represent F as this results in the estimated equation having a number of desirable properties, see (Greene (1993)) for details). That is,

$$\text{Probability}(\text{Invest} = 1) = \frac{e^{\beta' x}}{1 + e^{\beta' x}} = \Lambda(\beta' x)$$

Λ is the logistic cumulative distribution function. The above is called the Logit model which is estimated (as a standard method) by Maximum Likelihood technique.

3. Data and choice of variables

Our data set is based on a household survey conducted in 1994 in two groups of villages 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[5]. 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 choose a subset of households who have agriculture as the primary source of livelihood, and who do not belong to the poorest twenty percent of the total sample. That is, we exclude from the sample the near-destitute households. We are then left with a sample of 1267 households of which 502 households are from Chandina. There are a total of 279 households with migrants in the sample, of which Madhupur only has 30 households with migrants compared to 249 in Chandina.

As to the choice of variables for the regression model, there appears to be no natural candidate to represent the left-hand side variable, namely, entrepreneurship. We have a good deal of information on household ownership of various investment objects/productive assets, e.g., modern agricultural appliances such as tractors, etc., draught animals, milk cows, recent acquisition of agricultural land, and so forth. We use ***recent acquisition of agricultural land*** as the proxy for entrepreneurship or rural investment. The logic for this choice is as follows. About 90% of households who reported to have purchased land in

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

previous five years declared agricultural production to be the intended use of the land. Recall that we indicated in section two that leasing of land could be a means of acquiring land for entrepreneurship. Since we do not have access to readily available data on land lease, data on recent purchase of land are thought to be a reasonable substitute. Note that about 40% of all households in the sample reported to have acquired land recently. However, this choice of dependent variable does throw up an *alternative hypothesis*, namely that the acquisition of land could well be looked upon as a form of saving or a hedge against income risks rather than a risky investment. That is, higher household income from migration simply leads to higher savings in the form of acquisition of real assets, e.g., land. An appropriate test for our main hypothesis would then be equivalent to testing the following:

a) If the presence of migrants in the family has *positive impact* on the acquisition of land (via *diversification benefits*),
   in addition to the possibility that
b) higher family income due to the presence of migrants leads to acquisition of land, (where land is a form of saving).

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, and other investment objects that may affect the left-hand side variable), 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:

Dependent variable (for the Logit model):

$$\text{INVEST} = \begin{cases} 1, \text{if the household has purchased land in the last five years,} \\ 0, \text{otherwise.} \end{cases}$$

Independent variables are listed in Table 1 below.

Table 1

Variable name	*Variable definition*	*Apriori sign*
Variables representing/affecting returns to investments		
YIELD	Value of total yield of operated land	+
INVEST2	Ownership of major agricultural appliances (in number)	+
NCD	Ownership of draught animal (in number)	+
INCOME_AGRI	Off-farm sources of income (agricultural)	-
INCOME_NONAGRI	Off-farm sources of income (non-agricultural)	-
MALES	Number of adult males (over age 14) in the household	+/-
FEMALES	Number of adult females (over age 14) in the household	-
HEAD_SEX	Sex of household head =1, if male =0, if female	-
Proxies for variance of return:		
NGO	Access to non-governmental lending institutions (NGOs)	-
HH_EDU	Education level of household head	+
C_LAND	Total crop land owned	+
CROP_LAN	Total land area under cultivation	+
IRRI_LAN	Total access to irrigated land	-/?
Proxies for diversification benefits from other investments		
MIGRANT	=1, if the household has temporary/permanent migrants =0, if household has no migrants	+
PONDDUM	=1, if the household owns fish pond, =0, if not.	+
Competing hypothesis		
NETINCOME	Farm income including income of migrants	+
Other variables		
RELIGION	=1, if muslim household = 0, if hindu household	+/?
REGION	=1, if the household is from Modhupur =0, if the household is from Chandina	+

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

Results

Table 2

Logit estimates (marginal effects) Number of observations =1267 Pseudo R-squared=0.1092			Figures in parentheses are Z-values * indicates significance at 90% ** indicates significance at 95% *** indicates significance at 99%
Variables	Coefficient, *Chandina*	Coefficient, *Modhupu*r	Coefficient, common
YIELD			0.0000003 (0.21)
INVEST2	0.035 (0.57)	0.101** (2.35)	
NCD			0.043*** (3.51)
INCOME_AGRI			-0.0000059* (-1.93)
INCOME_NONAGRI			0.00000009 (0.87)
MALES			-0.067*** (-2.98)
FEMALES			-0.079*** (-3.0)
HEAD_SEX			0.15** (2.09)
HH_EDU			-0.007 (-1.58)
NGO	0.078 (0.56)	0.017 (0.33)	
C_LAND			0.00006 (0.5)
CROP_LAN			0.00034*** (2.78)
IRRI_LAN	0.00008 (0.17)	-0.00003* (-1.9)	
MIGRANT			0.124** (2.07)
PONDDUM			0.078* (1.75)
NETINCOME			0.000002* (1.69)
RELIGION			-0.066 (-0.99)
CRISDUM			-0.077 (-1.33)
REGION		0.232*** (3.85)	

3.1. Discussion of results

Before we embark on the analyses of the empirical findings, we wish to reiterate that the estimating model is developed on the theoretical premise that the household acquisition of land is a risky investment. The competing argument that land acquisition is a savings instrument or a hedge against income risks is not theoretically modelled. We have tried to capture this in estimation by incorporating an income variable (representing migrants' income) on the right-hand side in an ad-hoc manner. Below we analyze the results in Table 2 taking each variable (or pairs of related variables) at a time.

YIELD

This variable represents total gross return to cultivation. It could be argued that the average return (i.e., return per unit of land) to cultivation would be a more appropriate variable. We do not however use average return simply because it may not be entirely comparable (across households). The reasons for this are among others, land-quality across households are not uniform, and households have differential access to irrigation and accordingly they may choose different crop-mix. The *a priori* hypothesis here is that higher the total return, (having controlled for land area), more likely it would be for households to buy new agricultural land. The results show that this variable is not significant.

INVEST2 and NCD

Both these variables represent *complementary* factors to land in agricultural production. We expect that higher amounts of these factors simply raise the yield of land and therefore encourage the purchase of new land. This intuition is largely borne out in the results. Note however that INVEST2 is only significant for *Modhupur* region. *Modhupur* is the wealthier of the two regions with better socio-economic infrastructure including better access to irrigation. This is likely to facilitate both the acquisition and use of modern appliances in *Modhupur*. The result above could be a indication of this fact.

INCOME_AGRI and **INCOME_NONAGRI**

Both these variables represent income from sources other than cultivation/entrepreneurship activities, (also, not including migrant labours' income). **INCOME_AGRI** is the household labour income for both peak and off-peak periods, and **INCOME_NONAGRI** stands for all other off-farm income (excluding remittances form migrants). Both of these

could be thought of as alternative/competing sources of income to entrepreneurship. Higher income from off-farm sources indicates higher return from off-farm activities. This is likely to discourage further investment in new land (an alternative activity). This is the substitution effect. However, higher alternative income may encourage additional investment in land due to possibilities for diversification benefits (or the competing notion of savings). Given that these alternative sources are of local origin, possible benefits from diversification may not be large. The results show that **INCOME_AGRI** is highly significant and negative, but **INCOME_NONAGRI** is insignificant**.** The result appears to agree with the intuition that higher labour income, especially in the off-peak season will discourage investment in land.

MALES and FEMALES

Large number of males in the household certainly facilitates entrepreneurship. However having many male members will also increase the possibility of alternative income and accordingly discourage investment in entrepreneurship. Expected net effect is therefore ambiguous. Having many females over age 14, on the other hand, cannot be advantageous for entrepreneurship since women in general do not participate in outdoor production activities. Additionally, women of marriageable age may imply that funds for possible purchase of land would be siphoned off to alternative use such as marriage expenses. The results show that both the variables have negative and significant coefficients, which agree with our apriori intuition.

NGO

Access to institutional loan is expected to reduce the perceived riskiness of entrepreneurship. It may also affect the net return to land acquisition positively. The expected effect is therefore positive. NGO-loans are however typically allocated on a short-term basis to finance projects with quick turnover/returns. Land purchase would not qualify as one such project. The relevant coefficients for both regions are insignificant. The apriori reason for distinguishing between the regions is that there is a very strong presence of NGOs in the Modhupur region in contrast to Chandina where very few NGOs operate.

HH_EDU

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. The relevant coefficient is however insignificant.

C_LAND and **CROP_LAN**

Ownership of (large amount of) cropland (net of newly acquired land) is a main source of insurance against income shock in rural economies. Larger ownership therefore implies a larger risk-bearing ability and a higher probability for investing in entrepreneurship.

Households who on the other hand operate large amount of cropland (but do not necessarily own a lot of land) are likely to have lower returns to additional investment in land. These households are however typically highly efficient in farming, and are better equipped to utilize additional land relative to small operators. Both large owners and large operators of cropland are expected to be more inclined to make additional investment in land. The results show that ownership of cropland is an insignificant variable, however the size of operated cropland has significant positive effect on new acquisition of land.

IRRI_LAN

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 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. It could be argued that grater access to irrigated land is a substitute for new land and therefore will discourage further acquisition of land. The results lend weak support to this claim.

NETINCOME

This captures the net farm income *including the income of all migrants* in the family. This variable is weakly significant indicating that higher income leads to higher probability of acquiring new land. This lends support (*albeit* a weak one) to the notion that acquisition of land is a form of saving. Note however that this result in no way refutes our claim that acquisition of land affords households diversification benefits. Both effects can, and in the present case does, coexist.[6]

[6] One could argue that the relevant variable here should be *income of migrants* alone (excluding other farm income). This point is relevant. We do not however have at the moment separate data on migrants' income. We are in fact in the process of calculating this. Future version of the paper will incorporate this.

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 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 hindu community gives access to a source of insurance against income risks. Whether this factor also provides impetus for investment in land (entrepreneurship) is an open question. The relevant coefficient is insignificant.

MIGRANT

This variable captures the key hypothesis of our model, namely that having migrant members in the family facilitates investment in new cropland. As argued in section two, it is often advantageous for farm households (contemplating risky investments) to undertake simultaneous investment in two projects instead of a single investment. The reason is that a joint investment affords reduction of total risk via diversification. It is also argued in section two that migration and entrepreneurship could be substitutes, thus one could crowd-out the other. In order for our initial claim to hold, the diversification benefits must outweigh the crowding-out effect. The results show that the presence of migrants (both temporary and long-term) in the family exerts significant influence on the decision to purchase new cropland lending support to our main hypothesis.

PONDDUM

Income from fishpond (i.e., fish farming) is expected to be uncorrelated with entrepreneurship income. Here, the ownership of fishpond performs the same role as having migrants in the family. That is, the diversification argument made in the two-investment case can simply be extended to multiple investments. The role of fishpond turns out to be weakly significant in the decision to acquire cropland.

HEAD_SEX

The results show that the female-headed households have a significantly lower incidence of acquiring new cropland relative to male-headed households. The intuition is as follows. The female household heads are typically widows or divorcees who are typically resource

poor in terms of both assets/capital and labour, (that is, these households are less likely to have adult male), which makes costs of investment very high.

REGION

This is a dummy variable constructed in order to capture regional differences in the probability for land purchase that are not explained by the individual explanatory variables. The estimates show that belonging to the Modhupur significantly raises the average probability of acquiring new land. 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.

4. Some concluding remarks

The results on the whole appear to lend strong support to our main hypothesis that acquisition of land is a risky investment and that the presence of migrants in the family facilitates this acquisition via benefits from risk diversification. For example, the notion that new land is an investment is supported by the significant positive coefficients of the complementary variables, namely, draught animals and agricultural appliances, and the negative significance of the substitutes, e.g., off-farm labour income. Further, the strong significance of the variable MIGRANT confirms that having migrants in the family does facilitate acquisition of land over and above the effect migrants' income may have on land acquisition. (*This part is to be expanded to include additional discussion of results and policy recommendations*).

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