Migration and Technological Change in Rural Households: Complements or Substitutes?

Mariapia Mendola
University of Milan and Centro Studi L. d'Agliano

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Abstract

In this paper we study the interrelationship between determinants of migration, conceived as a family strategy, and the potential impact of having a migrant household member on people left behind. Labour migration is often related to poverty but given its lumpy-investment nature, poverty may constitute a motivation to migrate as well as a constraint to do it. We use cross-sectional household data from two rural regions of Bangladesh to test whether migration is a form of income diversification strategy that significantly influences the risk-taking behaviour of source farm households in agricultural activities. We account for heterogeneity of migration constraints differentiating between domestic (temporary and permanent) and international moving destinations. We find that richer and large-holder households are more likely to participate in costly high-return migration (i.e. international migration) and employ modern technologies, thereby achieving higher productivity. Poorer households, on the other hand, are not able to overcome entry costs of moving abroad and fall back on migration with low entry costs, and low returns (i.e. domestic migration); the latter does not help them to achieve production enhancements and may act as a poverty-trap locking households into persistent poverty.

JEL Classifications: O12, D13, F22, Q12
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1. Introduction

Migration from developing countries has become a central issue of economic development, but whether this process should be promoted or discouraged is currently largely debated. This paper contributes to the debate shedding some light on the potential complementarity between rural out-migration and productive activities in farm households at origin. It looks, in particular, at the economic impact of domestic, both temporary and permanent, and international outflows from rural Bangladesh on such productive investment in sending households as the adoption of a modern farming technology.

It is largely recognised that 'spatially-diversified' families represent an institution arising from or influenced by the risky nature of rural production and the difficulties of self-insurance in low-income, rural settings (Rosenzweig, 1988). The insurance motives for migration has been emphasised by the New Economics of Labour Migration (NELM), according to which greater income uncertainty may encourage out migration as a risk diversification strategy (see Stark, O. and Levhari, D., 1982; Katz, E. and Stark, O. 1986; Stark, 1991). On the other hand, migration of people entails a loss of labour force and human capital resources in the place of origin, along with several fixed and opportunity costs for the whole household, in terms of forgone working capital, skills, yield, and income. Overall, whether or not migration leads to productive investments at origin is an open question on a theoretical ground but there is a paucity of empirical works offering insights into the issue (Rozelle et al. 1999; and Lucas 1987).

This paper adds to the debate by offering new empirical evidence on the potential effect of different forms of migration on productivity-enhancement choices in farm households at origin, such as the adoption of high-yielding varieties (HYVs) of rice rather than traditional ones. Production of rice is central to Bangladeshi agricultural economy and modern seeds are a relatively spread, divisible and profitable technology, but well-known as being more susceptible to yield variability than traditional varieties[1].

According to the NELM approach, determinants of household choice (or chance) to have a migrant member may have simultaneous implications on the productive capacity of source households and, overall, on the economic effect of migration-strategy on people left behind.

[1] Causes of instability are identified mainly in genetic vulnerability and increased covariation across regions. In an earlier work of the author it has been shown that adoption of HYVs of rice has a positive impact on household wellbeing (see Mendola, 2003).

Thus, we use cross-sectional household data from two rural regions of Bangladesh to examine the simultaneous household decisions whether to adopt a new agricultural technology and whether to have a temporary domestic, permanent domestic or international migrant member.

By specifying a simultaneous framework of determinants and consequences of migration, this paper is particularly concerned with the role of entry constraints in undertaking a remunerative and risk-reducing migration strategy. In general, if access to profitable activities requires some initial cash outlay or start-up costs (to be paid in advance to investment returns), then multiple equilibria are likely to arise and poverty traps phenomena may be observed[2]. We look at heterogeneity of migration constraints in Bangladeshis farm households by differentiating between three forms of migration, which typically coexist but are little researched in a simultaneous framework.

Information on alternative outside destinations included in our data-set show that domestic, both temporary and permanent, and international migration have sharply different net-returns, in terms of initial costs and remittances sent back home. Therefore, although they all represent activity-diversification strategies improving farm household risk-management, not all migration forms may induce risk-taking behaviour in agricultural production in source households. Moreover, given the costly nature of moving, poor farmers may well be excluded by the high-costs-high-returns opportunities of migration, whilst better-resourced farm households are more likely to take advantage of these strategies; indeed, the latter may represent an important route for enrichment through, for example, raising agricultural productivity.

Thus, we argue that the choice between temporary, permanent and international migration at household level can provide an interesting ground of analysis to assess the role of entry costs in shaping migration choices and the potential non-monotonic effects of these strategies on household productive investments at origin. We do so through a twofold empirical analysis: in first place we look at the determinants of household decision of having a migrant member, whereby migration choice is mapped into the three categories of moving. After showing the importance of heterogeneity of entry constraints in shaping household migration behaviour, we estimate a simultaneous equations model in order to assess the impact of the different typologies of migration on agricultural performance of sending farm households.

[2] There are several theoretical and empirical contributions on the consequences of imperfect credit market and initial constraints in terms of risk-management capacity, low-risk investment by poorer farmers, ability to overcome entry barriers into high-return activities for better-resourced households, poverty traps (Eswaran and Kotwan , 1990, Banerjee and Newman 1993; Dercon 1996, 1998, Morduch, 1995)

We find that richer and large-holder households are more likely to participate in costly high-return migration (i.e. international migration) and employ modern technologies, thereby achieving higher productivity. Poorer households, on the other hand, are not able to overcome entry costs of moving abroad and fall back on migration with low entry costs and low returns (i.e. domestic migration), which does not help them to achieve production enhancements.

The remaining portion of the paper is organised as follows. Section II draws on NELM insights to briefly discuss migration as a costly household subsistence strategy that may lead to complementarities or else trade offs between economic opportunities elsewhere and productive activities at home. Section III discusses some specific feature of internal and overseas migration in Bangladesh. In section IV we present the data set and descriptive statistics of main variables used in the inferential analysis. Section V presents our estimation strategy and empirical results and section VI concludes.

2. Understanding migration: development-strategy or poverty-trap?

The world's great migrations out of rural areas are accelerating, making internal and international migration one of the most pervasive features of agricultural transformations and economic development both in developed and less-developed countries (Taylor and Martin, 2001).

Yet, the economic literature on migration provides different explanations of the reasons why people move and offers competing insights into the role migration plays in fostering (or hindering) economic development in sending communities[3].

Drawing on the seminal work of Stark (1978), the NELM theory has explained migration as an inter-temporal household strategy entailing interrelationships between determinants and impacts for the migrant and for the whole household left behind (Stark, 1991). Following this perspective, a wide array of contributions have emphasised the existence of complex motivations behind migration, such as risk-management strategy, alleviation of credit constrains and diversification of income portfolios[4].

Differently from a neoclassical migration framework (Todaro, 1969; Harris-Todaro 1970) the NELM perspective explains *family* motivations to send out a migrant arising from

[3] See Williamson (1998), Taylor and Martin (2001) for a review of theoretical foundations and empirical evidence on migration.

[4] Daveri and Faini (1998) formalise the argument that migration is a household decision driven by risk motivations. Using aggregate data, they also provide some evidence on the importance of risk in shaping domestic and international emigration behaviour in Southern Italian regions. The micro-economic literature on this issue also includes Katz, E. and Stark, O. 1986; Lucas and Stark, 1985,88; Rosenzweig M., 1988; Rosenzweig and Stark, 1989; Lucas, R.E.B., 1997.

imperfections not necessarily in labour markets but rather in markets for credit and risk. However, "while constituting a motivation for migration, imperfections in capital and insurance markets may also constrain migration, resulting in the seeming paradox that increases in rural incomes (which enable households to self-finance migration costs and self-insure against migration risks) may promote, rather than impede, migration" (Taylor J.E. and Martin, P., 2001).

Following the existing literature on migration, there are three competing channels through which this process can affect household members left behind: decreased domestic availability of family labour; increased cash-inflows (remittances); diversification of resources (insurance provision). Yet, what is not clear from the literature is to what extent the beneficial effects of migration strategy in protecting household members left behind from economic pitfalls are able to improve the productive-investment capacity in sending rural households[5].

The bulk of empirical contributions on the impact of migration on sending households are mostly focused on the role of remittances in improving source household's consumption or income. Yet, given the typical non-separable nature of consumption and production household decisions in rural settings with incomplete markets, migration is likely to influence production choices at origin. Better "insured" source households - those with migrants working elsewhere - may be more able to undertake higher-risk profitable activities than households with no migrants. Furthermore, subsequent remittances from migrant members increase household liquidity and may contribute to alleviate binding credit constraints in productive activities (Katz, E. and Stark, O. 1986; Stark, 1991).

Few empirical studies have shown that earnings of international migrants have a positive impact on crop productivity and may also serve as a source of capital accumulation in rural households (Rozelle et al., 1999; and Lucas, 1987). Yet, there is little evidence on the heterogeneity of migration constraints (or the shadow value of remittances) in shaping the potential impact of people movement on source households.

The contribution of remittances to the income level of sending households has been typically considered the key variable for assessing the impact of migration on economic development.

[5] In other words it is not clear whether remittances sent back by migrants are able to compensate for the opportunity cost of allocating a marginal unit of family time to migration, that is the loss of net income from production. Household may not be able to simultaneously devote time to migrant labour and to investment activities in home areas. Moreover, it has been argued that human and physical capital embodied in ('certain types' of) migration is likely to complement other family resources in production, strengthening the negative effect from less family labour (i.e. "brain drain" argument. See Faini, R. 2003). Another argument in this direction provided by the literature is the one of moral hazard phenomena in sending households: if migrant work is lucrative enough household members remaining behind may entirely forgo productive activities and live primarily on remittances receipts. For evidence on this see Gubert, F 2000. On the other hand, though, people left behind may invest more so as to motivate the migrant to send more remittances (de Janvry et al., 1997).

It is fairly well known that for many developing countries, remittances are an important source of income[6]. Moreover, remittances are now largely recognised as part of an informal familial arrangement that goes well beyond altruism and entails "exchange motives" (Lucas and Stark 1985, Cox et al. 1998)[7].

However, the sign and dimension of their economic effects depend on a host of intervening (and often conflicting) variables such as informational and financial costs of migration and the opportunity cost to move (in terms of forgone human and physical capital)[8]. In second place, remittances are endogenous to the migration selection process and typically vary directly with the cost, risk and social dislocation associated with the move (i.e. with the form of migration). Lastly, the insurance provision provided by family members working in different labour markets may influence sending farm households (and their productive capacity) even without remittances (Stark 1980).

Therefore, household behaviour towards migration is crucial in shaping the economic effect of this process, which may act as a shelter against income and production risks faced by people left behind. In particular, when a farm household decides to send out a migrant, this has simultaneous implications on its productive capacity and may modify productivity-enhancement choices, such as a change of agricultural technology. Farm household decides about its present labour and other inputs allocations, on one hand, and on its investments in household's (human and physical) resources and saving management strategy on the other. There is considerable evidence in the development literature on the widespread diversification of farm household income sources as a way to manage risk in developing countries (see, for example, Morduch, 1995) [9]. There is also a growing evidence, though, that entry constraints may limit the usefulness of income diversification strategies. Indeed, risk-management strategies may imply an efficiency loss for the poor, which the rich – typically better protected via assets and institutional arrangements – do not have to endure (see Dercon 2002). This is to say that when farm household resources are scarce (i.e. credit and risk constraints are binding), not all households are able to send migrants to work in a different market and even when they do so, it is not straightforward whether migration will result in a virtuous strategy -

[6] E.g. South Africa gold workers to neighbouring countries; Mexican migrants in the US; unskilled South Asia (e.g. India, Pakistan, Bangladesh) migrants in the Gulf.

[7] According to the "exchange hypothesis" remittances must be seen as repayments for services provided by parent household such as childcare, education, bequests and inheritance, coinsurance, social standing. The exchange motive can be further divided into insurance motives (to spread risk across a broader portfolio) and investment motives (to build up household assets to be inherited later, or to repay previous investments that allow the migrant to retain the right to inherit).

[8] Differently said, the same expected value of remittances may not have the same effect on the probability to migrate for households at different points in the wealth distribution.

[9] See Mendola (2004) for a literature review on this.

able to help relatives left behind to overcome production constraints and improve agricultural productivity- or in a poverty-trap. The body of economic literature that generally tends to conclude that migration is a subsistence strategy enabling households to escape poverty, fails to consider people not able to migrate and those who experience a poverty-trap because of migration.

3. Migration flows in Bangladesh

Bangladeshi economy has registered positive figures with respect to economic and human development achievements over the last 25 years. Average annual GDP growth rate has increased from 2.4% in the 1980s to 4.9% during the 1990s (WB, 2000). The HDI has increased from 0.335 in 1975 to 0.478 in 2000 (UNDP, 2002). Literacy has also increased; the national literacy rate was 23.8% in 1981 and rose to 40.8% in 2001. Nonetheless Bangladesh remains one of the least developed countries of the world, where half of population lives below the poverty line (WB, 2000)[10].

Historically, labour migration within and across national frontiers has been an enduring component of Bangladeshi development pattern. After independence in 1971, the labour markets in the Middle East offered a large scope for Bangladeshi migrant labour, and later such migration also expanded to the newly industrialised countries of South East Asia (IOM 2005). There is paucity of accurate data on labour migration from Bangladesh. However, gross official figures indicate that between 1976 and 2004 more than 3.8 million Bangladeshis have migrated for employment and, since late '90s, every year some 200,000 or more people leave the country officially to work elsewhere (Bureau of Manpower Employment and Training data reported in IOM 2005).

Determinants of both short and long-term migration are complex, resulting of many factors representing economic, social and cultural realities. According to official figures, *international* migrants are predominately young male, and female accounts for only 1%. This is so because the Bangladeshi government has banned certain types of female labour from independent emigration, even though many choose to do emigrate through unofficial channels (INSTRAW and IOM 2000).

[10] In the late 1970s, 68% of the Bangladeshi population lived below the poverty line; the figure dropped to 44.7% in the second half of 1990s (MHHDC, 2001) but then raised again to 50% in 2000 (WB, 2000). The three-quarters of the population resides in rural areas where the rate of severe poverty remains twice (37.5%) as high as in urban areas (19%) (WB 2000).

According to micro-level studies, the labour force of Bangladesh working in different parts of the world is primarily made up of unskilled and semi skilled workers (Hossain, 2001; Siddiqui, 2003). In 2001, for example, 58 percent of the migrant workers are unskilled or semi-skilled, while the proportion of professionals was 3 percent (IOM 2005).

Bangladesh exports contract labour mostly to Middle Eastern and Southeast Asian countries (the larger communities are in Saudi Arabia, Kuwait, Malaysia, South Korea, Singapore). The UK and US are the two main destination in the West[11] (IOM 2005).

Over the last decades, also *domestic* migration has resumed greater importance as a component of people's subsistence strategies and in shaping the national economy. According to recent surveys by the United Nations, International Labour Organization and the Bangladesh Bureau of Statistics (BBS), rural to urban migration in Bangladesh accounts for two-third of the overall migration flow (where the remaining 10 percent is represented by rural-rural migration and 24 percent by international migration) (see Afsar et al., 2000)[12]. Traditionally, most economic migrants to internal urban areas are young males, but this changed significantly with the recent increase in demand for female labour in the readymade garment factories of Dhaka Khulna and Chittagong metropolitan areas (Siddiqui 2003).

Most of migrants send part of their earnings home on a regular or irregular basis. According to official data, remittance flow to Bangladesh has increased dramatically in the last 3 decades: while it amounted to US$ 24 million in 1976, this number stood at more than US$ 2,600 million in 2002 (IOM 2005).

The scanty evidence on Bangladeshi migration show that remittances have represented a crucial source of income for consumption, to repay loans and to expand business in agricultural products or construction materials. Remittances also helped to generate savings, the major source of capital in Bangladesh, in the absence of institutional credit on easy terms (IOM 2005; Siddiqui, 2003).

Little studies are available on the migration patters from *rural* Bangladeshi areas. It is assumed that the extreme poor people are more likely to gradually migrate to other parts of the country, passing through a period of temporary migration (Siddiqui, T. 2003). Some rural people also migrate internationally but little data are available on the proportion of international migrants from rural areas. It has been argued that international migration

[11] Australia, Canada, Germany, France are also preferred countries for Bangladeshi migration (IOM 2005).

[12] Figure on rural-rural migration flow seems to be way out of line with other evidence on India for example (IOM 2005b). Indeed, due to paucity of data, the figure comes out from panel data generated from 62 randomly sampled villages drawn from the Bangladesh Bureau of Statistics (BBS) 'sample vital registration', which estimates lifetime migration (Rahman et al. 1996 quoted in Afsar 2003). Afsar, though, argue that data from vital registration system suffer from sampling and non-sampling errors. Moreover, they overlook temporary or seasonal rural-rural migration.

typically generates sharply higher levels of remittances with respect to rural-rural or rural-urban migration. Yet, in Bangladesh there are financial obligations to migrate abroad, which include the cost of purchasing a visa, the airfare, and commission costs to the recruiting agencies[13] (Afsar et al. 2000). Given structural problems in the Bangladeshi migration process and the importance of the repayment of the cost of migration, the migration-development nexus may not be straightforward.

4. Data and descriptive statistics[14]

The empirical analysis is based on a survey of 5062 households from 8 villages in Chandina and Madhupur *thanas* in Bangladesh, conducted by the Institute of Development Studies in 1994/95. The survey collected detailed information on household characteristics, assets endowment, food production and non-farm activities. In each household, information on migration of household's members was gathered, including information on duration and destination of migration, moving costs and remittances sent home by migrants.

In the present study we restrict the sample to 3404 farm households operating land, among which 30 percent have households members who left to work elsewhere. Yet, a crucial point of our study is to map three different types of migration: domestic *temporary*, domestic *permanent*, *international* permanent migration. Migration categories are identified through household questionnaires: sample households report whether they have experienced migration for work of family members and, for each migrant, they provide information about the destination of migration (either abroad or within the country) and whether it has a temporary or permanent feature - along with some migrants' characteristics.

Overall, there are 1241 migrants in the sample distributed as follows with the following features (Table 1).

Across different categories of migration, sample migrants are predominately young men, around 30 years old. What differs across types of migration is the education level of migrants, clearly higher in the case of permanent and international migration, and in the latter cases the percentage of single migrants is also higher than in case of domestic temporary migration[15].

[13] The recruitment process of migrant workers in Bangladesh is quite complex. A host of intermediaries, some of which are official and formal, while other are dubious, dominate the whole process. The latter is mostly privatised and, after the selection process, the recruitment agency organizes the visa, travel documentation , air ticket and placement of workers in the receiving country against relatively high fees. Recently the proliferation of recruitment agencies has lowered the agency costs. See also IOM 2005.

[14] A more detailed description of the data set is in Mendola 2003. This holds for figures on HYVs characteristics and productivity differentials as well.

[15] Since the age of migrants is not very different, the single status of migrants can be considered as a 'cost' of permanent and international migration.

TABLE 1

CHARACTERISTICS OF MIGRANTS

MIGRATION TYPE	TEMPORARY	PERMANENT	INTERNATIONAL
Number of migrants	521	562	158
(percentage)	(42%)	(45%)	(13%)
Average age of migrants	33.34	29.13	31.96
Average education of migrants (year of schooling)	1.24	5.42	6.15
Average migration spell (how many years before 1995 migrants left for the first time)	8.7	7.6	3.5
Percentage of male migrants	99.62	95.02	100
Percentage of married migrants	84.45	56.23	64.56
Percentage of single migrants	14.97	42.53	34.81

Eventually, international migration seems the most recent type of moving, as sample migrants left on average around 1991, while permanent migration started earlier and temporary migration more than eight years prior the year of the survey.

The unit of analysis of this study, though, is the household as a whole, including temporary and permanent migrant members. This reflects the fact that, following the NELM theoretical framework, migration is family strategy whereby migrants and resident household members act collectively and cooperate over long distances through a combination of familial loyalty, exchange of transfers and parental asset pooling.

Among sample households having migrant members, 62 percent have only one migrant. In 27 percent of the cases there are two migrants; 9 percent have 3 migrants and in the remaining 1 percent four members have emigrated. When there is more than one migrant member in the same household, in the 30 percent of cases they do not belong to the same migration typology. This is to say that migration types are not mutually exclusive in the same household. Though, we can map out the different types of movement at household level by 'ordering' migration categories in such a way that, if there is more than one migrant in the same household, international migration category is always captured, followed by permanent migration and temporary migration respectively[16]. Incidences of different forms of migration at household level are as in Table 1:

TABLE 1

INCIDENCE OF MIGRATION AMONG HOUSEHOLDS

Types of migration	Freq.	Percent
No migration	2417	71
Temporary migration	411	12.07
Permanent migration	431	12.66
International migration	145	4.26
Tot.	3404	100

[16] The reason for this will be clearer throughout the paper and in the inferential analysis below. See note….??.

Figure 1 shows the sample average migration costs and remittances by different categories of migration at household level. Moving costs as well as remittances are directly asked to the survey respondent for each migrant family member. They refer to initial costs sustained by the household to send out a migrant (i.e. costs of travel, visa, recruiting agency etc) and the amount of money they receive from her/him.

It is clearly evident the increase in net-returns across typologies of migration, with international migration yielding the highest level of costs and remittances[17]. Moreover, Tables 3 shows the percentage of migrants remitting, which is very high in all categories, suggesting a high correspondence between migration and remittances sent back home.

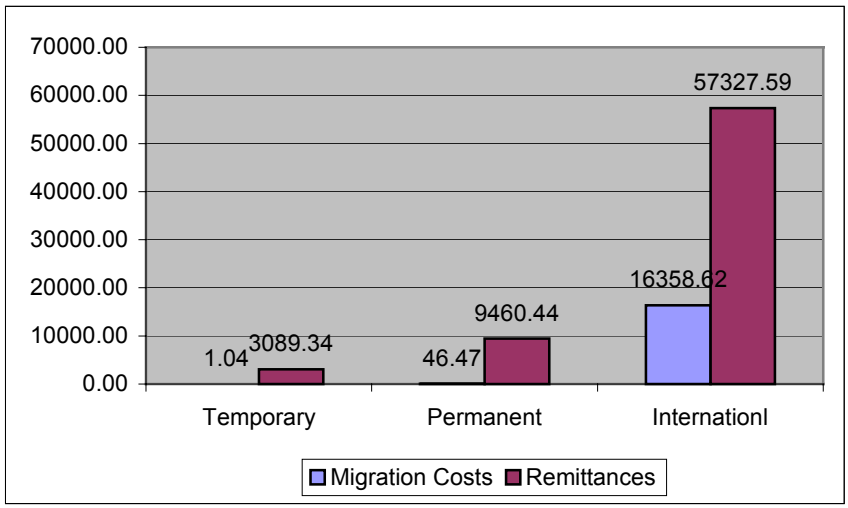

Figure 1: Migration costs and remittances across types of migration (averages, in Taka)

TABLE 3

Percentage of remitting migrants	
Temporary	99.27
Permanent	94.43
International	97.24

Table 4 shows some farm household characteristics across types of migration.

[17] It is also interesting to note that migration giving the largest rate of returns is the temporary, while the one producing the largest absolute return is the international migration. This is perhaps why there is still a substantial percentage of people incurring in temporary national migration.

TABLE 4

Characteristics of farm households by migration categories

Variable	NO MIGRATION			TEMPORARY			PERMANENT			INTERNATIONAL		
	Obs	Mean	St Dev.	Obs	Mean	St Dev.	Obs	Mean	St Dev.	Obs	Mean	St Dev.
*Household characteristics and assets**												
Household size (including migrants)	2417	5,37	2,25	411	5,93	2,30	431	7,05	2,71	145	8,81	3,68
Average education level of hh. members	2417	1,85	2,15	411	0,91	1,53	431	2,85	2,63	145	3,53	2,15
Land size (acre)	2417	0,77	1,37	411	0,47	1,16	431	0,84	1,08	145	1,81	1,92
Land size (p.a.e)	2417	0,18	0,29	411	0,09	0,19	431	0,15	0,20	145	0,25	0,24
Area of land operated (acre)	2417	1,97	2,20	411	1,38	2,78	431	1,6	1,77	145	2,8	3,06
Area of irrigated land (acre)	2417	0,89	1,36	411	0,31	0,93	431	0,39	0,82	145	0,62	0,73
Cattle owned (unit)	2417	1,19	1,74	411	0,57	1,13	431	0,75	1,19	145	1,15	1,45
Cattle owned (pae)	2417	0,27	0,39	411	0,11	0,20	431	0,13	0,23	145	0,15	0,18
Average number of migrants per household	2417	0	0,00	411	1,1	0,34	431	1,3	0,61	145	1,4	0 .64
*Income flows***												
Crop income (pae) (Taka)	2417	3212,41	4174,99	411	1259,79	6882,01	431	2125,13	3198,34	145	3865,26	6450,04
Crop income as % of tot.income	2417	38%	0,28	411	20%	0,19	431	26%	0,21	145	22%	0,20
Agricultural income [b] (pae)	2417	1175,25	1320,58	411	628,1	762,97	431	922,61	1317,74	145	1318,19	1680,07
Agricultural income as % of tot.income	2417	17%	0,17	411	13%	0,14	431	14%	0,15	145	9%	0,09
Off-farm income (excluding remittances) (pae)	2417	3135,85	4110,85	411	2456,27	4627,52	431	1202,28	1970,31	145	759,16	1479,74
Off-farm income as % of tot.income	2417	43,31%	0,32	411	50,13%	0,21	431	18,50%	0,24	145	6,17%	0,11
Income from pond (pae)	2417	130,27	440,80	411	104,7	182,31	431	273,11	552,61	145	431,4	683,70
Income from pond as % of tot.income	2417	2%	0,05	411	2%	0,04	431	4%	0,06	145	3%	0,04
Amount of 'temporary' remittances (pae)	2417	0	0,00	411	785,68	1342,54	431	67,66	334,45	145	22	105,20
Amount of 'permanent' remittances (pae)	2417	0	0,00	411	0	0,00	431	2619,19	3362,44	145	430,16	2488,83
Amount of 'international' remittances (pae)	2417	0	0,00	411	0	0,00	431	0	0,00	145	12842,9	34696,75
Tot. remittances as % of tot.income	2417	0	0,00	411	15%	0,14	431	39%	0,28		60%	0,24
Total gross income (pae)	2417	7626,96	6488,28	411	5194,17	11673,76	431	7185,19	5991,46	145	19665,2	37887,29
Amount of total loans from Ngos (pae)	2417	331,95	1058,65	411	121,47	456,05	431	46,89	291,73	145	23,68	174,66
% of hhs adopting HYVs of rice	2417	24,6%	0,47	411	15.5%	0,36	431	15,6%	0,36	145	18,6%	0,39
% of poor households [a]	2417	30,04%	0,46	411	51,34%	0,50	431	36,43%	0,48	145	4,83%	0,22

*Pae = per adult equivalent (including migrant members); ** Pae = per adult equivalent (not including migrant members)

a) The poverty line is based on the Food Adequacy Standard and has been set at 4200 Tk per (adult male equivalent) head per annum for 1994 (see Mendola 2003)

b) Agricultural income = homestead earnings, livestock, wood, straw.

In general, households with international migrants tend to be the largest[18] and wealthier, with the highest amount of land owned (also per adult equivalent - that is to say, controlling for households size does not change the strength of the correspondence), the highest amount of land operated, the lowest incidence of poverty and the highest total gross income[19]. The opposite can be said for households who have temporary migrants among their members, namely they seem to be the worst-off with respect to all indicators. Households with no-migrants, instead, appear more engaged than the others in such 'diversified' activities different from migration as cattle and off-farm activities. Though, they are poorer in terms of land and total income than households with international migrants.

As decomposed income flows are concerned, households with international migrant members have the highest level of crop and agricultural income, and the lowest amount of off-farm income (excluding remittances) with respect to all the other categories. As shares of total income, though, the latter income flows represent a smaller percentage of total household earnings than it is the case in the other groups; this is due to the significantly high amount of remittances they receive from international migrants, which account for 60 percent of total income. Moreover, as for farming investments, figures show that relatively few farmers with temporary migrants adopt high-yielding varieties (HYVs) of rice, whilst the highest shares of adopting households belong to the group with 'international' migrants and with 'no-migrants'. Thus, the crucial point here is to understand to what extent migration and remittances are complementary to other productive assets and activities but, given the endogenous nature of migration behaviour, descriptive statistics does not fully help in this regard.

Furthermore, it should be noted that also land ownership - which is a proxy for household wealth – might be thought as endogenous but, given missing Bangladeshi land market, it can be reasonably assumed exogenous. In order to focus on the relationship between land asset and migration, Table 5 shows the distribution of the three types of migration by the standard classification of land-size classes[20]:

[18] It should be noted that household size may be endogenous, in that affected by the (successful) migration process, but there is little literature on the impact of migration on fertility in source households.

[19] The correlation between gross household income and land owned is 52%, which is not surprisingly high.

[20] Near-landless have less than 0.049 acres; small farms more than that and less than 2.49 acres; medium-large farmers have more than 2.5 acres. It is worth stressing that our dataset is skewed towards small and medium-farmers, as there are only 17 sample farm households being 'properly' large, i.e. owning more than 7.50 acres of land.

TABLE 5

Categories of landowners	Types of migration				
	No mig	Temporary	Permanent	International	Total
Near landless	853	133	74	8	1,068
(%)	79.8%	12.5%	6.9%	0.8%	100%
Small farms	1,383	270	328	104	2,085
(%)	66.3%	13.0%	15.7%	5.0%	100%
Medium-Large farms	181	8	29	33	251
(%)	72.1%	3.2%	11.5%	13.15%	100%
Total	2,417	411	431	145	3,404
	71.0%	12.1%	12.7%	4.3%	100%

It is interesting to see that among families sending out migrants, near-landless do it mostly temporarily, small farmers have mainly temporary and permanent migrants, and medium-large farmers have a majority of permanent and international migrants. This is important in the selection process of migration at household level.

5. Estimation strategy and empirical results

The empirical analysis we carry out is twofold and aims at answering to the following questions: What determines the decision to participate in the migration process? Is it always a "profitable" - in that constraints-alleviating - household strategy as suggested by the NELM insights? In particular, given the income uncertainty farm households typically face, does migration have any importance in risk-taking behaviour in agricultural production?

The first step of our empirical strategy is estimating the determinants of household choice of having a migrant member in the household. Since there are different types of migration - which yield extremely different levels of (net) remittances as we saw above - we estimate household behaviour with respect to all types of moving, i.e. permanent, temporary and international migration, throughout binomial and multinomial logit models[21].

In the second step of our empirical analysis, we estimate the impact of the three different typologies of migration on the adoption of high-productive varieties of rice, technology relatively more risky but higher yielding than traditional seeds. We do so through three-stage least squares (3sls) estimation of linear probability models, in order to solve the problem of simultaneous determination of migration and adoption decisions at household level.

[21] See below for further explanations on this. We estimate linear probability models as well and results from the latter are similar to marginal effects predicted by non-linear binary models.

Understanding household migration behaviour in the first step is needed in order to estimate the economic effect of this endogenous process on the propensity to invest in agricultural activities in source farm households in the second step.

The estimation strategy of a simultaneous linear probability equations aims at sorting out problems of both endogeneity of migration choices and cross-correlation of household decisions towards technology and migration. Linear probability models have the advantages that are generally more tractable for assessing causation and applicable to data with limited-dependent outcome variable and dummy endogenous regressors (Angrist, 2001; see also below). Moreover, included explanatory variables shaping technology and migration actual investment decisions are often of greater analytical and policy interest than are latent index structural coefficients. Though, since the migration selection process is endogenous and shaped by many of the same characteristics that determine technology adoption in each regime, correct identification of the model depends on finding instrumental variables (IV) that affect technology adoption solely through their impact on migration choices.

5.1 The determinants of the migration choice

In the former section we saw that three existent types of migration, i.e. (domestic) temporary migration, (domestic) permanent migration, and international (permanent) migration, generate very different net-returns at household level.

Thus, why do people decide to migrate in general, and why do they do it for a low *vs* high remunerative migration type? Our hypothesis is that, in a context of missing or rationed credit and insurance markets, household characteristics and migration entry costs shape the expected future return differentials and the decision to participate in a specific type of migration.

Following the NELM theoretical framework, our unit of analysis is the household as a whole (including migrant members); this is to say that the spectrum of factors influencing the decision to migrate involves family characteristics and their endowment of human, physical and social capital.

In first place, we estimate a logit model for the migration decision *overall,* that is the probability of having a migrant member in the household *i* as a function of a set of household characteristics (plus a regional dummy) X_i. Thus, the dependent variable is defined as follows:

$M_i = 0$, if household does not have any migrant member

$M_i = 1$, if household has at least one member migrated for work.

The observable factors X_i determining the participation to the migration process are: household demographic characteristics (that are also tied with family labour endowment),

human capital-related attributes (including experience and schooling), cultural and social ties (e.g. religion, migration networks), economic and institutional environment (e.g. region of living) and the wealth position of the household. With respect to the latter, we included three capital-related variables, i.e. landholdings, cattle owned[22] and agricultural capital (i.e farm equipment and owned tubewell for irrigation), in order to control for differences in physical capital across households.

Yet, it is worth stressing the differences between assets, in particular the illiquid and liquid nature of land and cattle endowments. Land is the main inheritable form of wealth for Bangladeshis households and the main asset (beyond labour) that allow people to invest in widening opportunities[23]. Moreover, land is a great issue in Bangladesh because of its scarcity and because it is taken as a collateral in credit programmes. Yet, Bangladeshi land market is very thin or even missing so that it is reasonable to treat land ownership as exogenous[24]. Cattle owning, on the other hand, is a form of saving or liquid asset, whose role is to cope with risk; for this reason, differently from land, it may suffer from endogeneity drawbacks[25]. Table 6 reports estimated coefficients and marginal effects for two logit model specifications of the migration decision rule.

Interestingly, the land asset variable appears significant and negative in the first specification, but significant and positive when squared (second specification). The same holds for cattle endowment. This is to say that the negative effect of land and cattle endowment on migration marginally increases as assets increases.

[22] Both variables are included per adult equivalent (pae).

[23] Poor households typically own less land than the non-poor, and are highly represented among the near-landless (i.e. those owning less than 0.05 acres) (WB 2003). Moreover, financial assets in the form of micro credit have become more available to the rural poor in the recent decades, thanks to successful innovations adopted by various non-governmental organizations in Bangladesh. However, despite tremendous progress in this area, land is still considered the main form of collateral by micro credit financial institutions and formal-sector lenders. See note 13 above.

[24] On the exogeneity of land ownership in Bangladesh see the debate between Morduch and Pitt (Pitt, 1988, Morduch, 1998, Pitt, 1999). The exogeneity of land ownership challenges the potential inverse relationship between (past) migration and (today's) wealth.

[25] It may be difficult to instrument for cattle, but the exclusion of this variable does not change our results. Given the limited access to financial institutions, the most available form of savings for rural households in developing countries is livestock (the other forms of saving in kind are grain stock and land, but both are not easily realisable due to the tiny land market and to the lack of stocking utilities, especially for smallholder), which serve as the major form of wealth and as an insurance substitute, yielding a positive expected return and providing risk-diversification benefits (Dercon, 1996). The existing literature on the risk-coping role of livestock generally find that the latter perform a function as a liquid asset , which enables rural households to direct more inputs into high-return activities. Thus, assuming credit constraints under which few farmers have access to credit, livestock play the same role NELM attributes to the migration process, that is liquidity and risk alleviation at a household level, although livestock may be a relatively cheaper investment than migration. In this sense owing livestock and participating in the migration process might be viewed as substituted in their economic effect in enabling farm households to overcome production constraints.

TABLE 6

Determinants of migration decision (logit model)

	Specif. (1)	Marginal and fixed effects	Specif. (2)	Marginal and fixed effects
Number of males in the hh.	0.698	0.101	0.707	0.103
	(11.39)***		(11.44)***	
Number of females in the hh.	0.189	0.027	0.193	0.028
	(2.75)***		(2.80)***	
Number of children in the hh.	-0.115	-0.017	-0.113	-0.016
	(3.49)***		(3.41)***	
Most educated in the hh	-0.044	-0.006	-0.021	-0.003
	(-0.58)		(-0.27)	
Age of hh. head	0.004	0.001	0.003	0.000
	(-0.18)		(-0.13)	
(Age of hh.head)^2	0	0.000	0	0.000
	(-0.6)		(-0.52)	
Religion (whether it is Muslim)	1.058	0.114	1.077	0.117
	(6.53)***		(6.59)***	
Land owned (pae)	-1.112	-0.160	-1.622	-0.236
	(3.31)***		(4.73)***	
[Land owned (pae)]^2			0.385	0.056
			(3.67)***	
Cattle owned (pae)	-1.418	-0.204	-1.987	-0.289
	(5.69)***		(6.39)***	
[Cattle owned (pae)]^2			0.715	0.104
			(4.21)***	
Farm equipment owned	-0.061	-0.009	-0.039	-0.006
	(-0.64)		(-0.42)	
Whether own tubewells	0.282	0.044	0.199	0.031
	(-0.77)		(-0.54)	
Self-poor assessment	-0.039	-0.006	-0.06	-0.009
	(-0.37)		(-0.58)	
% out-migrants in the village	4.401	0.634	4.42	0.644
	(5.32)***		(5.31)***	
Regional dummy	-1.076	-0.154	-1.106	-0.159
	(2.61)***		(2.68)***	
Constant	-3.887		-3.879	
	(5.49)***		(5.43)***	
Observations	3404		3404	
Pseudo R2 =	0.3352		0.3381	
			Chi2(2) = 22.45	
Joint Sign.Land[1]			P = 0.000	
			Chi2(2) = 42.72	
Joint Sign.Cattle[2]			P = 0.000	
% of correct predicted probabilities	80.35%		80.55%	

Robust - statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

[1] Joint significance of land owned and land owned squared.

[2] Joint significance of cattle owned and cattle owned squared.

Being land a typical proxy for household wealth in Bangladesh, this result seems to suggest that at a lower level of wealth, a small increase in assets tends to discourage households to participate in the migration process, but the marginal propensity to migrate of better-off wealthy households increases in assets endowment. This U-shaped relationship between asset

holding and migration seems to challenge the widely accepted argument of 'migration hump' or J-curve effect[26].

Other household characteristics have the expected sign in shaping the propensity to migrate, although the educational variable included in the model (i.e. the education level of the most educated person in the household) does not appear significant. This result would contradict the human capital theory of migration and the argument of selectivity effects of individual's skills and education on migration (Sjaastad, 1962). Yet, if education typically promotes rural out-migration, it may not be the case with respect to all potential migrant destinations.

Overall, motivations and selectivity of migration (i.e. the effects of some physical and human capital variables) may differ across migrant destinations and our first round results highlight the need of new estimations of migration decision with respect to different typologies of moving.

More in general, as we argued above, household characteristics (that influence individuals' income creation as migrants and/or non migrants) and migration costs significantly affect the decision to send a household member to work in a different market, so that heterogeneity of household strategies toward migration needs to be better disentangled. Thus, in the next section we present migration probability models for different typologies of migration conceived as separated household alternatives.

5.2 The determinants of different typologies of migration

In order to estimate the relative probability of household to participate in one of the three categories of migration with respect to the option of staying put we run a multinomial logit model. As we mentioned above household migration decision has multiple outcomes, which are not close substitutes for each other, though. In such case if on the one hand three separated binary logit models include redundant information, on the other hand the multinomial logit may have potential weakness[27]. Still, the latter model provides more information about the simultaneous effects of independent variables across different migration outcomes, allowing for comparisons among all combinations of the categorical dependent variable. Moreover, for diagnostic purposes, Table A.1 and A.2 in Appendix show results from running three logit and linear probability models respectively, which separately predict the probability to migrate either temporary, permanently or internationally (with respect to "all the other options",

[26] See Stark and Taylor (1991), Faini and Venturini (1993). Hatton and Williamson (2002).

[27] By assumption, the odds ratios in the multinomial logit model are independent of the other alternatives. On models for nominal outcomes see Greene 1997, and J. Scott Long, 1997.

including non-migration). Findings are close to those presented below, even though interpretation of multinomial logit coefficients allow for all comparisons among migration outcomes.

As we already pointed out, some households have more than one migrant belonging to different categories or, differently said, migration typologies are not necessarily mutually-exclusive within a same household. On the other hand, though, they are very different household strategies each of which entails highly different patterns in terms of both determinants and impacts on people left behind. Therefore - even if we are forced to overlook potential interactions between household migration strategies – we argue it is reasonable to kind of 'order' them in such a way that, if there is more than one migrant in the household, international migration category will be always captured, followed by permanent migration and then temporary migration[28]. This is to say that the dependent variable of the multinomial logit is defined as follows:

Mij = 0, if household *i* has no migrant members;

Mij = 1 if household *i* has at least one migrant belonging to the *j*th category

where *j* = temporary migration *without any* permanent or international migrant; permanent migration *without any* international migrant; international migration.

Results of the estimation of the multiple migration-options model, where the base category is "no migration", are shown in Table 8 [29].

According to Wald tests, the hypothesis that all coefficients are simultaneously insignificant across categorical outcomes is rejected at 0.01 level for all regressors but 'farm equipment' and 'tubwell owned'. Wald test for combining outcomes is passed as well, meaning that the hypothesis that categories can be collapsed (namely, all coefficients except intercepts associated with given pair of outcomes are null) is rejected at 0.01 level.

Looking at raw coefficients (i.e. marginal effects on the log odds ratios in terms of the base category), household demographic characteristics significantly affect the decision to migrate, with the reasonable exceptions of female adult members that seem not to influence (be involved in) temporary migration, and children not influencing international migration.

[28] This is because the three types of migration involve different levels of investment costs (not only financial), whereby international and temporary migration and the highest and the lowest tails respectively. In this sense, if a household can afford sending a household member abroad, for example – which entails much higher costs and returns than other migration types - it would be insignificant whether it has also a migrant moving temporarily.

[29] In our multinomial logit, though, the dependent variable is uneven in the sense that different migration categories have uneven number of observations. In particular small international migration likelihood has an influence on the calculated marginal effects for this group, which are bound to be smaller and less significant.

TABLE 8

Determinants of participation to different categories of migration at household level (multinomial logit model)

	Temporary mig			Permanent mig.			International mig.		
Migration-type	**Coef.**	**z-stat.**	**P-value**	**Coef.**	**z-stat.**	**P-value**	**Coef.**	**z-stat.**	**P-value**
Number of males in the hh.	0.60 ***	4.73	0.00	0.70 ***	12.49	0.00	0.90 ***	7.52	0.00
Number of females in the hh.	0.06	0.46	0.65	0.21 ***	2.28	0.02	0.44 ***	4.46	0.00
Number of children in the hh.	-0.12 ***	-2.94	0.00	-0.15 ***	-6.76	0.00	0.00	-0.05	0.96
Most educated in the hh	-0.68 ***	-3.66	0.00	0.35 ***	4.67	0.00	0.51 ***	2.11	0.03
Age of hh. head	-0.01	-0.45	0.66	0.05	1.49	0.14	-0.01	-0.09	0.93
(Age of hh.head)^2	0.00	-0.20	0.84	0.00	-1.47	0.14	0.00	-0.16	0.87
Religion (whether it is Muslim)	3.02 ***	4.09	0.00	0.53 ***	2.54	0.01	1.26 ***	6.50	0.00
Land owned (pae)	-3.01 ***	-6.80	0.00	-1.70 ***	-2.86	0.00	2.11 **	1.96	0.05
[Land owned (pae)]^2	0.73 ***	6.81	0.00	0.38 ***	2.30	0.02	-1.63 *	-1.74	0.08
Cattle owned (pae)	-0.59 ***	-2.23	0.03	-2.36 ***	-11.00	0.00	-3.56 ***	-4.16	0.00
[Cattle owned (pae)]^2	-0.22	-0.70	0.48	0.98 ***	7.68	0.00	0.85	0.68	0.50
Farm equipment owned	-0.14	-0.63	0.53	-0.11	-0.85	0.40	-0.05	-0.28	0.78
Whether own tubewells	-0.30	-0.50	0.62	0.50	1.28	0.20	0.78	1.47	0.14
Self-poor assessment	0.24 ***	3.02	0.00	-0.13	-1.34	0.18	-1.12 ***	-3.52	0.00
% out-temp. migrants in the village	10.97 ***	14.58	0.00	1.96 ***	4.16	0.00	2.15 ***	2.93	0.00
% out-perm. migrants in the village	-6.54 ***	-4.83	0.00	9.67 ***	5.72	0.00	5.45 ***	3.05	0.00
% out-intern. migrants in the village	-4.47 ***	-5.62	0.00	5.31 ***	3.99	0.00	17.58 ***	10.00	0.00
Regional dummy	-2.80 ***	-8.87	0.00	-0.48	-1.23	0.22	-1.40 ***	-2.60	0.01
Constant	-2.93 ***	-2.85	0.00	-6.96 ***	-7.12	0.00	-8.84 ***	-3.82	0.00

Pseudo R2 = 0.3144

Joint Sign.Land[1:] Chi2(6) = 448.96
Prob > chi2 = 0.000

Joint Sign.Cattle[2:] Chi2(6) = 4233.00
Prob > chi2 = 0.000

Robust - statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

[1] Joint significance of land owned and land owned squared.

[2] Joint significance of cattle owned and cattle owned squared.

Interestingly, the education level of the most educated person in the household results now significant and with opposite signs across migration types: it has a positive effect in increasing the propensity to permanent and international migration with respect to non-migration, and is negatively correlated with temporary migration. This is reasonable if temporary migration is mainly devoted to low-skill jobs, differently from the other two types of movements.

Muslim households show a higher propensity to migrate, and household subjective perception of being poor ('self-poor assessment') significantly increases the probability to migrate only temporarily and decreases international migration. The latter is a 'behavioural variable' reporting, directly through household questionnaires, whether the respondent considers her household to be chronically or occasionally in food deficit (against the break even or surplus situation). Finding that household self-assessment of poverty status has a significant negative effect on the propensity to migrate abroad is consistent with the idea that this form of migration is the most difficult and costly.

Another interesting result is the relationship between migration and land asset endowment, which is downward sloping in cases of temporary and permanent migration, and inversely shaped for international migration. This is to say that a marginal increase in land-size decreases (at an increasing rate) the probability to migrate either temporarily or permanently, but the effect is reversed with respect to international migration, i.e. more land-ownership accelerate (at a declining rate) migration abroad. Cattle ownership, instead, has a negative effect on the propensity to migrate (at a lowering rate in case of permanent migration), and agricultural capital endowment does not appear significant (but mainly with negative signs). This seems to suggest that migration and cattle, are substitute activities (or cattle is sold to finance migration) and the reason for this may lie in the theoretical argument that cattle is a liquid asset, playing the 'same' role as migration in the household risk management[30].

Finally, the 'migration history' of the village (the proportion of the sample village labour force out-migrated either temporary, permanently and internationally)[31] significantly affect the probability to migrate. These are proxy variables for social migration networks capturing the idea that village members who have already out-migrated may help drive down some of the up-front cots of migration, as they share information about jobs in other areas with their

[30] Nonetheless, if cattle and migration are similarly household saving-strategies to cope with risk and liquidity constraints, the 'scale' of the strategy is different in that migration has sharply higher entry costs and subsequent returns which can have a big impact on the long-run household welfare.

[31] This variable represent the 'emigration stock' at village level and it is different from the 'network' variable, which captures the 'chain effect' within the same household.

neighbours (Massey, et al. 1993)[32]. Interestingly, incidence of permanent or international migration at village level negatively affect the probability to migrate only temporarily, supporting the hypothesis of external behaviours influencing household decision to migrate.

In order to show how land ownership affects the probability to migrate either temporary, nationally or internationally, Figure 2 illustrates the three *summed* predicted probabilities for all migration outcomes against the option of staying put.

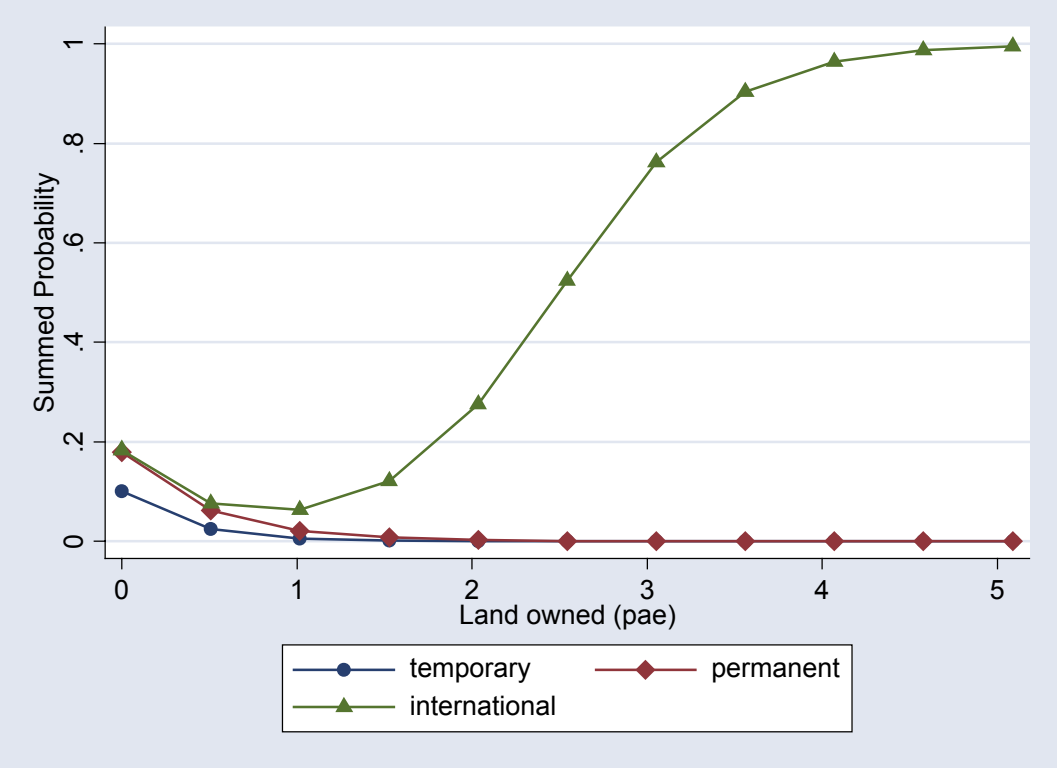

Figure 2: Summed predicted probabilities according to household land-ownership

The lowest line (temporary) plots the probability of having a temporary migrant for a given size of land owned. The upper line (permanent) plots the sum of the probability of having a temporary migrant or permanent migrant (i.e. the area between the two lines is the probability of having a permanent migrant only). And top line (international) plots the summed probability of migrating either temporary, permanently or internationally against the option of non-migrating. The shape and areas of predicted probability clearly illustrate the non-linear relationship between land asset ownership and the household participation to the migration process.

[32] The literature on migration has largely emphasised the important role migration networks play in driving the decision to move (Taylor et. al. 1996).

The differently-shaped non-linear relations can be explained as follows. At low level of wealth a marginal increase of land-ownership decreases the propensity to migrate internally, both temporarily of permanently (more rapidly in case of temporary migration than permanent migration). This is consistent with the idea that these migration typologies are low-cost and low remunerative in terms of remittances, thereby also little 'preferred' by households. In case of international migration instead, at low levels of wealth the propensity to migrate abroad is close to nil because of high initial barriers. As wealth rise, though, so too does the propensity to migrate abroad (up to a certain level, than it decreased again, according to a J-shaped curve). In other words, land ownership releases household effective barriers to movement and favour outflows overseas. This sheds some light on the poverty-migration nexus in Bangladesh, which is not straightforward due of paucity of studies and data[33]. Our findings are also consistent with other conclusions on historical migration (such as Italian hump-shaped migration in early last century; see Faini and Venturini, 1994) and with the fact that Bangladesh is a very poor country[34] (therefore, we capture the first part of a hump-shaped wealth-international migration relationship).

Yet, according to the NELM approach, individual family members' labour time is *simultaneously* allocated between migration and non-migration work within a household subsistence strategy. The interplay between the household decision to participate in different typologies of migration and the investment behaviour of household members left behind with respect to the adoption of risky farming technologies is the focus of the next section.

5.3 Migration effects on source households' agricultural productivity

Investing in high-productivity technology, such as HYVs of rice, is subject to financial and risk constraints, which are strictly binding for small farmers living in contexts of missing credit and insurance markets. Furthermore, the adverse effect of lost labour faced by households with migrant members may be high, since migrants tend to be younger and better educated than the average rural laborer (Table 1).

The NELM hypothesis that migration is a subsistence strategy enabling rural households to overcome investment constraints and achieve the transition to high-productivity agricultural techniques is tested through a system of equations, in order to address the issue of

[33] Sociological studies such as Khun (2000) and Afsar (2002) argue that 'family migration' (which is different, though, from households having one migrant member) occurred more often among landless than those with land. Hossain (2001) on the other hand found that those who had larger land properties migrated more often than those with smaller bits of land.

[34] In addition, our dataset is even more skewed towards smallholder poor families, being large holders less represented than at national level (see note 17).

simultaneous household decisions towards investment in agricultural activities and alternative migration destinations. However, given the endogenous nature of the household migration, instruments are needed in order to identify migration equations.

Thus, we estimate the potential impact of different typologies of migration, i.e. temporary (T), permanent (P) and international (I) migration, on the farm household propensity to adopt high-productivity seeds (as a proxy for the household risk-management capacity) through a 3sls simultaneous equations linear probability model.

Based on the literature, we estimate a system of equations as follows:

$$Y_i = \gamma_0 + \gamma_1 X_{iT} + \gamma^J{}_2 M_i^J + \varepsilon_{iT}$$

$$M_i^J = \beta_0^J + \beta_1^J X_{iM} + \beta_2^J Z^J{}_{iM} + \varepsilon^J{}_{iM}; \qquad J=T;\ P;\ I, \tag{5.1}$$

where Y_i is a binary variable equal to 1 if household *i* adopts the new technology; X_{iT} is a set of observed farm household variables influencing the choice of technology; and ε_{iT} is the random variable of the estimated equation.

M_i^J, are binary endogenous variables equal to 1 if the ith household participates in the Jth migration alternative, i.e. to temporary, permanent or international migration[35] (and zero if there is no migrant members); X_{iM} is a vector of household characteristics influencing the decision to migrate (different effects may result across the three typologies of migration) and $Z^J{}_{iM}$ are exogenous variables to be used in the "first stage" of the system as instruments for the endogenous migration variables; $\varepsilon^J{}_{iM}$ is the random variable of each migration equation.

Household behaviour with respect to technology adoption can be thought (quite generally) as the result of a decision process whereby the standard separability condition between consumption and production does not hold, and production decisions are influenced by some of the same household characteristics that influence household migration behaviour[36].

For identification purpose, we use three instrument variables, namely the education level of the highest educated household member, the sample proportion of households in the origin village participating either to temporary, permanent or international migration (respectively)

[35] This is done in the same way as for the multinomial logit above, making categories mutually exclusive (i.e. household cannot belong to more than one category).

[36] See Mendola 2003 on the adoption behavior.

and a family 'chain migration' variable, that is the presence of more than one migrant in the household left more than three years prior to the survey year[37].

As mentioned above, the educational variable is related to the migration selection process in that migrants are more or less likely to be high-skilled, depending on the typology of migration. As long as we control for the average education level of household members, we can assume that the education level of the highest educated member does not directly influence the household adoption behaviour, unless throughout the migration process. The latter two instruments are proxy variables for extra-family migration networks and family social capital or 'chain migration'. As mentioned above, different village histories of migration – specifically for temporary, permanent and international migration – and former household migrants are likely to lower migration costs and increase the opportunities for village households to send out migrant members. According a cumulative causation theory (Massey, 1993), network effects and prior family migration may even overcome economic motivations to migration; for this reason they are assumed exogenous instruments, not directly affecting the propensity to adopt new farming technologies[38].

Endogenous migration variables in the model are correlated with the disturbance of the adoption equation, violating the assumption of ordinary least squares (Wu-Hausman F test rejects the null hypothesis that migration typologies are exogenous variables at 0.01 significance level)[39]; further, the simultaneous decision problem entails that the error terms among equations are (cross-) correlated as well. We use 3sls estimation in order to take account of both simultaneity and endogeneity biases.

Three-stage estimator uses an instrumental variables procedure to produce consistent estimates and generalised least squares to account for correlation structure in the disturbances across equations. Heckman and MaCurdy (1985) show that in case of simultaneous linear probability models, instrumental variable procedure produces consistent estimates. Moreover, this approach is the most tractable for our aim of estimating causal or *potential effect* of

[37] The choice of 3 years old 'chain migration' is made in order to minimise potential endogeneity of network effects from prior family migration and at the same time to have some variability in the dummy variable (as in this case 17 percent of all migrant families experience the '3 years chain migration').

[38] Similar instruments (with the exception of family 'chain') are used in Rozell et al. 1999.

[39] For comparison purposes, the adoption equation has been estimated using simple OLS but results are not encouraging for migration typologies. However, the estimation procedure ignores the problem of endogeneity of migration decisions and the possible cross-equation correlation. As a raw check of endogeneity, we also included three interacted variables between typologies of migration and the size of land owned by household. Signs of interaction variables for permanent and international migration turn to be significant, suggesting that these types of migrations coupled with land ownership may have a potential effect on the propensity to adopt a superior agricultural technology.

migration on the propensity to adopt risky technologies, rather than latent index coefficients (see Angrist, 2001)[40]. This is so because the two-stage and single-stage estimates are directly comparable[41].

In the first equation of the model (5.1), which explains the adoption of modern seeds, the dependent variable is equal to one if farm household has adopted the risky HYVs. As explanatory variables we include farm household characteristics such as household demographic variables, representative of family labour endowment; the average level of education of household members, which is not expected to be highly significant with respect to the relatively well known 'green revolution' technology package; the amount of cultivated and owned land (both per consumption unit); land-tenure related variables, in order to take into account 'tenurial-insecurity' effects on risk management; farm equipment and means of ploughing owned (dummy equal to one in case of power ploughing); the quality of land (i.e. the percentage of irrigated land); religion and self poor assessment of the household; regional dummy variable (equal to one whether household lives in Madhupur).
Specifications of migration equations are based on the first part of our empirical analysis conducted above about the determinants of temporary, permanent and international migration. The validity of instruments is checked through a Sargan's test of overidentification, which shows that we cannot reject the hypothesis that instruments are uncorrelated with the error process and therefore they appear appropriate[42].
Results of 3sls estimates, robust to a number of alternative specifications, are presented in Table 10.

[40] Limited dependent variable models with dummy endogenous regressors were first estimated using distributional assumptions and maximum likelihood (Heckman, 1978, Amemiya, 1978, Newey, 1985). Angrist (2001) argues that if the aim is to estimate causal or potential effect on the outcome of interest - rather than structural parameters of latent variables model - linear models are no less appropriate for binary dependent variables than non-linear models.
[41] In a former version of the paper, though, for robustness purpose we presented *structural* results obtained through different estimators (such as GMM and Amemiya Generalized Least Squares (AGLS)), getting similar results.
[42] The Sargan test is a test of overidentifying restrictions. The joint null hypothesis is that the instruments are valid instruments, i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. Under the null, the test statistic is distributed as chi-squared in the number of overidentifying restrictions. The Sargan's statistic is typically calculated as N*R-squared from a regression of the IV residuals on the full set of instruments.

TABLE 10: **3SLS ESTIMATE OF THE IMPACT OF DIFFERENT TYPOLOGIES OF MIGRATION ON HYVS ADOPTION**

	DEPENDENT VARIABLES			
	ADOPTION OF HYVS	TEMPORARY MIG.	PERMANENT MIG.	INTERNATIONAL MIG.
Temporary migration	**-0,36**			
	(1.73)*			
Permanent migration	**-0,226**			
	(1.96)**			
International migration	**0,632**			
	(2.41)**			
Number of males in the hh.	0,015	0,016	0,031	0,02
	-1,38	(2.71)***	(5.24)***	(5.26)***
Number of females in the hh.	-0,004	-0,009	0,004	0,024
	-0,34	-1,22	-0,55	(5.16)***
Number of children in the hh.	0,009	-0,007	-0,011	0,006
	-1,54	(2.23)**	(3.29)***	(2.69)***
Average years of schooling in the hh.	-0,002			
	-0,3			
Religion (whether it is Muslim)	0,031	0,182	-0,03	0,041
	-0,57	(9.33)***	-1,54	(3.35)***
Amount of land operated	0,128			
	(5.55)***			
% of temple land	-0,026			
	(2.16)**			
% of cash-in land	0			
	-0,01			
% of mortgaged-out land	-0,05			
	(2.28)**			
Farm equipment owned	0,008			
	-0,69			
Power means of ploughing	0,044			
	(2.61)***			
Self-poor assessment	-0,064	0,029	-0,008	-0,037
	(3.27)***	(2.59)***	-0,73	(5.23)***
Regional dummy	0,078	-0,084	0,053	0,031
	-1,46	(3.08)***	-1,34	(2.68)***
% of irrigated land	0,286			
	(12.01)***			
Land owned (pae)	0,055	-0,133	-0,131	0,055
	1,45	(4.18)***	(4.04)***	(2.76)***
[Land owned (pae)]^2		0,044	0,028	-0,02
		(3.35)***	(2.08)**	(2.43)**
Cattle owned (pae)	0,123	-0,06	-0,1	-0,057
	(4.37)***	(2.04)**	(3.30)***	(3.11)***
[Cattle owned (pae)]^2		0,033	0,054	0,016
		(1.70)*	(2.70)***	-1,37
Constant	0,074	0,02	-0,097	-0,15
	-1,55	-0,52	(2.06)**	(7.91)***
Instruments:				
Most educated in the hh		-0,062	0,048	0,016
		(7.74)***	(5.95)***	(3.19)***
Family 'chain mig.'		0,002	0,312	0,091
		-0,06	(12.10)***	(5.70)***
% temp.migrants in the village		0,781		
		(5.56)***		
% perm.migrants in the village			1,02	
			(5.63)***	
% intern.migrants in the village				1,027
				(8.71)***
Observations	3404	3404	3404	3404

Sargan test: Chi2 (2) = 2.304 [0.315]
Absolute value of z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

All explanatory variables of the propensity to adopt modern seeds have the expected sign; in particular, the amount of land operated is positively correlated with the propensity to adopt, whilst tenure insecurity (the share of temple-land[43] and mortgaged-out land) has a negative impact on that. The percentage of irrigated land and power means of ploughing have a significant positive sign as they are typically important complementary input for modern seeds[44].

As for the variables this paper is concerned with, the impact of migration on the propensity to adopt high-yielding varieties of rice depends on which type of migration households participate in and, in turn, on the determinants of the migration decision. Our findings show that migration significantly affects agricultural technology upgrading; however, while having a household member migrated abroad has a highly significant and positive effect in fostering household propensity to adopt modern and risky seeds, domestic temporary and permanent migration have a negative impact on the adoption propensity in source households. Therefore, if migration is a risk and credit-alleviating strategy, this seems not to be true for all types of migration in Bangladesh. Explanations for this may lie on both risk and credit arguments: indeed, overseas economic opportunities are likely to be less correlated with local earnings and provides much higher returns (remittances) than it is the case for domestic migration.

In this sense international migration acts as a shelter against local uncertain income prospects, as predicted by the NELM perspective and shown by our results. However, given that migration is an endogenously shaped process, this seems not to hold for all farm households.

Indeed, all other estimated results are consistent with what we found above about determinants of different types of migration. A small increase in household wealth (i.e land owned) lowers the propensity to participate in temporary and permanent migration and increases the household propensity to participate in international migration. The human capital endowment (i.e. highest level of education), as well, is positively correlated with relatively higher-return migrations (permanent and international) and negatively associated with temporary migration. As for liquid assets (i.e. cattle owned), though, they appear to be a substitute investment strategy with respect to migration and, in turn, to significantly increase the propensity to adopt superior seeds (although by a smaller percentage than migration)[45].

Finally, poverty 'self-assessment' increases the propensity to have a temporary migrant member within the household, whilst decreases the propensity to participate in higher-remunerative forms of migration and to adopt new and high-yielding varieties of rice. This is

[43] In Bangladesh temple may own land (from donation or purchase to bear its own maintenance cost), but it has no manpower to cultivate this land. Therefore, they lease land to the adjoining villagers for sharecropping.

[44] For a deeper discussion on determinants of HYVs adoption in Bangladesh see Mendola, M. 2003.

[45] Yet, in that it is a (small scale/short-run) risk-diversification strategy itself, cattle ownership might not be strictly exogenous here; however, the exclusion of it does not change estimation results.

consistent with the idea that high-return migrations (especially international migration) and adopting new farming technologies are high-risk and costly activities, not easily undertaken by (subjective) poor families.

Overall, households endowed with more land and human capital are able to overcome 'entry barriers' to the 'most-remunerative' international migration and, in turn, are more likely to employ modern farming technology and achieve higher productivity. Asset-poorer households, on the other hand, are unable to support migration costs and fall back on domestic migration, which does not help them to overcome financial or risk constraints, thereby locking them into poor productive performance. This, in turn, raises questions on the potential (non-monotonic) role of different forms of migration – especially the international one - in contributing to alleviate poverty and foster development in source communities.

6. Conclusions

According to the NELM approach, the typical migrant is part of a rural extended family who dispatches members to other places of employment to generate capital and to obtain new investment opportunities (e.g. change of technology) for the family farm.

The main idea underlying this study is that if on the one hand imperfections in capital and insurance markets constitute a motivation to migrate – as stated by the NELM hypothesis, on the other hand they may also represent a constraint to do it. This is so because migration is a form of lumpy investment, especially onerous for such households as those living in poor rural areas of Bangladesh. Therefore, determinants of migration simultaneously shape the economic impact of having a migrant member on farm households left behind. This has important implications while seeking to understand the complex linkages between migration opportunities and economic development in local communities.

Assuming that higher initial asset holdings make it less likely that liquidity constraints bind, our empirical evidence shows that household's wealth-related capital (mainly in the form of land, which can be assumed exogenous) is crucial in shaping heterogeneous migration behaviour towards different typologies of migration. Asset-poor farm households are more likely to enter into domestic migration with low entry costs, and low absolute returns. Entry into high-return migration (i.e. international migration), in which most households would probably like to engage in a 'first-best' perspective, is restricted to richer and large-holder households. In particular, throughout a multinomial logit model estimation, we find that at low level of wealth, an increase in asset ownership reduces, at different rates, the propensity to migrate either temporarily, permanently or abroad. At higher level of household wealth,

though, asset ownership is estimated to increase overseas emigration only; this captures the effects of high entry costs to international outflows and household liquidity constraints in non-monotonically shaping migration behaviour. Indeed, higher asset holdings release household constraints to move abroad and favour high-return international migration.

These findings seem to challenge both conventional arguments that absolute poverty raises out-migration or that better-off households stay put. At the same time, they highlight the heterogeneity of household behaviour at different points of the wealth distribution with respect to different forms of migration.

Furthermore, not all moving typologies may play the same role in mitigating household credit or risk constraints at origin. Taking advantage of micro-data containing information on domestic and international migration from low-developed rural communities (which are generally scarce), we estimate the economic impact of having a migrant member - either temporary, permanent or international - on the propensity to adopt new high-yielding farming technologies in source rural households. We found that international migration has a positive effect on the investment in a superior agricultural technology, whilst temporary and permanent migrations do not encourage such a risky agricultural investment. The estimation strategy we used is a simultaneous equations model, in order to take into account both the endogenous migration choice and the cross-correlation of household decisions with respect to its (human and physical) resources allocation.

We interpret our results as evidence that if migration is a profitable alternative household activity, entry constraints may limit the access to it and its effectiveness as income diversification strategy. Lack of resources to bear the costs of migration faced by poor households may generate a poverty-trap whereby only better-off households have access to the most 'profitable' type of migration and are able to exploit a virtuosos circle of complementarities between overseas economic opportunities and productive activities at origin. This intends to question the idea that migration is a straightforward strategy to escape poverty, and to emphasise the potential role of a better distribution of resources and information in 'connecting' poor people to development-enhancing processes at a global level.

REFERENCES

Adams R., (1991), "The Effects of International Remittances on Poverty, Inequality and Developemnt in Rural Egypt", IFPRI, Washington-DC.

Alauddin, M. and Tisdell, C., (1988), "Patterns and Determinants of Adoption of High Yielding Varieties: Farm-level Evidence from Bangladesh", *The Pakistan Development Review,* Vol. XXVII, No.2. 183-210.

Afsar, R. (2003), **"**Internal Migration and the Development Nexus: The Case of Bangladesh**"**, 22–24 June 2003 in Dhaka, Bangladesh Refugee and Migratory Movements Research Unit, Bangladesh/ DFID UK.

Afsar, R. (2002). Migration and rural livelihoods. in Toufique, K.A. and Turton, C. (2002) "Hands Not Land: How Livelihoods are Changing in Rural Bangladesh", Bangladesh Institute of Development Studies/DFID.

Afsar, R., Yunus Md., and Shansul Islam ABM, (2000) "A Study of Cost-Benefit Analysis of Overseas Migration by the Bangladesh labour", Geneva, IOM.

Amemiya, T. (1978), "The Estimation of a Simultaneous Equation Generalized Probit Model", *Econometrica* 46 (5), 1193-1205.

Angrist, J. D. (2001), "Estimation of Limited Dependent Variable Models with Dummy Endogenous Regressors: Simple Strategies for Empirical Practice", *Journal of Business & Economic Statistics* 19 (1), 2-16.

Banerjee, A. and A. Newman (1993), "Occupational Choice and the Process of Development," *Journal of Political Economy 101 (2).*

Bangladesh Bureau of Statistic (1999), *Statistical Yearbook of Bangladesh.*

Cox, D. and Jimenez, E. (1990), "Social Objectives trough Private Transfers: a review", *The World Bank Res. Observer* 5, 205-218.

Cox, Donald, Zekeriya Eser, and Emanuel Jimenez (1998),"Motives for Private Transfers Over the Life-Cycle: An Analytical Framework and Evidence for Peru." *Journal of Development Economics 55: 57-80.*

de Janvry, A., Fafchamps, M. and Saudoulet E. 1991 "Peasant Household Behaviour with Missing Markets: Some Paradoxes" *The Economic Journal,* Vol. 101, N. 409, 1400-1417.

de Janvry, A., de la Briere, B., Lambert, S. and Saudoulet E. 1992 "Why Do Migrants Remit? An Analysis for the Dominican Sierra", IFPRI Discussion Paper No. 37, Washington DC.

Dercon, S. (1996), "Risk, Crop Choice and Savings: Evidence from Tanzania", *Economic Development and Cultural Change,* vol. 44(3), pp. 485-513.

Dercon, S. (2002), 'Income Risk, Coping Strategies and Safety Nets', *World Bank Research Observer*, vol. 17, 141-166.

Eswaran, M. and Kotwal, A. (1986*):* "Access to Capital and Agrarian Production Organisation," *Economic Journal*, Vol. 96, 482-98.

Eswaran, M., and Kotwal, A.(1989), "Credit as insurance in Agrarian Economies", *Journal of Development Economics,* Vol. 31, 37-53.

Eswaran, M., and Kotwal, A.(1990), "Implications of Credit Constraints for risk behaviour in less developed economies" *Oxford University Papers,* Vol. 6, pp.87-103.

Faini and Venturini, (1993), "Trade aid and migrations. Some basic policy issues", *European Economic Review, 37, 435-442*

Faini, R. (2003): Is the Brain Drain an Unmitigated Blessing?, Discussion Paper No. 2003/64, UNU/WIDER,

Gill, G:J: (2003), "Seasonal Labour Migration in Rural Nepal: A Preliminary Overview", Overseas Development Institute (ODI), London.

Greene, William H. (1997), *Econometric Analysis,* 3rd edition, London, Prentice Hall.

Gubert, F. (2000), "Migration, Remittances and Moral Hazard. Evidence from the Kayes Area", CERDI, *Etudes et Documents* 2000-17

Harris and Todaro (1970), "Migration, Unemployment and Development: a Two Sector Analysis", *The American Economic Review,* vol. 60 No.1, 126-142.

Heckman, J. J. (1978). Dummy Endogenous Variables in a Simultaneous Equation System, *Econometrica* 46 (5), 931-959.

Heckman and MaCurdy (1985), "A Simultanoues equations Linear Probability Model", *Canadian Journal of Economics,* Vol. 18-1, 28-37.

Hossain, M.Z. (2001), "Rural-urban migration in Bangladesh: a micro-level study", paper presented at 24th IUSSP General Conference, Salvador, Brazil.

Hillel Rapoport (2002), "Migration, credit constraints and self-employment: A simple model of occupational choice, inequality and growth", *Economics Bulletin, vol. 15, issue 7, pp 1-5* .

INSTRAW and IOM (2000), *Temporary Labour Migration of Women. Case Studies of Bangladesh and Sri Lanka,* INSTRAW/IOM, Santo Domingo.

IOM (2005) "Dynamics of Remittance Utilization in Bangladesh" *Migration Research Series N. 18.*

IOM (2005b) "Internal Migration and Development: a global perspective" *Migration Research Series N. 19.*

Kabeer, N. (2000), "The Power to Choose: Bangladeshi Women and Labour Market Decisions in London and Dhaka", London and New York: Verso Press.

Katz, E. and Stark, O. (1986), "Labor Migration and Risk Aversion in Less developed Countries", *Journal of Labor Economics,* Vol.4 No.1, 134-149.

Kuhn, R.S., (2000) "The Logic of Letting Go: Family and Individual Migration from Rural Bangladesh," Papers 00-09, RAND - Labor and Population Program.

Lucas and Stark (1988) "Migration, Remittances and the Family", *Economic Development and Cultural change,* 36.

Lucas and Stark, (1985), "Motivations to remit: Evidence from Botswana", Journal of Political Economy,

Lucas R.E.B. (1987), "Emigration to South Africa's Mines", *The American Economic Review,* Vol.77 No.3, 313-330.

Lucas, R.E.B. (1997), *Internal Migration in Developing Countries,* in Rosenzweig M. and Stark, O. "Handbook of Population and Family Economics"….

Maddala, G.S. 1983. *Limited-Dependent and Qualitative Variables in Econometrics*, Cambridge: Cambridge University Press.

Massey, D., Arango, J., Hugo, G., Kouaouci, A., Pellegrino, A., & Taylor, J. 1993. Theories of International Migration - a Review and Appraisal. *Population and Development Review*, 19(3):431-466.

Mendola, M. (2003), *"Agricultural technology and poverty reduction: a micro-level analysis of causal effects"*, Development Studies Working Paper N. 179, Centro Studi Luca D'Agliano, Milan.

Mendola, M. (2004), *"*Farm Households Production Theories: a Review of 'Institutional' and 'Behavioural' Responses", Working Paper No.1.2005, Department of Economics, University of Milan, Italy.

Morduch., J., (1994), "Poverty and Vulnerability", *The American Economic Review,* Vol. 84, No.2, Paper and Proceedings of the Hundred and Sixth Annual Meeting of the American Economic Association, 221-225.

Morduch., J., (1995), "Income smoothing and Consumption Smoothing", *Journal of Economic Perspectives, 9, No.3: 103-114*

Morduch., J., (1998), "Does Microfinance Really Help the Poor? New Evidence from Flagship Programs in Bangladesh", Working Paper, NYU.

Newey, W. K. (1987). Efficient Estimation of Limited Dependent Variable Models with Endogenous Explanatory Variables, *Journal of Econometrics* 36, 231-250.

Pitt, M. and Khandker, S.R. (1988) "The Impact of Group-Based Credit Programs on Poor Households in Bangladesh: Does the Gender of Participants Matter?", *Journal of Political Economy*, 1988, Vol. 106, No. 5.

Pitt, M. (1999) Reply to Jonathan Morduch's "Does Microfinance Really Help the Poor? New Evidence from Flagship Programs in Bangladesh", mimeo.

Rosenzweig M. (1988), "Risk, Implicit Contracts and the Family in rural Areas of Low Income Countries", *The Economic Journal,* Vol. 98 No. 393, 1148-1170.

Rosenzweig M.R., and Stark, O., (1989), "Consumption Smoothing, Migration and Marriage: Evidence from Rural India", *Journal of Political Economy* 97(4): 905-26.

Rozelle, S., Taylor, E. and deBrauw A. (1999), "Migration, Remittances and Agricultural Productivity in China", *The American Economic Review,* Vol. 89 No.2, 287-291.

Scott Long, J, 1997, "Regression Models for Categorical and Limited Dependent Variables", Advanced Quantitative Techniques in the Social Sciences, Volume 7. Sage Publications.

Siddiqui, T. (2003), "Migration as a livelihood strategy for the poor: the Bangladesh case", paper presented at *Migration Development Pro-Poor Policy Choices in Asia, Dhaka, Bangladesh*.

Sjaastad, L.A. (1962), "The Costs and Returns of Human Migration", *Journal of Political Economy* 70(5)80-93.

Skeldon F., (1997), "Rural to Urban Migration and its Implication for Poverty Alleviation", *Asia Pacific Population Journal,* 12 (1).

Skeldon, R. (2002), "Migration and Poverty", *Asia-Pacific Population Journal, December, pp. 67-82 M.*

Stark, O. (1978), "Economic-Demographic Interactions in Agricultural Development: The Case of Rural-to-Urban Migration", Food and Agriculture Organization of the United Nations (FAO), Rome.

Stark, O. (1991), *The migration of labour,* Basil Blackwell, Cambridge.

Stark, O. and Levhari, D (1982), "On Migration and Risk in LDCs", *Economic Development and Cultural Change* 31, 191-96.

Statistical Year Book of Bangladesh, 1995-2000, Bangladesh Bureau of Statistics.

Taylor , J.E. (1992), "Remittances and Inequality Reconsidered: Direct, Indirect and Intertemporal Effects", *Journal of Policy Modelling,* 14(2), pp-187-208.

Taylor, E.J. (1996) "International Migration and National Development", Population Index, Vol. 62 (2), p.181-212.

Taylor J.E. and Martin, P. (2001), "Human Capital: Migration and Rural Population Change" in *Handbook for Agricultural Economics,* Elsevier Science, New York.

Taylor, E. and Yunez-Naude A. (1999), "Education, Migration and Productivity: An Analytical Approach and Evidence from rural Mexico", development Centre of the Organizations for economic Co-operation and Development (OECD) Vol 95, No.5: 901-918.

Williamson, J.G. (1998), *Migration and Urbanization,* in Handbook of Development Economics, Elsevier, New York.

World Bank 2003. Poverty in Bangladesh: Building on Progress. The World Bank.

World Migration (2003): Managing Migration (Challenges and Responses for People on the Move). IOM – International Organization for Migration.

APPENDIX

TABLE A.1

Determinants of participation to different categories of migration (logit models)

	TEMPORARY		PERMANENT		INTERNATIONAL	
	Raw Coeff.	Marginal and fixed effects	Raw Coeff.	Marginal and fixed effects	Raw Coeff.	Marginal and fixed effects
Number of males in the hh.	0.264	0.013	0.258	0.014	0.453	0.003
	(3.49)***		(3.92)***		(4.87)***	
Number of females in the hh.	-0.054	-0.003	0.039	0.002	0.334	0.002
	-0.65		-0.51		(3.33)***	
Number of children in the hh.	-0.082	-0.004	-0.136	-0.007	0.076	0.000
	(2.04)**		(3.31)***		-1.36	
Most educated in the hh	-0.814	-0.040	0.512	0.028	0.521	0.003
	(7.44)***		(5.86)***		(3.61)***	
Age of hh. head	-0.014	-0.001	0.072	0.004	-0.011	0.000
	-0.44		(2.40)**		-0.25	
(Age of hh.head)^2	0	0.000	-0.001	0.000	0	0.000
	-0.04		(2.06)**		-0.02	
Religion (whether it is Muslim)	2.852	0.061	-0.075	-0.004	0.885	0.004
	(5.39)***		-0.42		(2.98)***	
Land owned (pae)	-2.674	-0.130	-1.392	-0.076	3.57	0.022
	(4.45)***		(3.13)***		(3.10)***	
[Land owned (pae)]^2	0.673	0.033	0.291	0.016	-2.388	-0.015
	(5.39)***		(2.78)***		(2.33)**	
Cattle owned (pae)	0.275	0.013	-1.45	-0.079	-2.351	-0.015
	-0.47		(3.90)***		(1.96)**	
[Cattle owned (pae)]^2	-0.75	-0.037	0.626	0.034	0.147	0.001
	-1.19		(3.57)***		-0.08	
Farm equipment owned	-0.128	-0.006	-0.148	-0.008	-0.012	0.000
	-0.59		-1.17		-0.1	
Whether own tubwells	-0.268	-0.012	0.537	0.036	0.645	0.005
	-0.45		-1.07		-1.04	
Self-poor assessment	0.34	0.017	-0.115	-0.006	-1.143	-0.007
	(2.60)***		-0.91		(4.39)***	
% out-temp. migrants in the village	10.397	0.506	-1.636	-0.089	-0.041	0.000
	(4.27)***		-0.7		-0.01	
% out-perm. migrants in the village	-9.677	-0.471	11.811	0.641	1.91	0.012
	(2.36)**		(2.94)***		-0.25	
% out-intern. migrants in the village	-7.316	-0.356	3.916	0.213	15.936	0.098
	(2.58)***		-1.35		(3.24)***	
Family 'chain mig.'	-0.04	-0.002	1.2	0.106	0.552	0.004
	-0.16		(5.88)***		(1.87)*	
Regional dummy	-3.407	-0.206	0.068	0.004	-1.503	-0.010
	(4.07)***		-0.08		-1.04	
Constant	-1.462		-6.783		-7.292	
	-1.24		(6.15)***		(4.12)***	
Observations	3404		3404		3404	
Pseudo R2 =	0.248		0.257		0.351	
Joint Sign.Land[1]	Chi2(2)=29.04 P = 0.000		Chi2(2) =9.83 P = 0.007		Chi2(2)=11.78 P = 0.002	
Joint Sign.Cattle[2]	Chi2(2) = 2.89 P = 0.23		Chi2(2)=16.27 P=0.000		Chi2(2)=15.25 P=0.000	
% of correct predicted probabilities	87.93%		88.22%		96.09%	

Robust - statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

[1] Joint significance of land owned and land owned squared.

[2] Joint significance of cattle owned and cattle owned squared.

Table A.2: Determinants of participation to different typologies of migration

	TEMPORARY		PERMANENT		INTERNATIONAL	
	Marginal and fixed effects of logit model	Linear probability model	Marginal and fixed effects of logit model	Linear probability model	Marginal and fixed effects of logit model	Linear probability model
Number of males in the hh.	0.013	0.023	0.014	0.029	0.003	0.003
		(3.80)***		(3.93)***		(4.58)***
Number of females in the hh.	-0.003	-0.006	0.002	0.005	0.002	0.025
		-0.84		-0.6		(4.16)***
Number of children in the hh.	-0.004	-0.008	-0.007	-0.012	0.000	0.007
		(2.33)**		(2.91)***		(2.51)**
Most educated in the hh	-0.040	-0.065	0.028	0.046	0.003	0.018
		(8.67)***		(5.51)***		(3.42)***
Age of hh. head	-0.001	-0.001	0.004	0.004	0.000	-0.003
		-0.3		(1.84)*		(2.48)**
$(\text{Age of hh.head})^2$	0.000	0	0.000	0	0.000	0
		-0.32		-1.53		(1.86)*
Religion (whether it is Muslim)	0.061	0.086	-0.004	-0.043	0.004	0.044
		(12.08)***		-1.62		(2.78)***
Land owned (pae)	-0.130	-0.115	-0.076	-0.124	0.022	0.057
		(3.74)***		(4.22)***		(2.65)***
$[\text{Land owned (pae)}]^2$	0.033	0.038	0.016	0.027	-0.015	-0.019
		(1.94)*		(2.96)***		(2.35)**
Cattle owned (pae)	0.013	-0.034	-0.079	-0.095	-0.015	-0.072
		-1.43		(3.65)***		(4.75)***
$[\text{Cattle owned (pae)}]^2$	-0.037	0.011	0.034	0.05	0.001	0.03
		-0.92		(2.91)***		(3.87)***
Farm equipment owned	-0.006	-0.006	-0.008	-0.011	0.000	0.007
		-0.8		-1.41		-0.96
Whether own tubwells	-0.012	0.063	0.036	0.011	0.005	-0.006
		(4.52)***		-0.45		(1.87)*
Self-poor assessment	0.017	0.033	-0.006	-0.01	-0.007	-0.036
		(2.82)***		-0.88		(5.09)***
% out-temp. migrants in the village	0.506	1.056	-0.089	-0.046	0.000	0.087
		(4.01)***		-0.17		-0.5
% out-perm. migrants in the village	-0.471	-0.794	0.641	1.359	0.012	-0.033
		-1.63		(2.76)***		-0.46
% out-intern. migrants in the village	-0.356	-0.632	0.213	0.391	0.098	0.928
		-1.51		-0.98		(3.36)***
Family 'chain mig.'	-0.002	0.005	0.106	0.312	0.004	0.087
		-0.16		(7.64)***		(2.86)***
Regional dummy	-0.206	-0.251	0.004	0.169	-0.010	0.006
		(2.37)**		-1.58		-0.08
Constant		0.213		-0.299		-0.056
		(1.80)*		(2.55)**		-0.72
Observations		3404		3404		3404

Robust - statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%