ESSAYS ON MIGRATION, REMITTANCE AND HOUSEHOLD'S CONSUMPTION, PRODUCTION AND INVESTMENT DECISION: EVIDENCE FROM BANGLADESH

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Abstract

This dissertation consists of three related essays on the motivation of migration, remittance, and the effect of remittance on households. For the empirical analysis, we use Household Income Expenditure Survey (HIES-2010) data sets from Bangladesh, managed and developed by Bangladesh Bureau of Statistics (BBS). Chapter one gives an introduction to the essays.

In chapter two, we employ multinomial conditional logit estimation to study the risk diversification motive of migration using household level data from Bangladesh. The household as a whole takes migration decisions to maximize expected utility. Risk-averse household allocates its members to rural agricultural, urban formal or urban informal sectors to maximize the expected utility of the household. The rural agricultural and the urban informal sector incomes are assumed to be stochastic and potentially correlated. Families send members to the urban informal sector to reduce the volatility of aggregate income as in the portfolio choice model in finance. Empirical results support the predictions of the model. Rural households are more likely to send a member to an urban destination with a higher average monthly income and lower income volatility. Households are also more likely to send a member to a destination that has a low-income correlation with the location of origin. The multinomial conditional logit model also admits the use of both alternative specific and household specific variables that are of interest in migration analysis.

In chapter three, we examine the motivation for sending remittance by migrant members. International and internal remittances contribute a significant amount to the disposable income for many households in developing countries like Bangladesh. We discuss a simple theory of remittance where insurance is a particular case of the altruistic model. Our results show that the number of migrants and total household income per-capita are inversely related to the amount of remittance sent by a migrant, thus supporting the altruistic motive for remittances. We find that the Heckman selection estimation is asymptotically consistent for the sample and insurance model is nested in the altruistic model of remittance.

In chapter four, we use the Heckman selection, multinomial logit and three-stage least square estimations to analyze the effects of internal and international remittances on the recipient household's consumption structure, human capital investment, choice of school and crop production in Bangladesh. First, for both internal and international remittances have a positive and significant impact on all expenditure categories. Second, controlling both endogeneity and selection issues, results show that both domestic and international remittance increases households' investments in human capital. Third, foreign remittance has a positive effect on children regarding their choice of private schools with and without government grant and other schools. Internal remittance has a positive effect on attendance in institutions other than public and private schools. Finally, domestic and international remittances increase households' crop production. These findings support the growing view that remittances improve households' living standards through a variety of channels.

Dedication

This thesis is dedicated to my parents.

For their unconditional love, support and encouragement.

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Chapter 1

Introduction

This dissertation is centered on three aspects of migration and remittances sent by migrants, with corresponding empirical evidence from Bangladesh. Firstly, the research focuses on the portfolio theory of rural-urban migration, where households send urban migrants to minimize family income risk. Secondly, we investigate the motivation behind remittance flow. In particular, we examine whether altruism or insurance motives drive remittances. Finally, we study the impact of remittances on a number of expenditure, investment and production decisions by households. In this introductory chapter, we present an overview along with the relevant literature survey of each of these migration-cum-remittance issues, and how we framed them for analysis in the subsequent chapters of the dissertation.

Chapter two presents the rural-urban migration model, in which households place migrants to different destinations in order to diversify and thereby reduce the volatility of family income. The literature on rural-urban migration has been a growing field of research since the seminal theoretical contribution by Harris & Todaro (1970), henceforth H-T. Rural-urban migration plays a key role in theories of economic growth and development. Through rural-urban migration, human resources move from less productive rural sector to more productive urban sector and improve the sectoral allocation of resources. Migration also causes changes in income distribution, access to quality education, rural brain drain, increasing number of single-parent households, increased density of urban population, demand for urban housing and public services. The main focus of this chapter is to analyze portfolio motive of migration, where household as a whole takes the decision to send a member to one of the urban locations to maximize household expected utility by diversifying

income risk.

Literature in line with Harris & Todaro (1970), assumes that individuals are risk-neutral and migration is driven by significant income difference between the rural and the urban sector. A number of extensions of Harris and Todaro model have incorporated other factors, including risk-aversion (Stark & Levhari (1982), Stark (1984), Katz & Stark (1986), Taylor (1987)), relative deprivation (Stark (1991) and Stark (1984)), asymmetric information Esfahani & Salehi-Isfahani (1989) and capital market imperfection Katz & Stark (1986). In all these extensions, it has been assumed that migration is the decision of the individual, not the entire household.

An alternative approach argued that destination of migration is a family decision (Connell *et al.* (1976), Low (1986), and Stark & Levhari (1982)) and the decision is driven by the desire to diversify income risk. Rural and urban income is considered stochastic and potentially correlated. Therefore, families may be able to minimize income uncertainty by sending a working member to one of the urban locations. This is similar to portfolio diversification by risk-averse individuals in financial decision making. The idea has been analyzed by Banerjee & Kanbur (1981), Paulson (1994), Ghatak *et al.* (1996), Daveri & Faini (1999), Chen *et al.* (2003), Anam & Chiang (2007) and Caruthers (2013).

The theoretical model of chapter two of the dissertation is motivated by Anam & Chiang (2007). Building on Anam & Chiang (2007) our data sets will show the expected wage of the urban informal sector is assumed to be greater and more volatile than the rural agricultural sector. One difference noted from Anam & Chiang (2007), is the impact of the job creation in the formal sector on migration is positive which is in line with the standard H-T model. This study also incorporates costs of migration (includes information costs, psychological costs, and cost associated with adaptability to different cultures) in the model.

The previous empirical studies of internal migration have been done mostly on aggregate movements using aggregate data and focusing only on location-specific attributes. Arzaghi & Rupasingha (2013) employs village level data to examine migration as a tool of diversification, utilizing the correlation between rural and urban locations in the United States. On the other hand, Davies *et al.* (2001) employ individual-level data to investigate interstate migration in the United States as a response to destination-specific economic opportunities and other non-economic factors. Every member in the household participates in decisions to send members to urban locations based

on both location-specific and household-specific variables. Mueller (1982) uses disaggregated data at the individual level of the United States inter-regional migration with alternative destination-specific attributes and personal attributes to analyze the decision to move and the destination choice.

The choice behavior of a household is considered as a multinomial experiment. Each household can choose to stay together at rural origin or can opt to send a member to one of the four urban locations. Unlike multinomial logit, the conditional logit model allows us to use both location-specific and household-specific variables. One restrictive assumption of conditional logit estimation is the independence of irrelevant alternatives (IIA). According to Cushing & Cushing (2007), nested logit and mixed logit relax the IIA assumption at the cost of computational complexity, but the conditional logit model can often be used as an approximation as long as it is well specified. Multinomial logit and conditional logit estimations are very similar; any model that can be estimated by multinomial logit can also be estimated by conditional logit using extra steps. While multinomial conditional logit estimation gives the same results, conditional logit requires an additional step Hendrickx *et al.* (2000). The parameters of the estimation are the parameters of household's utility function.

Each household's choice set is restricted to a rural origin and four different urban locations. The variables used for each alternative are average monthly income, square of average monthly income, income risk, correlation of income between the rural-agricultural sector and the urban-informal sector and natural log of distance between each rural and urban location. Observed household attributes have a significant influence on the decision to send a member to an urban location. Unobserved alternative specific characteristics also play a vital role in the decision process.

The novelty of this study lies in its use of micro-level data with both alternative-specific and household-specific variables to study diversification motive of migration, where household as a whole take the decision to send a member to one of the urban locations to diversify income risk. The model estimated for the full sample with and without household specific attributes and different sub-samples by gender of household head, average age group of household and level of education of household head. Micro-level data permits estimation of the model for different sub-samples. The results of both specifications and all the sub-samples are quite stable and consistent with the conventional theory. A household's expected utility function is specified to be quadratic in average

monthly income, which allows us to capture risk aversion under uncertainty.

In the theoretical literature, there are two types of models explaining the motive for the flow of remittance to households by migrants. In one type of model, remittance is driven by altruistic motive and in the other by insurance motive. Todaro (1969) was one of the first paper to study the role of migration as the outcome of individual utility maximization. The seminal theoretical contribution by Harris & Todaro (1970) assumes that individuals are risk-neutral, and migration is driven by significant income difference between rural and urban sector. Another strand of literature argued that migration is a collective decision and powered by household utility maximization, (Connell *et al.* (1976), Low (1986), and Stark & Levhari (1982)) .

The primary focus of chapter three is to analyze the motive of migrants for sending remittance to the household. In the literature of migration and remittance, researchers have concentrated on insurance and altruistic motives to explain behavior regarding remittances. The insurance motive for sending remittance implies that migrants periodically send remittance as a premium to cover for income risk (Stark (1991), Lucas & Stark (1985), Stark (1991) and Gubert (2002)). The standard altruistic model of remittance assumes that migrants derive utility not only from their own consumption but also from the utility level attained by the rest of the household members (Barro (1974) and Becker (1974), Becker (2009))). Both insurance and altruistic motive could simultaneously explain why migrants send remittance. Lucas & Stark (1985), Sana & Massey (2005) and Van Dalen *et al.* (2005) suggest that altruistic behavior enforces the implicit contracts of insurance between the migrant and the household.

Using data on Mexican migrants in the United States, Amuedo-Dorantes & Pozo (2006), found that increases in income risk significantly raise remittance sent by migrants to households. Lucas & Stark (1985) and Gubert (2002) also found that migrants send more remittance to households exposed to a broad range of risk which also supports the insurance motive for remittance.

Altonji *et al.* (1992) study altruistic motive for remittance flow between parents and their adult children. Using Panel Study of Income Dynamics data, their findings suggest that very few U.S. households and migrant children are altruistically linked. Agarwal & Horowitz (2002) compare and contrast between pure insurance and pure altruistic motive for sending remittances using Guyanese data. They find that altruistic model of remittance outperforms the insurance model. The likelihood of sending remittance and the amount of remittance are positively related

to the income of migrants (Lucas & Stark (1985), Vanwey (2004)), but negatively related to the household's income (Lucas & Stark (1985) and Agarwal & Horowitz (2002)). Durand *et al.* (1996) showed that Mexican migrants in the United States send 4.5% more remittances with years of education up to a certain age.

In chapter three we present a simple model explaining migrant's decision for sending remittances to households. For simplicity, we assume that individuals live in a two-period world, where, in the first period, migrants income is certain, while second-period income is not and households total expected income in both periods is equal. Migrant's expected utility depends on their consumption and per-capita consumption of the household in both periods. Migrants may choose to insure themselves against a bad state by sending remittance to the household as a risk premium. On the other hand, under the altruistic model, migrants care about both their welfare and non-migrating members' well-being. Therefore, they send remittance to the household out of an altruistic motive. Theoretically, we show that pure insurance is a particular case of the altruistic motivation of remittances, where migrants only care about themselves and send remittance to households to insure against future uncertainty.

Both insurance and altruistic motive for sending remittance is empirically testable. Under the insurance model, migrants only care about themselves and their decision to send remittance to the household is independent of the number of household members, the number of total migrant members and households total non-remittance income, and only depends on their own characteristics. By contrast, in the altruistic model, migrants are concerned about the utility of non-migrant household members. The presence of other migrants who also send remittance to the household, households income and household size, along with migrant's characteristics, influence the amount of remittance sent by migrants to the household.

We use the Heckman (1976) selection model to study the motives for sending remittance by migrants to households. The ordinary least squares (OLS) approach generates biased estimators for this type of model, as it does not consider the selection process associated with the decision to remit by the migrant. A Heckman selection model addresses the selection issue in this type of model and generates asymptotically efficient and unbiased estimators. The novelty of our study is that we use a previously unused data set to provide evidence to support existing theories that explain the motivation behind migrants decision to remit. Our study is different from the previous

studies in that we examine both insurance and altruistic motive for remittance for internal and international migrants.

Chapter four's theme is the impact of remittances on household behavior. The development of new economic tools and techniques over the last few decades allows us to examine the impact of remittance at both the micro and macro levels. Moreover, considerable improvement in the econometric tools and the availability of a large amount of micro data allow for applied research of the impact of remittance at the household level.

Household remittance is the sum of personal transfers and includes all current transfers in cash or kind between resident and nonresident individuals of a household. A member of a household may migrate within or outside the border of a country. A member who lives outside of their community of origin but within the boundary of the state is an internal migrant, and someone who lives outside the country is an international migrant. With increased urbanization and globalization, both internal migration and international migration are growing rapidly. Internal migration and subsequent domestic remittance are making a significant contribution to improving the living standard and welfare of the remittance-recipient households.

While the aggregate level of domestic remittance is unknown, international remittance to Bangladesh is US $14,982.84 million, which is 8.7% of the GDP in 2014 WBG (2016). In 2015, Bangladesh ranked as the tenth top remittance receiving country. International remittance is becoming an increasingly important source of foreign currency for Bangladesh. It is the second largest source of foreign exchange for Bangladesh after the export of readymade garments and textiles. The ratio of international remittance to total export of Bangladesh is 0.4579, 2014 WBG (2016). Remittance can increase economic growth by increasing aggregate consumption and investment, Anyanwu and Erhijakpor (2010). Despite the popular consensus regarding the significant role of international remittance on Bangladesh's economy, it gets little attention from researchers. We examine the impact of internal and international remittances on Bangladeshi households' consumption behavior, human capital investment, choice of school for children and households' agricultural production.

Using urban household survey from 2004, Beyene (2014) studies the effect of international remittance on poverty and inequality in Ethiopia. Using the Heckman two-stage selection estimation, the study find a significant decline in poverty but no change in inequality. Using Ghana Living Standards Survey, 2005 - 2006, Adams & Cuecuecha (2013) examine the impact of internal and

international remittances on investment and poverty in Ghana by Heckman two-stage selection estimation. They find that households receiving remittance spend less on food and more on education, housing and health. Their results also show that remittance reduces inter-household poverty. Using Vietnam Household Living Standard Survey of 2010, Bui *et al.* (2015) reveal that households receiving remittance spend less on food. Furthermore, international remittance increases investment in education and business. They estimate the model with OLS and logistic regressions.

Through a randomized experiment on El Salvadoran migrants using matching funds remittance for amounts spent on education find that the matches lead to increased educational expenditure, higher private school attendance and lower labor supply of youths in households receiving remittance Ambler *et al.* (2015). They also find no evidence of any shift of spending away from one student to other and no change in remittance flow.

Controlling for the endogeneity of remittance with linear probability and probit estimations, Amuedo-Dorantes & Pozo (2006) find that, some communities in Haiti with a large number of schools, remittance raises school attendance regardless of whether a household member lives abroad or not. However, in communities with a lack of easy access to schools, remittance increases school attendance only for the children with no migrant members. The study uses Haitian community files from the Latin American Migration Project data.

Using a nationally representative households' standard of living survey in 2007 from Morocco, Bouoiyour & Miftah (2015) analyze the impact of remittance on children's human capital accumulation, while Binci & Giannelli (2016) study the effect of internal and international remittance on child labor and schooling using Vietnam Living Standards Surveys from 1992-1993 and 1997-1998. Both studies find that remittance increases schooling and reduces child labor. The earlier study uses probit estimation, and the later one uses binomial logit and two-sided censored regression. Moreover, Bouoiyour & Miftah (2015) find that remittance significantly lowers the level of no schooling for girls.

Employing bias-corrected matching estimators to control for self-selection and using Sri Lanka Integrated Survey from 1999-2000, De & Ratha (2012) show that remittance improves the living standard of the families in the bottom quartile of the income distribution and hence reduces inter-household inequality. They also reveal that remittance has a positive and significant impact on children's health and education but no effect on consumption or asset accumulation.

To investigate the effect of remittance on the education and health of children in Kyrgyzstan, Kroeger & Anderson (2014) use quarterly data from Kyrgyzstan Integrated Household Surveys from 2005 to 2009. Estimating a fixed effect panel, they find that remittance has no impact on human capital of children left behind, but school enrollment increases for young children and declines for older children. Using the Vietnam Household and Living Standard Surveys in 2006 and 2008, and relying on estimation of fixed effects with a Poisson regression, Nguyen & Nguyen (2015) also find no evidence of remittance having an impact on school enrollment or child labor but detect a positive effect on the number of completed grades by children.

Using the Nepal Living Standards Survey, 2003-2004, with multinomial logit estimation, Acharya & Leon-Gonzalez (2014) show that remittance has a significant positive impact on the schooling of Nepali children of uneducated mothers and those who are from poor, rural, landless and small land-holding households. Moreover, using the Nepal Living Standards Survey in 1995-1996 and applying with instrumental variable estimation, Bansak & Chezum (2009) show that $relative - net - remit$ is consistently positive and statistically significant only for the young male and female sub-samples. They also find that young girls benefit relatively less from remittance and also suffer less harm from household disruption.

Using the New Economics of Labor Migration framework to trace the complex linkages among migration, remittance and agricultural production in China, Rozelle *et al.* (1999) show that migration has a negative but remittance has a positive impact on maize production. This can be explained by the fact that, when individuals migrate, shortage of labor reduces output and increases remittance received by households, which in turn, increases their capital holding and production.

Motivated by the aforementioned literature, chapter four studies the impact of remittance on households' economic behavior in Bangladesh. There are a limited number of non-academic studies examining the impact of remittance in Bangladesh focusing on the flow of remittance at the macro level. To our knowledge, rigorous studies investigating the effect of remittance on households in Bangladesh has not been done so far. From an economic development point of view, key issues surrounding the flow of internal and international remittances on recipient households are: how remittances are spent by households and whether the remittance-receiving households invest this income in developing human capital and agricultural production. In spite of a vast number of empirical studies, theoretical frameworks to examine the effect of remittance on recipient households

are rare. The novelty of this study is that we extend the household-farm model with migrant household members sending remittance to the household by allowing for the endogenous capital formation.

To examine the impact of internal and international remittances on households' consumption behavior and human capital investment, we use the Heckman two-stage selection estimation procedure that correct for self-selection bias. To investigate the impact of remittance on the choice of schooling, we use multinomial logit estimation. Finally, to analyze the impact of remittance on households' agricultural production, we use a three-stage least square estimation to take care of the possible cross-equation endogeneity between migration decision, remittance sent and crop production.

For the empirical part of the analysis in each chapter, we use the Household Income Expenditure Survey (HIES, 2010) data sets from Bangladesh, which is managed and developed by Bangladesh Bureau of Statistics (BBS). Though the HIES is also available for 1990, 1995 and 2005, we use only data sets for 2010, because HIES 2010 provides the first country-wide comprehensive household-level data on internal and international remittances to Bangladesh with both non-migrant and migrant-specific and household-specific information. The advantage of using this data set over data sets used in earlier studies is the large number of observations and extensive type of information it provides.

The HIES 2010 contains detailed information on individual income, occupation, personal and household characteristics. Importantly for this research, it also provides information on whether a household has any member that migrated to other location within the country or outside the country. For households with migrants, the HIES 2010 reports information on the total number of migrant members, if and how much remittances are sent by migrants, how the remittances are spent and invested, tangible household assets, sources of household income, the location of origin of the household, migrants destination, location-specific attributes and other household and migrant-specific attributes.

The HIES 2010 reports a total of 12,240 households out of which 7,840 live in different rural areas. There are a total of 2,100 migrants within the households, and number of households have multiple migrants. Out of this 2,100 migrants, 728 are migrants within the country and 1,372 outside the country; 695 of the 728 internal migrants and 1,337 of the 1,372 international migrants

send remittance to their families.

The detailed and rich data set allows us to conduct a micro-level empirical analysis of rural-urban migration triggered by diversification motive of potentially risk-averse households, the motive for sending remittance, the effect of remittance on households' consumption behavior, investment in human capital, children's choice of schooling and level of agricultural production.

Chapter five presents concluding remarks.

Chapter 2

Portfolio Theory of Rural-Urban Migration: An Empirical Study of Bangladesh

In line with Harris & Todaro (1970), most of the empirical studies on migration have examined how wage differentials determine the flow of migration. In this chapter, we analyze the migration decisions of risk-averse households using household level disaggregated data from Bangladesh. We only consider internal migrants because there are entry barriers and restrictions for international migration. Our results support the fact that households take decisions of migration to minimize income uncertainty through income diversification.

The rest of the chapter will proceed as follows: Section 2.1 discusses the risk diversification motive of migration model based on the household decision. Section 2.2 studies the implications of the theory through comparative statics and provides intuition for the results. Section 2.3 is devoted to building the empirical model and explains the estimation technique. Section 2.4 discusses the data source and the approach used to construct the variables for estimation; it also gives summary statistics of demographic attributes of migrants, alternative specific economic attributes, income correlation and the distance between each rural and urban locations. Section 2.5 presents and discusses empirical results of the model. Finally, Section 2.6 summarizes the chapter.

2.1 Theoretical Model

The model of migration from rural to urban locations is based on portfolio theory of risk diversification where households minimize their income uncertainty to maximize expected utility. The country is composed of four regions; each region is composed of two locations; rural and urban, denoted by R and U, over which the household allocates its members. It is assumed that households living in rural areas could send working members to urban areas. The rural economy is composed of a single agriculture sector. In the urban economy, there are two employment options. The first is the formal sector consisting of government organizations, semi-government organizations, autonomous bodies, private offices, public or private factories, local government organizations and NGO's. The second is an informal sector, for example, domestic help, private establishment, store keepers, rickshaw pullers and daily laborer. Following stylized facts in developing countries, it is assumed that there is surplus labor in rural areas. Therefore, the average and marginal products of rural labor are constant but subject to a random shock. In urban areas, the formal sector profit-maximizing firms employ sector-specific capital and labor. It is assumed that, on average, the formal sector pays a constant non-stochastic wage higher than the average wage in the rural agricultural sector and urban informal sector. As in the agricultural sector, urban informal sector's average and marginal products of labor are constant and subject to a random shock.

A location $r \epsilon R$ is associated with a region specific wage w_r. A location $u \epsilon U$ is associated with sector-specific wage w_f in the formal sector and w_i in the informal sector, where w_r and w_i are subject to region-specific shocks ε_r and ε_i, respectively (w_f is non-stochastic).[1] The shocks are assumed to be distributed as $\varepsilon_r \sim N(1, \sigma_r)$, $\varepsilon_i \sim N(1, \sigma_i)$ and $E(\varepsilon_r \varepsilon_i) = \sigma_{ri}$. Within sectors individuals are homogeneous in productivity and skills. An individual earns $y_r = w_r \varepsilon_r$ in agriculture sector r, $y_f = w_f$ in urban-formal sector f and $y_i = w_i \varepsilon_i$ in urban-informal sector i. Income uncertainty is assumed to be multiplicative because it relaxes the uniform effect on all individuals with different levels of income.[2] Following these assumptions, incomes in different sectors are distributed as $y_r \sim N(w_r, w_r^2 \sigma_r^2)$, $y_f \sim N(w_f, 0)$ and $y_i \sim N(w_i, w_i^2 \sigma_i^2)$. For each individual, the region-specific cost of migration is $d_{ri} > 0$, which includes costs of migration.

There are N identical households with n number of working members each supplying a given

[1] Monthly wage in USD.

[2] Instead of multiplicative uncertainty, if we assume additive uncertainty our results will not change.

unit of labor. Households are assumed to be risk-averse with an identical quadratic utility which is a function of aggregate household income. m is the number of individuals migrating from rural to the urban area and, therefore the rest are employed in the agriculture sector. The number of workers employed in the urban-formal sector l^* is determined according to firm's profit maximization condition, $f'(l^*, N) = w_f$, where $f'(l^*, N)$ is the marginal product of labor. A fraction of each household's members who live in the urban location work in the urban-formal sector and the remaining $(m - l^*)$ are employed in the urban informal sector. Total household income is equal to the sum of each household's income from all the sectors:

$$Y = \sum_{j=1}^{n} y_j = (w_f - d_{ri})l^* + (w_i\varepsilon_i - d_{ri})(m - l^*) + w_r\varepsilon_r(n - m) \tag{2.1}$$

It is assumed that household expected utility follows a mean-variance utility function given by:

$$EU(Y) = E(Y) - \theta Var(Y) \tag{2.2}$$

where θ [3] denotes the degree of risk aversion, $E(Y) = w_f l^* + w_i(m - l^*) + w_r(n - m) - d_{ri}m$ and $Var(Y) = w_i^2(m - l^*)^2\sigma_i^2 + w_r^2(n - m)^2\sigma_r^2 + 2w_i w_r(m - l^*)(n - m)\sigma_{ri}$.

Expected utility optimization with respect to m yields the following conditions:

$$\begin{aligned} MU = \frac{\partial EU}{\partial m} =& w_i - w_r - d_{ri} - 2\theta[(m - l^*)w_i^2\sigma_i^2 - (n - m)w_r^2\sigma_r^2 \\ &+ (n - m)w_i w_r\sigma_{ri} - (m + l^*)w_i w_r\sigma_{ri}] \end{aligned} \tag{2.3}$$

$$\frac{\partial^2 EU}{\partial m^2} = -2\theta[w_i^2\sigma_i^2 + w_r^2\sigma_r^2 - 2w_i w_r\sigma_{ri}] < 0 \tag{2.4}$$

The formal sector offers the highest and risk-free wage, implying that family utility increases with additional members employed in the sector. Families send more migrants than can be absorbed in the formal sector and $m \geq l^*$. This can be inferred from the following equation:

$$\frac{\partial EU}{\partial m}|_{m=l^*} = w_i - w_r - d_{ri} - 2\theta(n - m)w_r[-w_r\sigma_r^2 + w_i\sigma_{ri}] \tag{2.5}$$

[3] Degree of risk aversion, $\theta > 0$

If $w_r > w_i - d_{ri}$ and there is no uncertainty and dependency between rural and urban informal sectors (i.e. $\sigma_r^2 = \sigma_{ri} = 0$), the urban-informal sector can not exist in this model. For the existence of the urban-informal sector, it is assumed that $w_r < w_i - d_{ri}$ and $\sigma_r^2 \neq 0$ with a sufficiently low level of dependency between the two sectors, which is supported by our data. Even though urban-informal sector pays more than rural sector and there is a free entry into the urban-informal sector, the entire family does not migrate to the urban sector due to a higher level of uncertainty in that sector. Migration from rural to the urban area increases family level aggregate income with uncertainty. The latter effect arises due to stochastic rural and urban-informal incomes and their potential covariance. Migration will exceed the formal sector employment when $\frac{\partial EU}{\partial m}|_{m=l^*} > 0$. This will hold if a) $-w_r\sigma_r^2 + w_i\sigma_{ri} < 0$ is sufficiently negative or b) $-w_r\sigma_r^2 + w_i\sigma_{ri} < 0$ and θ is sufficiently large. When these conditions are satisfied, the rise in expected aggregate family income is offset by the rise in the variance of aggregate family income. Highly volatile urban informal income coupled with the lower level of covariance between agriculture and urban-informal sector incomes makes this event likely as is well known in portfolio theory.

2.2 Comparative Statics

This section now examines comparative statics of the model. If $w_f > w_i - d_{ri} > w_r$, optimal migration must hold $m^* > l^*$ when $w_i - w_r - d_{ri} - 2\theta(-w_r\sigma_r^2 + w_i\sigma_{ri})(n-m)w_r > 0$. Following are the partial derivatives of the model:

$$\frac{\partial m^*}{\partial \sigma_i} = -\frac{2w_i^2\sigma_i(m-l^*)}{w_i^2\sigma_i^2 + w_r^2\sigma_r^2 - 2w_iw_r\sigma_{ri}} < 0 \tag{2.6}$$

$$\frac{\partial m^*}{\partial \sigma_r} = \frac{2w_r^2\sigma_r(n-m)}{w_i^2\sigma_i^2 + w_r^2\sigma_r^2 - 2w_iw_r\sigma_{ri}} > 0 \tag{2.7}$$

$$\frac{\partial m^*}{\partial \sigma_{ri}} = -\frac{w_iw_r(n-2m+l^*)}{w_i^2\sigma_i^2 + w_r^2\sigma_r^2 - 2w_iw_r\sigma_{ri}} >< 0 \qquad as (n-m) <> (m-l^*) \tag{2.8}$$

Equations (2.6) and (2.7) indicate that an increase in the standard deviation of income in the urban-informal (agriculture) sector will discourage (encourage) migration to the urban area. Though urban-informal sector pays more than the rural area all members of a family would not

migrate to cities due to the higher level of uncertainty in the sector. Moreover, when a urban-informal sector becomes more uncertain, families are discouraged to allocate members to the sector. Counter-arguments hold for the rural income uncertainty. Equation (2.8) shows that, as covariance increases in a positive direction, a member of the family migrates more (less) as $(n-m) < (>)(m-l^*)$, where the left-hand side is rural sector employment and the right-hand side is urban-informal sector employment. This condition indicates that with an increase in positive covariance the family would like to stay concentrated rather than diversify. When rural employment is lower (higher) than the urban-informal employment, family members are more (less) willing to migrate from rural area to urban area with an increase in positive covariance.

$$\frac{\partial m^*}{\partial w_i} = \frac{1-\theta[2(m-l^*)w_i\sigma_i^2 + (n-2m+l^*)w_r\sigma_{ri}]}{\theta(w_i^2\sigma_i^2 + w_r^2\sigma_r^2 - 2w_iw_r\sigma_{ri})} >< 0 \tag{2.9}$$

$$\frac{\partial m^*}{\partial w_r} = \frac{-1+\theta[2(n-m)w_r\sigma_r^2 - (n-2m+l^*)w_i\sigma_{ri}]}{\theta(w_i^2\sigma_i^2 + w_r^2\sigma_r^2 - 2w_iw_r\sigma_{ri})} >< 0 \tag{2.10}$$

$$\frac{\partial m^*}{\partial d_{ri}} = -\frac{1}{2\theta(w_i^2\sigma_i^2 + w_r^2\sigma_r^2 - 2w_iw_r\sigma_{ri})} < 0 \tag{2.11}$$

Equations (2.9) and (2.10) explains the effects of changes in agricultural and urban-informal wages on migration. The effects of these two variables are ambiguous and depend on the uncertainty parameters, which contrasts with the conventional H-T model. According to the H-T model, an increase in urban-informal (agricultural) wage increases (decreases) rural to urban migration. Intuitively, an increase in these wages has two opposing effects on the incentive for migration. Though the rise in wage motivates families to allocate more members to the sector, a simultaneous increase in the income variance of the sector, given the multiplicative uncertainty, reduces the incentive to migrate. The outcome depends on the dominant effect. The effect of migration cost on migration is very straightforward. According to (2.11), an increase in the cost of migration decreases the net marginal utility of migration which is very intuitive.

$$\frac{\partial m^*}{\partial l^*} = \frac{w_i(w_i\sigma_i^2 - w_r\sigma_{ri})}{w_i^2\sigma_i^2 + w_r^2\sigma_r^2 - 2w_iw_r\sigma_{ri}} > 0 \qquad as w_i\sigma_i^2 - w_r\sigma_{ri} > 0 \tag{2.12}$$

$$\frac{\partial m^*}{\partial n} = \frac{w_r(w_r\sigma_r^2 - w_i\sigma_{ri})}{w_i^2\sigma_i^2 + w_r^2\sigma_r^2 - 2w_iw_r\sigma_{ri}} > 0 \qquad as w_r\sigma_r^2 - w_i\sigma_{ri} > 0 \tag{2.13}$$

$$\begin{aligned}\frac{\partial m^*}{\partial \theta}\frac{\theta}{m^*} = &- \frac{w_i(m-l^*)[w_i\sigma_i^2 - w_r\sigma_{ri}] - w_r(n-m)[w_r\sigma_r^2 - w_i\sigma_{ri}]}{m^*[w_i^2\sigma_i^2 + w_r^2\sigma_r^2 - 2w_iw_r\sigma_{ri}]} >< 0 \\ &as (n-m) >< (m-l^*)\end{aligned} \tag{2.14}$$

Formal sector employment may increase due to events like employment subsidies or investment in the sector. The effect of an increase in formal sector employment is given by (2.12). Consistent with the standard H-T intuition, the impact of formal sector job creation on migration is positive. Migration may decrease when the correlation between agriculture and urban-informal sector incomes is sufficiently positive. The intuition is as follows. When the number of jobs in the formal sector increases, assume initially that members move from the urban-informal to the urban-formal sector, keeping the level of migration constant. In the process, the expected wage and the variance of wage in the urban-informal sector raises. However, with significant positive correlation, the variance of aggregate family income can be minimized by moving additional members back to the agriculture sector from the urban-informal sector so that urban-informal sector ceases to exist. According to portfolio theory, when asset returns are positively correlated, risk-averse investors prefer specialized rather than diversified portfolios. According to (2.13), an increase in the number of household members increases the net marginal utility of migration which is also very intuitive.

It is less obvious how changes in the household risk-aversion parameter impact the migration decision. The partial derivative on household risk aversion equals the negative of the change in the variance of household income resulting from migration. The effect of an increase in the risk aversion parameter is presented in (2.14). A change in the household risk aversion has an ambiguous effect on migration. Equation (2.14) shows that, as risk aversion increases, members of the family migrate less if $(n-m) \leq (m-l^*)$. A member of the family relocates more if and only if the number of members employed in the informal sector is significantly lower than the number of members working in the rural area. From the above discussion, the model yields the following testable hypothesis:

H_0 **1:** Wage increases in the agriculture and the urban-informal sectors have an ambiguous effect on migration.

H_0 **2:** Wage variance increases in the agriculture (urban-informal) sector encourage (discourage) migration.

H_0 **3:** Increases in the wage covariance between agriculture and urban-informal sectors discourage (encourage) migration if the initial agricultural employment is greater (less) than the urban-informal sector employment.

H_0 **4:** Migration costs increases discourage migration.

H_0 **5:** Formal sector job creation and number of family member increases encourage migration.

H_0 **6:** A higher level of risk aversion encourages (discourages) migration if the initial agricultural employment is greater (less) than the urban-informal sector employment.

2.3 Empirical Specification

The migration decision is an outcome of a household utility maximization problem, where each household must choose one of the several possible discrete destinations for its members. A multinomial logit (MNL) estimation strategy has been used in recent empirical studies O'Keefe (2004). Special attention is given to segmented labor market to highlight the importance of individual specific attributes. A conditional logit is more appropriate then MNL since it allows for the inclusion of both household-specific and alternative-specific variables by interacting household-specific variables with alternative dummies (Davies *et al.* (2001); Cushing & Cushing (2007) and McFadden *et al.* (1973)). The household's decision to send a member to one of the urban locations or keep everyone in the rural origin location also depends on unobserved preferences. The multinomial conditional logit is used to estimate the effect of personal attributes and alternative attributes. Finally, the empirical model is set up to incorporate risk aversion, uncertainty, and risk diversification by including a square of average income, volatility of income and income correlation between the rural agricultural sector and urban informal sector.

There are four major regions (Chittagong, Dhaka, Khulna, and Rajshahi) in Bangladesh, each consisting of disjoint rural and urban areas. A household living in rural region R has five migration location options: the four metropolitan areas and the rural home region. Migration location options indexed by the variable $k\epsilon\{1,2,...,5\}$, where $k = U$ if the household sends a family member to urban region U, and $k = 1$ if the household stays in the home area. The household $h's$ utility at alternative k is augmented as follows:

$$W_{hk} = W(X_{hk}, \eta_{hk}) \tag{2.15}$$

where X_{hk} denotes observed personal attributes and location specific economic attributes at k and η_{hk} denotes unobserved characteristics (tastes). The multinomial conditional logit model assumes household will choose the option that maximizes expected utility. Household h, living in the rural area r, will choose option k if and only if the expected utility of choosing k is greater than the expected utility from the other four choices, that is,

$$W_{hk} > W_{hl}, \qquad \forall \quad l \neq k$$

There is no prior information on the specification of the distribution of the expected idiosyncratic utilities. Computationally, practical expressions for the probabilities result if the expected idiosyncratic utilities are independently identically distributed according to the Weibull distribution McFadden (1974). The cumulative Weibull distribution is $F(\eta) = exp[-exp(\eta)]$. Substituting the cumulative Weibull distribution into the cumulative density and performing the integration yields the following expression for the selection probabilities:

$$P(W_h = k|x_h) = \frac{exp(X_{hk}\beta)}{\sum_{l=1}^{5} exp(X_{hl}\beta)}, \qquad k = 1, ..., K$$

where X_{hk} is a vector of observed personal attributes and location specific attributes and β are the respective parameters.

The defined selection probabilities are those of the multinomial conditional logit model. Dropping the subscript h and differentiating with respect to X gives the marginal effects as:

$$\frac{\partial p_k(X)}{\partial X_{kl}} = p_j(X)[1 - p_j(X)]\beta_l, \qquad l \neq k$$

where $p_j(X)$ is the response probability and β_l is the lth element of β.

The conditional logit and MNL models differ in some important respects. In the MNL model, explanatory variables are unique to the individual but not to the alternatives. This model is appropriate when characteristics of the alternatives are unimportant. Whereas, the conditional logit model is appropriate when different choices are made based on observed attributes of each alternative. Empirically, conditional logit model often includes both personal and alternative specific variables and thus allows for estimating their separate effects on utility.

The conditional logit model is convenient to model probabilistic choice, but with some restrictions. One limitation of a conditional logit model is the assumption of independence of irrelevant alternatives (IIA). IIA implies that the relative odds of choosing one option over another are the same regardless of what other options may be available or the characteristics of the other options. The odds that the household h choose alternative k over l is written as:

$$p_k/p_l = \frac{exp(x_k\beta)}{exp(x_l\beta)} = exp[(x_k - x_l)\beta)]$$

Which states that the relative probabilities of selecting one alternative over another depend only on the expected utilities of two options. It implies that adding another choice or changing the characteristics of any alternative does not affect the relative odds between alternatives k and l. This implication is unlikely with similar alternatives Wooldridge (2010).

The log likelihood function for all households having at least one migrant individual moving from any rural origin r to any urban location u is:

$$lnL = \Sigma_r m_{ru} lnp(m_{ru} = 1)$$

where $m_{ru} = 1$ if a household sends a member from rural area r to urban area u.

The existence of households with no migrant member allows us to estimate the unobserved difference between moving and staying. One alternative is to eliminate the rural origin option from the choice set and to focus on households with at least one migrant member. That would cause a

selection bias because the possibility of a stayer moving under a particular condition is eliminated. This paper's focus is on family migration decision from a rural to an urban location in Bangladesh. The total area of Bangladesh has been segregated into four main regions each containing disjoint rural and urban areas. Thus, each household has a total of 5 potential destination choices (including the rural origin). The corresponding log likelihood function is:

$$lnL = \Sigma_r \Sigma_k N_{rk} lnp(m_{rk} = 1)$$

where N_{rk} is the number of households from rural area r who choose the alternative option k.

Following Mueller (1982), under uncertainty, household h is utility function at alternative k is assumed to be the sum of a linear function of the observed household attributes z_h, a quadratic function of the observed alternative attributes v_{hk} and variances of the place attributes σ_{hk}.

$$W_{hk} = \beta_1' v_{hk} + \beta_2' v_{hk}^2 + \gamma' z_h + \delta' \sigma_{hk} + \zeta_{hk} \tag{2.16}$$

$$\frac{\partial W_{hk}}{\partial v_{hk}} = \beta_1' + 2\beta_2' v_{hk} > 0; \qquad (Positive \quad marginal \quad utility)$$

$$\frac{\partial^2 W_{hk}}{\partial v_{hk}^2} = 2\beta_2' < 0; \qquad (Strict \quad concavity)$$

$$\frac{\partial W_{hk}}{\partial \sigma_{hk}} = \delta' < 0;$$

The utility is a function of household characteristics, destination characteristics, and the migration costs. Keeping all the households with and without migrant member and the rural origin as potential destination choice, household h choose option k then their utility function follows:

$$W_{hk} = \beta_1 \bar{w}_{hk} + \beta_2 \bar{w}_{hk}^2 + \delta_1 \sigma_{hk} + \delta_2 \rho_{rk} + \delta_3 lndist_{rk} + \gamma_1' d_k + \gamma_2' z_h + \zeta_{hk} \tag{2.17}$$

where $\bar{w}_{hk}$ and σ_{hk} are average wage and standard deviation of wage by age, gender, education and location, respectively. ρ_{rk} is the correlation of wage between sending region r and receiving region k and $lndist_{rk}$ is the natural log of geographic distance between sending region r and receiving

region k. d_k and z_h are, a vector of destination specific and household specific latent variables. d_k includes four urban destination choice, Chittagong, Dhaka, Khulna, and Rajshahi. To avoid the dummy trap, we drop the rural choice from the destination choice. z_h includes non-migration, occupancy status, the gender of the household head, the average age of household members below 30, the average age of household between 30 to 40, and a log of usable space of closed rooms.

2.4 Data and Summary Statistics

This section first discusses the data source and how the sample of potential migrants are selected. Then it considers how the variables of interest are generated. Finally, it presents the summary statistics of demographic attributes of migrants, location specific economic attributes, risk diversification indicator and a proxy of the direct and indirect cost of migration.

2.4.1 Data Source and Selection Criteria

Household Income and Expenditure Survey (HIES) data from Bangladesh, managed and developed by the Bangladesh Bureau of Statistics (BBS), are used in the study to examine the portfolio theory of rural-urban migration. HIES data provide individual's income, occupation, personal and household characteristics for the following years 1995, 2000, 2005 and 2010 allowing us to conduct panel analysis. But there are two important limitations of the survey over the periods, which hinder incorporation of the time dimension in this study. First, there is no indicator to identify households over survey periods. Second and most importantly, HIES reports migration specific detail information of households only for 2010.

Due to the data limitation, this study focuses on a cross-section empirical analysis of household migration decision as a utility maximization problem. One of the advantages of this dataset is that it provides detailed information about both migrant and household members (age, gender, religion, relation with household head, education level, wage, occupation, job status, etc.) and household (asset, housing, credit, production, expenditure behavior, etc.). This allows us to do a micro-level analysis of rural-urban migration and study its impact on households.

The HIES 2010 reports on 12,240 households out of which 7,840 live in different rural areas. This study examines migration behavior of households from rural to urban areas and focuses on

the 7,840 households who live in the countryside. Table 2.1 reports the number of total households, rural households, rural households with and without migrant member by region of origin. Among these rural households, 446 had at least one member who migrated from rural to urban area. Out of 446 households, 17 households have migrant at multiple locations. 16 out of 17 households have members from two different towns, and one household has members in three different urban areas. For empirical purposes, this study splits households with multiple location migrants into multiple households [4] and end up with a total of 7,858 households and 464 rural households who send at least one of their member to an urban location. Finally when we match the income and standard deviation (by gender, age, education and location) with location choice latent variable we loose 708 households (9% of total households) due to missing income and standard deviation observations for at least one urban locations. The final total number of households becomes 7,150.

A total of 568 individuals migrated from rural to urban locations. Table 2.2 presents rural to urban migration flow by both origin and destination locations. Column 2 of Table 2.2 shows that household of all the countryside except Chittagong are sending migrant towards urban Dhaka. The first preference of rural households of Chittagong is urban Chittagong rather than urban Dhaka. The magnitude of urban migration is significantly higher to Dhaka and Chittagong, the two most important cities of the country in terms of economic activities and development. This is expected as most of the government and private corporations' headquarters are located in Dhaka, the capital, Bangladesh, and one of the two largest sea port in Bangladesh is located in Chittagong, also know as the business capital of Bangladesh.

Within each region, there are sub-regions known as districts. Distance is measured in kilometers between district headquarters and regional headquarters. Distance data were collected from the Government of the People's Republic of Bangladesh, Ministry of Communications, Roads and Highways Department. The distance between rural and urban areas of different regions is used as a proxy for the direct economic costs and indirect psychological costs of migration.

[4] A prerequisite to employ a multinomial conditional logit estimation is that sum of left hand side latent variable by each household must be equal to one. If a household have multiple migrants in multiple locations the prerequisite is not satisfied. There are two options to overcome this issue. One, we may exclude households with migrants in multiple location and second, we may split them into multiple households, each with only a single migrant. Excluding households with multiple location migrants does not change our results compared to splitting them.

2.4.2 Construction of Variables

Every household has five options, four alternative urban locations, and the rural origin location. The data set is constructed in such a way that each household has five observations where the dependent variable, Y, is equal to one for the urban option chosen by the household to send at least one of the member and is equal to zero for the remaining four alternatives. If the household chooses not to send any of its members to urban locations, then the rural origin option will take one, and all the four urban options will be zero. In the sample, 7,150 households live in rural areas of different regions which gives us 35,750 observations.[5]

Regional average monthly income or wage in US dollar, $\bar{w}$, (official average price of US dollar in 2010, 69.90, is used for conversion) and standard deviation of income or wage, σ, are included to represent the potential economics benefit and risk from migration. Average earnings, $\bar{w}$, and standard deviation of income, σ, are generated taking average and standard deviation of wage for all working individuals within each rural and urban location by age, gender, and education. Age is classified into four groups from 12-25, 26-40, 41-55 and 56 and above; education classified into three groups; no education to grade 4, grade 5 to grade 9 and above grade 10. The inclusion of age, gender, and education each rural and urban location generates 24 observation for an average of income and standard deviation of income.

These variables are generated by observed characteristics of the individual's because every household does not expect the same level of income or risk at each urban location. There are two types of households; one sends at least one member to one of the four urban areas and the other where all the members live in the rural origin. In the data sets, for each household, there are five observations. Households with no migrant members expect income and risk at all locations based on the household head's age, gender and education. Households with migrant members expect income and risk at all locations based on the migrant member's age, sex and education.

Individual wages depend on two factors: an individual's observed and unobserved characteristics. Income risk is generated from the unobserved part of the income. So, standard deviation of income is not the right measure of risk. To eliminate the observed part of income from the

[5]Each households may choose to send a member to one of the four urban locations or to keep everyone in the rural origin location. Thus, each households have five observations. There are a total of 7,150 households, which multiplied by five gives us 35,750 observations.

risk we first estimate the wage of all working individuals separately for each rural and urban location. Then, we use the residuals of the estimation to calculate standard error by age, gender, and education.

The correlation of income, ρ, between origin and destination location is included as an indicator of potential benefit from risk diversification. Income correlation, ρ, between each rural and urban location, is calculated using an average of the fitted value of wage estimation by age, gender, and education. The corresponding value of correlation, ρ, for the household who choose not to send any member to the urban location is one. Following standard literature of migration (Arzaghi & Rupasingha (2013), Davies *et al.* (2001), Cushing & Cushing (2007)), the distance between rural and urban areas of different regions is used as a proxy for the direct economic cost and indirect psychological costs of migration, $lndist$. The distance between the rural and urban areas of the various regions is generated by taking the average of distance from urban regional headquarter to a different rural district headquarter of the zone. The corresponding value of distance for the household who chooses not to send any member to the urban location is zero. For computational purposes, we add one with distance before taking the natural log of distance.

To diversification benefit from migration depends on the level of risk aversion. In the relevant literature, risk aversion has been estimated using investment in financial securities, hypothetical gambling survey data or time series of consumption data. It is impossible to use any of these three approaches here. First, the relevant sample households live in rural areas, and most of them do not invest in financial markets. Second, in HIES, there is no hypothetical gambling question designed to measure household risk aversion. Third, this is a cross section data set. By definition, the risk aversion index is the negative of the ratio of second order and first order derivatives of the utility function, $\theta_h = -\frac{2\beta_2}{\beta_1 + 2\beta_2 \bar{w_{hk}}}$. It is possible to incorporate the risk aversion parameter indirectly by estimating the quadratic form of the utility function.

Unobserved economic and non-economic location attributes are important factors in the migration decision. To capture these effects, a set of alternative destination dummy variables (location fixed effects) are included. Location fixed effects alone can not control for the difference between sending at least one of the member to one of the urban areas and all of the household's members staying at the rural origin because it is related to the unobserved costs associated with migration. A non-migration dummy variable is included, which is equal to one if all the household's members

chose to live at the rural origin location, to control these unobserved factors.

As mentioned earlier, the advantage of multinomial conditional logit estimation and the HIES data sets are that they allow for the use of both location specific and household-specific explanatory variables for explaining household migration decision. This study considers the role of six household-specific variables. Note that household-specific variables assume zero values for choices other than the rural origin, because the effects of personal characteristics are unique to the potential migrant's rural origin utility Mueller (1982).

Households own the place where they live, *Owner*, take one if they own the place, zero otherwise. Total usable space or area of closed rooms, *Space*, for computation purpose we add one with total space they have and take natural log. These three variables indicate the quality of living indicators for households. If a household's life quality indicators are low in the rural location, the probability that a least one migrant sent to the urban sector is expected to be high. We add three more latent variables of which one indicates whether the household head is male and other two show the average age range of the household. If the household head is male, $Male$, Average age of the household is below 30, $Agegroup1$, and in between 30 and 40, $Agegroup2$, take one if they are within the group otherwise zero. These latent variables influence the household's decision to send one of the members to one of the urban location. All the variables generated from HIES 2010.

2.4.3 Demographic Attributes of Migrants

The demographic attributes of the migrants are reported in Table 2.3. Table 2.3 presents the flow of migrants as a percentage of the similar non-migrant group (by age, education level, and gender). The first thing to note here is that male migration clearly dominates female migration in practically all cases of rural to urban migration in Bangladesh. Plausible reasons for a region getting more men than women migrants are: first, women in Bangladesh still do not participate significantly in work force compared to men and second, women's wage does not vary considerably between rural and urban locations for a given demographic cohort. The only exception is migration from rural Chittagong to urban Dhaka, where households send relatively more female members to Dhaka from Chittagong. On an average, urban Dhaka is receiving twice the number of male migrants than female. Urban Chittagong is receiving four times more male migrants than female migrants. Other two urban location Khulna and Rajshahi is receiving only male migrants.

Concerning education, on average, for each combination of areas, households are sending more members to urban locations with a higher level of education. For example, migrants from rural Chittagong to urban Chittagong with educational attainment below grade 5 as a proportion of non-migrants are 1.11%, those between grade 5 and 9 are 6.37%, and those above grade 9 are 12.30%. Concerning age, on average households are sending more young members to the urban locations. For example, migrants from rural Khulna to urban Dhaka with age below 26 as a proportion of non-migrants are 10.36%, those between 26 to 40 are 6.97%, those between 41 to 55 are 2.10%, and those above 55 are 1.55%.

2.4.4 Location Specific Economic Attributes

As discussed earlier risk averse migrants are more likely to migrate to destinations with higher average incomes and lower standard deviation of income. Income squared is included to account for risk aversion effects associated with income. Table 2.4 presents average monthly wage in US dollar and standard deviation of monthly salary for rural agricultural and urban informal sector by region. The table shows that an area's average monthly income, as well as its volatility, is higher in the urban informal sector than the area's rural agricultural sector. Noticeably, at both rural and urban Dhaka, average monthly income is very close. Dhaka is the most developed region and urban areas at Dhaka are by far the largest in the country. Thus both rural and urban areas in the Dhaka region are homogeneous with respect to agricultural and informal average incomes.

Table 2.5 presents average monthly wage in US dollar and standard deviation of monthly salary for rural agricultural and urban informal sector by gender, age and education. As age goes up, income in both rural agriculture and urban informal sectors initially increases and eventually declines. As the level of education increases, income in the urban informal sector goes up significantly, but rural agricultural sector's average income is similar irrespective of the level of education. Finally, men are earning higher than their female counterpart in both the rural agricultural and urban informal sectors. On average, a male working in the urban informal sector receives more than an individual with similar attributes working in the rural agricultural sector. However, on average, a female receives the same level of income at both rural and urban locations.

Table 2.6 presents mean and standard deviation of monthly wage in US dollar in a more disaggregated way. First, four columns are for education level below grade 5, the next four columns are

for educational attainment between 5 and 9, and the last four columns are for educational attainment above grade 9. Within each education group, there are four columns 1, 2, 3 and 4 representing age below 26, between 26 and 40, between 41 and 55 and above 55, respectively. The first eight rows are for females in urban informal, the next eight rows are for males in urban informal, the next eight rows are for women in rural agriculture, and the last eight rows are for male rural agricultural. From theory, each region's average individual monthly income in the urban-informal-sector is higher than the rural sector with higher standard deviation. Within these eight rows, there are four areas and each contains one row for mean wage and one row for the standard deviation of wage.

In line with Table 2.4 and Table 2.5, Table 2.6 shows that, in almost all cases, a male working in the urban informal sector earns more than a man with the same age and education level working in the rural agricultural sector. In most cases, this is also true for female individuals. Table 2.6 is also consistent with Table 2.5 in that both male and female earnings are initially increasing with age up to a certain level and then decreasing. Both male and female earnings rise in educational attainment for all locations.

2.4.5 Risk Diversification and Cost

The correlation of income between the rural agricultural sector and the urban informal sector is included as an indicator of potential benefit from risk diversification. Theory predicts that higher income correlation between these two sectors discourages households from sending members to urban areas. Correlation is measured from the fitted value of the estimated wage for rural and urban areas by region to eliminate the unobserved part. We then take the average of the fitted value by age, gender, and age. This process generates four rural and four urban vectors of wage each containing 24 observations followed by 16 correlation values between rural agricultural and urban informal sector. The values of correlation vary between 0.0701 to 0.9944 with a mean value of 0.7003 reported in Table 2.7. The corresponding value of correlation for the households who choose not to send any member to the urban locations is one.

The natural log of distance between the rural region and the urban region is included as a proxy for the direct economic costs and indirect psychological costs of sending rural household members to urban locations. Within each region, there are some sub-regions known as districts. Distance is

measured in kilometers between district headquarters and regional headquarters. Table 2.8 presents the distance between rural and urban areas of different regions in kilometers taking the average by the district. Distance varies between 93.41 km to 528.56 km with a mean value of 273.49 and standard deviation of 117.19.

2.5 Empirical Results

This section first presents the empirical results of multinomial conditional logit estimation for the full sample with and without household specific variables. We then present multinomial conditional logit estimation results for different sub-samples based on gender, age and education to check the robustness of the estimation.

2.5.1 Wage Estimation by Location

An individual's wage earning depends on their observed characteristics and unobserved attributes. To eliminate the observed part, we estimate individual's wage earning with all the individual specific observed attributes, for each location. The reason for this is that income risk depends only on unobserved characteristics, but we want to estimate the income correlation between each rural agricultural sector and the urban informal sector based only on the observed attributes. For each region, there are two locations: rural and urban. The only individuals who work in the rural area are considered to be in the agricultural sector and, the people who worked for the urban location, are considered to be in the informal sector. Table 2.9 presents the estimation results of the wage equation for both the rural agricultural sector and the urban informal sector across all the four regions.

Coefficients of the natural log of the number of days worked and male latent variables are strictly positive and statistically significant at 1% for all the locations, portraying that a male individual earns more than a female individuals and also works more days, the higher the earning is. Sign for the rest of the variables is not consistent and also not significant over the different locations. First, different attributes may have a different effect in the rural and urban areas. Second, the primary objective of estimating the wage equation over different areas is to eliminate the observed part of the income risk calculation, not to analyze the effect of these attributes on individuals earnings.

After estimation, we store the residual and fitted values of each location, and then we calculate the standard error of the residuals and the average of the fitted values for each location by gender, age and education level. The average fitted values are than used to calculate the correlation between the rural agricultural sector and urban informal sector.

2.5.2 Multinomial Conditional Logit Estimation

The multinomial conditional logit model described earlier section is estimated with and without household specific variables. Estimated coefficients are presented in Table 2.10. The results for most of the explanatory variables are consistent with the theoretical predictions and statistically significant at 1%. Results indicate that households are more likely to send a member to the destination with higher average monthly incomes. The coefficient of the average income variable with and without household specific variables specifications are 5.229 and 2.021, statistically significant at 1% and 10%, respectively. Results show that household specific variables also have an indirect effect on migration decision. The inclusion of those variables in the model increases the coefficient of the average income variable by more than 150%. A one dollar increase in the average destination income enhances the probability of sending a member to the urban location by 5.229%. The coefficients of the squared term of the average income variable without and with household specific variables specifications are 0.848 and -0.294, respectively. In contrary with our prediction, the first one shows a positive effect of the square of income variable on the probability of migration but the inclusion of household specific variables support it. But, both are statistically insignificant even at 10%. Though the magnitude is insignificant, our results confirm that on average households are risk averse.

For both specifications income risk, σ, the standard deviation of monthly income by age, gender, and education, has the expected sign and is statistically significant at 1%. The coefficient of σ is -2.278 and -1.361 for with and without household specific variables, respectively. Results indicate that a household prefers a location with less volatile income for sending a member to work. Income correlation between the rural agricultural sector and the urban informal sector, ρ, also has the expected sign and is statistically significant at 1%. The coefficient of ρ is -3.3961 and -3.993 for both specifications a result that supports the theoretical prediction of the model that households are diversifying their risk by sending members to one of the four urban locations.

The empirical model includes two proxies for the unobserved cost of migration: *lndist*, the distance between rural and each urban location, and $Non - mig$ which identifies the decision to stay in the rural origin location. These unobserved costs include information costs, psychological costs, and costs associated with adaptability to different cultures. Both reduces the probability of household sending a member to an urban location. The coefficient of *lndist* is -5.415 and -5.947 for with and without the household-specific variables, and significant at 1%, respectively. The coefficient of $Non - mig$ is -29.61 and -29.76 for both specifications, and significant at 1%, respectively. That supports previous studies that find that rural households don't prefer to send members to distinct urban regions. The magnitude of both *lndist* and $Non - mig$ coefficients suggests that unobserved costs of moving are necessary for households in their decision to send a member to urban locations.

Destination-specific fixed effects are included to capture unobserved economic and non-economic location factors associated with migration decision. All the destination-specific latent variables are positive and statistically significant at 1% for both specifications. The magnitude of the coefficients is comparatively large in both specifications, indicating that the urban locations are more attractive destinations than the omitted rural origin. The sign of the coefficients of all the five household specific variables are as expected, and the coefficients are statistically significant at 1%. Coefficients of *lnspace* and *Owner* are -0.496 and -1.001, indicating that a better standard of living at the current location reduces the probability of sending a member to the urban area, respectively. Coefficients of $Male$, $Agegroup1$, and $Agegroup2$ are 2.348, 1.021 and 0.555, indicating that, on average, young households and households with a male head have a higher probability of sending a member to an urban location, respectively. We perform the Hausman test and the likelihood ratio test on the model with and without household specific variables both tests reject the model without household specific variables at 1% level of significance. Hausman Chi^2 and Likelihood-Ratio Chi^2 are 474.09 and 983625.40; this is sufficient to reject the model without household specific variables.

2.5.3 Robustness Check

To check the reliability of the empirical model, Table 2.11 and Table 2.12 present the estimation results of the model with household specific variables for different sub-sample on household head's gender, level of education, the average age of the household, whether the household produces crop,

livestock, fish, level of income, own cultivable land or not, and whether they operate land or not. The sign of the coefficients is in line with earlier results and stable in most of the sub-samples. The coefficients of average income for all the sub-samples are positive except for the high income and male sub-sample, but both are statistically insignificant. The coefficient for the sub-sample with the female household head is 35.00, which is significantly higher than any other sub-sample indicating that an increase in urban informal average income increases the probability of sending a member to an urban location. But this probability is higher for the sub-sample where the household head is female, explained by the fact that female individuals are earning at the same level in both rural agricultural sector and urban informal sector.

The coefficient of the square of average income is negative but insignificant for the entire sample with household specific variables. Out of sixteen sub-samples, nine are positive with only one significant and 7 are negative with five significant. The results indicate that households with a female head, average age less than 36, does not produce crop, livestock, fish, low income, own cultivable land and operate land are risk averse. Supporting the theory and earlier results, the coefficients of σ are negative for all the sub-samples, vary between -0.62 and -9.705, and are statistically significant at 1% except for the male household head and high-income sub-sample. Similarly, the coefficients of ρ are negative, vary between -2.948 and -6.235, and statistically significant at 1%. The results indicate that all households are taking migration decision to diversify income risk.

The coefficients of the two proxy variables for unobserved cost and four destination specific fixed effect latent variables are negative and positive, stable between the sub-samples and statistically significant at 1%, respectively, a finding indicating that unobserved costs play a major role in the household decision to send members to urban locations, and urban areas are more attractive compared to the rural locations. All the coefficients of household specific variables are also consistent with previous results and stable over the different sub-samples. One noticeable result is that younger households have higher probabilities of sending members to an urban location for both male and female headed households. However, this chance is greater in magnitude for the male headed households sub-sample.

2.6 Summary

This chapter employs multinomial conditional logit estimation to study the diversification motive for migration, where households as whole take decisions to send members to an urban location to diversify income risk, using household level data from Bangladesh for 2010. Households that decide to send a member to urban location based on both locations specific and household specific variables. The novelty of this chapter lies in its use of micro-level data with both alternative specific and household specific variables to endorse the portfolio theory of migration which is one of the few studies in the existing literature. Results are supporting that wage difference, uncertainty of wage and correlation of wage between rural agricultural and urban-informal sector with cost of migration play an important role to make decision of migration and decision of destination of migration.

2.7 Tables

Table 2.1: Number of Household by Region

Region	Total	Rural	No Migrant	Migrant
Chittagong	3,060	2,080	1,964	115
Dhaka	3,540	2,100	1,978	121
Khulna	2,780	1,780	1,639	140
Rajshahi	2,860	1,880	1,810	70
Total	12,240	7,840	7,391	446

Table 2.2: Rural to Urban Migration Flow

		Urban				
		Chittagong	**Dhaka**	**Khulna**	**Rajshahi**	**Total**
Rural	**Chittagong**	91	58	7	2	158
	Dhaka	10	133	7	2	152
	Khulna	22	126	22	3	173
	Rajshahi	4	55	5	21	85
	Total	127	372	41	28	568

Table 2.3: Flow of Migration (Percentage of Non Migrant) by Region, Gender, Age and Education

Rural	**Urban**															
	Chittagong				Dhaka				Khulna				Rajshahi			
Age	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Chittagong	5.63	6.62	3.54	1.99	5.81	3.00	1.27	0.66	0.70	0.16	0.51	0.00	0.00	0.16	0.25	0.00
Dhaka	0.61	0.38	0.00	0.61	6.76	5.05	2.94	3.64	0.37	0.29	0.15	0.00	0.00	0.19	0.00	0.00
Khulna	1.39	1.42	0.52	0.00	10.36	6.97	2.10	1.55	0.60	1.30	1.22	0.52	0.40	0.00	0.17	0.00
Rajshahi	0.70	0.00	0.00	0.00	4.23	2.61	0.88	1.03	0.53	0.22	0.00	0.00	1.23	1.20	0.35	0.52
Total	1.96	1.68	0.78	0.57	6.69	4.49	1.88	1.70	0.53	0.49	0.46	0.14	0.37	0.41	0.18	0.14
Education	**5**	**6**	**7**		**5**	**6**	**7**		**5**	**6**	**7**		**5**	**6**	**7**	
Chittagong	1.11	6.37	12.30		0.87	5.84	4.81		0.12	0.53	0.80		0.12	0.18	0.00	
Dhaka	0.15	0.53	0.68		3.08	7.00	6.68		0.00	0.40	0.68		0.00	0.00	0.34	
Khulna	0.29	2.27	0.95		2.42	9.70	8.81		0.68	0.76	2.38		0.00	0.15	0.48	
Rajshahi	0.08	0.35	0.28		1.07	3.47	5.79		0.08	0.35	0.55		0.69	1.39	1.10	
Total	0.33	2.23	3.16		1.94	6.64	6.61		0.20	0.51	1.09		0.22	0.39	0.46	
Gender	**F**	**M**			**F**	**M**			**F**	**M**			**F**	**M**		
Chittagong	1.44	5.72			4.31	3.18			0.00	0.45			0.00	0.13		
Dhaka	0.00	0.45			1.16	5.70			0.00	0.31			0.00	0.09		
Khulna	0.70	1.09			2.81	6.45			0.00	1.20			0.00	0.16		
Rajshahi	0.00	0.21			1.17	2.67			0.00	0.26			0.00	1.10		
Total	0.40	1.62			2.06	4.60			0.00	0.54			0.00	0.37		

Note: **1**, **2**, **3** and **4** respectively stands for age below 26, between 26 to 40, between 41 to 55 and above 55. **5**, **6** and **7** respectively stands for education level below grade 5, between grade 5 to 9 and above grade 9. **F** and **M** stands for female and male.

Table 2.4: Mean and Standard Deviation of Monthly Wage in US Dollar by Region

Region	**Stat**	**Rural-Agricultural**	**Urban-Informal**
Chittagong	Mean	55.20	73.99
	Std	26.05	41.61
Dhaka	Mean	50.11	62.98
	Std	19.75	40.34
Khulna	Mean	38.78	59.59
	Std	23.29	33.57
Rajshahi	Mean	39.93	58.40
	Std	14.06	38.52

Table 2.5: Mean and Standard Deviation of Monthly Wage in US Dollar by Gender, Age and Education

Age	**Stat**	1	2	3	4
Rural	Mean	42.60	46.39	45.37	41.57
	Std	18.30	22.02	23.12	19.03
Urban	Mean	54.61	68.72	68.41	58.78
	Std	32.70	38.28	44.26	48.79
Education	**Stat**	1	2	3	
Rural	Mean	44.93	43.16	36.45	
	Std	21.16	22.50	9.09	
Urban	Mean	58.90	69.69	119.72	
	Std	33.41	42.75	77.64	
Gender	**Stat**	Female	Male		
Rural	Mean	27.47	46.15		
	Std	19.37	20.79		
Urban	Mean	26.29	68.26		
	Std	29.12	38.11		

Table 2.6: Mean and Standard Deviation of Monthly Wage in US Dollar by Region, Gender, Age and Education

Location	Gender	Education	Stat	Below grade 5				Between grade 5 to 9				Grade 10 and above			
		Age		1	2	3	4	1	2	3	4	1	2	3	4
Rural	Female	Chittagong	Mean	18.60	45.35	29.80									
			Std	3.50	55.51	7.57									
		Dhaka	Mean		43.40	27.90									
			Std		14.47	15.18									
		Khulna	Mean		18.29	21.13	29.47		14.45						
			Std		6.90	9.81	2.83		5.80						
		Rajshahi	Mean	26.65	25.45	25.29	30.66	28.21							
			Std	12.50	12.04	12.44	15.66	10.26							
	Male	Chittagong	Mean	50.84	59.04	63.03	50.94	50.55	59.37	69.83	38.44				
			Std	23.47	20.93	29.98	21.48	21.00	21.83	31.56	14.41				
		Dhaka	Mean	47.11	52.37	51.85	47.62	46.37	57.65	60.62					
			Std	15.69	19.57	16.55	18.42	17.13	43.26	21.23					
		Khulna	Mean	36.67	45.41	39.36	36.54	34.43	35.66	42.14	41.32				
			Std	14.30	27.22	26.04	21.11	17.10	13.99	20.68	28.86				
		Rajshahi	Mean	41.10	43.92	41.96	35.44	39.86	40.16	42.58	36.48		42.23	42.35	
			Std	12.71	14.23	12.30	10.00	14.62	11.32	20.82	9.10		6.83	3.24	
Urban	Female	Chittagong	Mean	64.66	28.65	18.60		9.54	25.04						
			Std	6.47	15.25	11.12		4.13	25.29						
		Dhaka	Mean	33.14	20.86	45.91	23.25	19.07	22.53	14.31					
			Std	53.41	8.19	73.80	3.58	20.65	13.31	10.12					
		Khulna	Mean	11.44	25.83	20.01	21.75	29.48	51.72						
			Std	6.00	28.98	20.53	11.76	27.53	30.17						
		Rajshahi	Mean	21.87	26.25	22.40	22.91	30.71	15.98						
			Std	16.95	20.01	11.81	16.41	25.75	6.65						
	Male	Chittagong	Mean	67.82	81.69	79.49	61.31	70.88	99.07	128.76				55.79	
			Std	34.41	40.54	35.52	34.51	29.97	39.53	76.60				18.21	
		Dhaka	Mean	53.24	69.37	63.98	71.75	59.95	95.55	68.94	59.25	129.47	105.87	115.45	
			Std	25.31	27.95	29.54	25.50	27.07	52.55	34.76	28.36	89.07	28.32	89.57	
		Khulna	Mean	50.13	66.93	71.46	59.96	53.95	69.75	86.20	42.16		100.57	108.69	
			Std	26.31	24.52	32.23	36.62	25.08	27.76	46.22	21.87		44.52	48.21	
		Rajshahi	Mean	49.42	61.46	62.08	50.08	55.96	64.34	95.75	61.76		103.24		184.69
			Std	22.82	28.66	29.14	31.55	28.90	30.14	62.18	26.33		50.56		135.09

Note: 1, 2, 3 and 4 respectively stands for age below 26, between 26 to 40, between 41 to 55 and above 55. For each location first row is the mean wage and the second row is the standard deviation of wage.

Table 2.7: Correlation between Rural to Urban Locations

		Urban			
		Chittagong	**Dhaka**	**Khulna**	**Rajshahi**
Rural	**Chittagong**	0.4676	0.2776	0.1113	0.0701
	Dhaka	0.8958	0.8046	0.6794	0.6394
	Khulna	0.9178	0.9759	0.9946	0.9909
	Rajshahi	0.9534	0.8629	0.7881	0.7748

Table 2.8: Distance between Rural to Urban Locations in Kilometers

		Urban			
		Chittagong	**Dhaka**	**Khulna**	**Rajshahi**
Rural	**Chittagong**	199.6	213.67	332.2	436.13
	Dhaka	312.12	93.41	224.47	251.47
	Khulna	378.69	188.31	113.25	288.44
	Rajshahi	528.56	288.81	364.63	162.06

Table 2.9: Wage Estimation by Location

Coefficient	**Chittagong**		**Dhaka**		**Khulna**		**Rajshahi**	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
lndaysw	1.051***	0.785***	0.879***	0.569***	1.044***	0.837***	0.826***	0.883***
Male	0.408***	1.256***	0.410***	0.737***	0.479***	1.028***	0.311***	0.864***
*Age*2	0.0341	0.0467	0.0913	0.353**	0.0732	0.177**	-0.048	0.0174
*Age*3	0.0872	-0.0947	0.114	0.287*	0.0944*	0.297***	-0.0568	0.159**
*Age*4	-0.111	-0.137	0.0145	0.0971	-0.0426	-0.00804	-0.125***	-0.0789
Muslim	0.0173	0.0574	0.0107	-0.0493	0.0839**	-0.0421	0.0628**	0.0725
Married	0.117*	0.299**	0.177**	0.0195	0.07	0.226**	0.0930**	0.0951
*Edu*2	0.011	0.126	-0.00523	0.219**	0.00894	0.148**	0.0174	0.115*
*Edu*3	-0.681***	-0.0278	-0.390***	0.143	0.221	0.519***	-0.114***	0.783***
HHead	-0.0351	-0.0821	-0.0786	0.573**	0.00564	0.123	0.0319	0.108
Child	-0.017	-0.0335	0.0531	0.599**	0.0425	0.241*	0.0406	0.0921
Constant	0.245	0.309	0.529	0.837**	-0.250*	-0.125	0.694***	0.0301
Observations	384	283	434	422	500	410	781	427
R^2	0.573	0.428	0.376	0.521	0.656	0.499	0.504	0.476

Table 2.10: Multinomial Conditional Logit Estimation for Rural-Urban Migration Decision to Diversify Risk, Full-Sample

Coefficients	**A**	**B**
$\bar{w}$	2.021*	5.229***
$\bar{w^2}$	0.848	-0.294
σ	-1.361***	-2.278***
ρ	-3.961***	-3.993***
$lndist$	-5.947***	-5.415***
$Non-mig$	-29.76***	-29.61***
$Chittagong$	27.59***	23.06***
$Dhaka$	28.32***	23.75***
$Khulna$	25.11***	20.57***
$Rajshahi$	26.53***	21.83***
$lnspace$		-0.496***
$Owner$		-1.001***
$Male$		2.348***
$Agegroup1$		1.021***
$Agegroup2$		0.555***
$Obs.$	36,250	36,250
$PseudoR^2$	0.86	0.874
$Wald\chi^2$	$1231.92^1 * **$	$814.32^1 * **$
Hausman Test		
A = Inconsistent under H_a, Efficient under H_o		
H_o: Difference in coefficients not systematic		
$\chi^2(10) = 0.47^1$***		
Likelihood-Ratio Test		
$LR \quad \chi^2(5) = 983.63^1$***		

*** p<0.01, ** p<0.05, * p<0.1

Note: 1 in thousands.

Table 2.11: Multinomial Conditional Logit Estimation for Rural-Urban Migration Decision to Diversify Risk, Sub-Samples

Coefficients	**Male**	**Female**	**Age** < 36	**Age** > 35	**Edu** < 5	**Edu** > 4
$\bar{w}$	-2.524	35.00***	9.990***	2.557*	3.413*	3.813*
$\bar{w^2}$	2.887***	-12.45***	-1.998**	0.716	0.944	0.358
σ	-0.62	-9.705***	-3.915***	-1.357***	-1.424***	-3.088***
ρ	-2.948***	-6.235***	-4.360***	-3.774***	-3.933***	-3.636***
$lndist$	-5.520***	-4.294***	-5.802***	-5.263***	-5.976***	-4.221***
$Non-mig$	-30.85***	-30.66***	-28.72***	-30.62***	-30.11***	-27.31***
$Chittagong$	22.51***	14.37***	23.27***	22.88***	25.78***	19.18***
$Dhaka$	23.32***	16.36***	24.24***	23.39***	26.72***	19.70***
$Khulna$	20.29***	12.21***	20.52***	20.49***	23.24***	16.98***
$Rajshahi$	20.74***	14.61***	22.73***	21.32***	24.81***	17.55***
$lnspace$	-0.450***	-0.508**	-0.621***	-0.367***	-0.398***	-0.548***
$Owner$	-1.075***	-1.124*	-1.109***	-0.919***	-1.256***	-0.651
$Agegroup1$	1.419***	0.503*			0.691***	1.953***
$Agegroup2$	0.662***	0.248			0.425***	0.813***
$Male$			2.992***	1.789***	1.991***	4.124***
$Obs.$	32,130	4,120	22,715	14,465	24,970	11,280
$PseudoR^2$	0.891	0.828	0.911	0.818	0.889	0.85
$Wald\chi^2$	959.66^1***	1.75^1***	485.30^1***	472.23^1***	638.06^1***	267.04^1***

*** p<0.01, ** p<0.05, * p<0.1

Note: 1 in thousands.

Table 2.12: Multinomial Conditional Logit Estimation for Rural-Urban Migration Decision to Diversify Risk, Sub-Samples

Coefficients	**Produce Crop**		**Livestock-Fish**		**Low Income**		**Own Cultivable**		**Operate Land**	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Low**	**High**
$\bar{w}$	1.97	9.363***	3.626***	12.81***	7.641***	-0.241	5.099***	4.065*	6.222***	3.27
$\bar{w^2}$	1.219	-2.035**	0.312	-3.282*	-1.101*	1.647	-0.348	0.75	-0.678	0.769
σ	-1.499***	-3.458***	-1.715***	-4.921***	-2.869***	-1.038	-2.193***	-2.193***	-2.683***	-1.598***
ρ	-3.446***	-4.725***	-3.657***	-5.483***	-4.107***	-3.777***	-3.789***	-4.311***	-3.890***	-4.235***
$lndist$	-5.099***	-5.916***	-5.351***	-5.686***	-5.275***	-6.018***	-4.937***	-6.381***	-5.186***	-5.936***
$Non-mig$	-28.74***	-28.86***	-29.87***	-29.21***	-29.95***	-28.62***	-28.18***	-30.30***	-29.87***	-29.25***
$Chittagong$	22.60***	24.31***	23.32***	22.81***	22.29***	25.34***	21.87***	26.84***	21.53***	26.89***
$Dhaka$	23.10***	25.40***	23.96***	23.61***	22.86***	26.46***	22.32***	27.93***	22.31***	27.37***
$Khulna$	20.36***	21.41***	20.98***	19.51***	19.58***	23.26***	19.72***	23.68***	19.16***	24.15***
$Rajshahi$	20.47***	23.90***	22.12***	21.18***	21.02***	24.11***	20.46***	25.88***	20.73***	24.15***
$lnspace$	-0.437***	-0.572***	-0.453***	-0.682***	-0.532***	-0.510***	-0.396***	-0.639***	-0.451***	-0.574***
$Owner$	-0.202	-1.682***	-0.777***	-1.347***	-0.903***	-1.353***	-0.363	-1.357***	-1.526***	0.374
$Male$	1.963***	2.804***	2.185***	3.320***	2.610***	1.665***	2.295***	2.417***	2.459***	2.334***
$Agegroup1$	0.993***	1.113***	1.023***	1.195***	1.155***	0.625**	0.924***	1.124***	1.123***	0.735***
$Agegroup2$	0.538***	0.586***	0.564***	0.608**	0.635***	0.28	0.559***	0.547***	0.551***	0.521***
$Obs.$	20,665	15,585	28,265	7,985	24,915	11,335	16,825	19,425	26,360	9,890
$PseudoR^2$	0.867	0.887	0.866	0.906	0.872	0.881	0.846	0.9	0.88	0.862
$Wald\chi^2$	557^1***	232^1***	670^1***	143^1***	497^1***	295^1***	414^1***	368^1***	617^1***	197^1***

*** p<0.01, ** p<0.05, * p<0.1

Note: 1 in thousands.

Chapter 3

Remittances as Insurance or Altruism? Evidence from Bangladesh

The global flow of remittance has swelled rapidly in recent years. Though the amount of internal remittance is a mystery, international remittance is one of the important sources of foreign currency for Bangladesh. In this chapter we examine the motivations to remit. In the literature altruism and insurance are the two primary incentives of remittance. We study this to the motive of remittance for both internal and international migrants using HEIS-2010 data sets from Bangladesh. Our results support both the theories. Moreover, it shows that the insurance model is nested in an altruistic model of remittance.

The rest of the chapter proceeds as follows: Section 3.1 discusses the pure insurance and altruistic motives for sending remittance models based on migrants utility maximization. Section 3.2 explains the empirical model and estimation technique. Section 3.3 describes the data source, defines variables of interest and provides summary statistics of the household-specific variables, the migrant-specific variables, within country location and international destination specific variables. Section 3.4 presents and discusses empirical results of both the insurance model and the altruistic mode for both internal and international migrants section 3.5 is the summary.

3.1 Theoretical Model

This section presents a simple model of remittance by migrants to households. The study analyzes the insurance and altruistic motive of remittance. For simplicity, it has assumed that individuals live in a two-period world. In the first period, migrants earn Y_m^1 with certainty, while the second-period income is uncertain. There are two possible states in period two, good and bad. If the good state prevails in period 2 with probability, π, migrants' earn a high income Y_m^{2g}, and if a bad state prevails in period 2 with probability, $(1-\pi)$, migrants' earn a low income Y_m^{2b}. A households' total expected income in both periods is Y_h. Migrant utility depends on each individual's consumption and the per-capita consumption of the household in both periods. There are n non-migrating members in each household. Migrants' and households' first period consumption are respectively denoted by C_m^1 and C_h^1. The second period discounted consumption is respectively C_m^{2j} and C_h^{2j}, where j represents possible states in the second period.

As income in period two is uncertain and migrants may choose to insure themselves against a bad state. A payment of r to the family in period one will ensure a payoff of $t(r)$ in period two. If a bad state prevails in the second period then, $t(r)+Y_m^{2b} \leq Y_m^{2g}$, indicates that migrants ensure their uncertain future income by sending remittance to the family in the first period. It is assumed that the payoff function $t(r)$ satisfies $t'(r) > 0$ and $t''(r) < 0$ and $t(r) \leq Y_m^{2g} - Y_m^{2b}$. Insurance coverage by family increases at a decreasing rate on the insurance premium paid in period one. Under altruism, the transfer from household to migrant is exogenous, independent from the remittance decision. We assume there are additional m number of migrants of a household, who, on average send x dollars to the household in period one. If a bad state prevails in the second period, the household will transfer a total of T dollars to the other m migrants. The household consumes a fraction α of all remittances in the first period and the remainder $(1-\alpha)$ in the second period. We let θ be the migrant's altruistic weight toward the non-migrating household members. The migrant's expected utility is as follows:

$$EU = \theta[lnC_h^1 + \delta lnC_h^2] + (1-\theta)[lnC_m^1 + \delta lnC_m^2] \tag{3.1}$$

where δ denotes relative preference between period one and period two.

A migrant's first-period consumption constrained by the level of remittance sent, r, to the household. The second-period consumption is limited by their level of income in the second period,

Y_m^{2i}, at different states and transfer payments by household in the second period $t(r)$:

$$C_m^1 \leq Y_m^1 - r \tag{3.2}$$

$$C_m^2 \leq \pi(Y_m^{2g}) + (1-\pi)(Y_m^{2b} + t(r)) \tag{3.3}$$

Expected income constraints: The household's first period per-capita consumption, Y_h and total remittance received, $r + xm$, from all migrant members in the first period. The second period per-capita consumption constrained by household expected income, Y_h; total remittance received from all migrant members, $r + xm$ in the first period and total transfer payment made to all the migrant members, $t(r) + T$ in the second period:

$$C_h^1 \leq \frac{Y_h + b(r + xm)}{n} \tag{3.4}$$

$$C_h^2 \leq \pi \frac{Y_h + (1-b)(r + xm)}{n} + (1-\pi)\frac{Y_h - t - T + (1-b)(r + xm)}{n} \tag{3.5}$$

Thus, a migrant chooses an amount of remittance r to maximize own utility, subject to the four constraints (3.2 - 3.5). Optimization problems under altruistic motive result in the following first order conditions:

$$\begin{aligned} \frac{\partial EU}{\partial r} &= -\frac{1-\theta}{C_m^1} + \frac{\theta}{C_h^1}\frac{b}{n} + \pi\frac{\delta\theta}{C_h^2}\frac{1-b}{n} + (1-\pi)\frac{\delta\theta}{C_h^2}\frac{1-b}{n} = 0 \\ or \quad \frac{1-\theta}{C_m^1} &= \frac{\theta}{C_h^1}\frac{b}{n} + \frac{\delta\theta}{C_h^2}\frac{1-b}{n} \end{aligned} \tag{3.6}$$

According to the above equation, if migrant's motive for sending remittance is pure altruism, optimization requires that marginal utility from own consumption is equal to the marginal utility from the household consumption. (3.6) defines an implicit remittance function for altruism:

$$r^A = (Y_m^{ij}, Y_h, \theta, n, m, x, \pi) \tag{3.7}$$

where superscript i and j respectively denotes period and states of the second period.

Using implicit differentiation we obtain the following: $\frac{\partial r}{\partial Y_m^{ij}} > 0$, $\frac{\partial r}{\partial Y_h} < 0$, $\frac{\partial r}{\partial \theta} > 0$, $\frac{\partial r}{\partial m} < 0$, $\frac{\partial r}{\partial x} < 0$, $\frac{\partial r}{\partial n} < 0$ if absolute risk-aversion is sufficiently large and $\frac{\partial r}{\partial \pi}$ ambiguous. Implicit differentiation

suggest that migrants send more remittance with the increase in income irrespective of periods and states. Migrant's altruistic weight towards the non-migrant household members also has a positive effect on remittance. The amount of remittance sent by a migrant decreases with the increase in the household's income, the number of other migrant members, remittance from another migrants and number of non-migrating members.

Now, if migrant members care only about their own consumption and remittance is solely motivated by insurance, $\theta = 0$, then (3.1) collapses to:

$$EU = lnC_m^1 + \delta lnC_m^2 \tag{3.8}$$

Optimization problem under pure insurance motive results in the following first order conditions:

$$\begin{aligned} \frac{\partial EU}{\partial r} &= -\frac{1}{C_m^1} + (1-\pi)\frac{\delta}{C_m^2}t'(r) \\ or \quad C_m^2 &= C_m^1(1-\pi)\delta t'(r) \end{aligned} \tag{3.9}$$

(3.9) suggests that if a migrant's remittance motive is pure insurance, at the optimum, the ratio of period 2 to period 1's consumption of migrant depends on the marginal contribution of insurance premium, relative time preference of consumption and the probability of bad state in the second period.

$$r^I = (Y_m^{ij}, \pi) \tag{3.10}$$

where superscript i and j respectively denotes period and states of the second period.

Using implicit differentiation we obtain the following results: $\frac{\partial r}{\partial Y_m^1} > 0$, $\frac{\partial r}{\partial Y_m^{2g}} > 0$, $\frac{\partial r}{\partial Y_m^{2b}} < 0$ and $\frac{\partial r}{\partial \pi} > 0$. Implicit differentiation suggests that migrants send more remittance with an increase in income in period one, an increase of income in period two if the good state prevails and the probability that in the second period that a bad state prevails. If a bad state prevails, migrants send less remittance with the increase in income in the second period, compared to the good state.

The empirical test can determine the effect of the number of other migrants on individual migrant's level of remittance sent to the household. Under altruistic motive, migrants care about the non-migrating household member's well-being. The presence of other migrants who also send remittance to the household will affect the average remittance level received by the household will

reduce individual migrant's level of remittance forwarded to the household. On the other hand, under insurance motive, the number of other migrants should not affect the amount of remittance sent by a migrant.

The model also predicts that in the altruistic model, higher households earning should reduce the amount of remittance sent by the migrants. Moreover, the model under insurance households earning should not affect the amount remitted by the migrants. The effect of the total number of households on the amount remitted is ambiguous under the altruistic model and neutral under the insurance model. As mentioned earlier, migrant's incomes are proxied by their observed attributes which are gender, education, years of migration and other destination specific variables. Being male, highly educated and a long term migrant is expected to positively affect the earning level of the individual.

3.2 Empirical Specification

The decision to send remittance to the household modeled as the outcome of migrant's utility maximization problem is motivated by insurance or altruistic behavior. Ordinary least squares (OLS) approach is not suitable for this type of model estimation because OLS does not consider the selection process associated with the decision to send positive remittance to households. A Heckman selection model, Heckman (1976), is appropriate since it accounts for the selection issue. The Heckman selection model assumes that there exists an underlying regression relationship:

$$Y_j = X_{jk}\beta_k + \upsilon_{1j} \tag{3.11}$$

where Y_j is a vector containing a log of remittance sent by the jth migrant. For computational purposes, we add one to the level of remittance sent by the migrant than take natural log. X_k are consisting of a k number of migrant-specific and household of the migrant specific independent variables, β_k is a vector of parameters and υ_j is a noise term.

All migrants do not necessarily send remittance to households. The decision to send remittance

to household is captured by the following selection equation:

$$R_j^\star = Z_{jl}\gamma + \upsilon_{2j}$$
$$R_j = \begin{cases} 1 & if \quad R_j^\star > 0; \\ 0 & otherwise \end{cases} \tag{3.12}$$

where $R_j^\star$ is a latent variable that is positive when migrant member send positive amount to the household and 0 otherwise. Z_l consists of l number of independent variables in the selection equation. One notable comment is that X_k variables are a subset of Z_k variables. Variables of interest are discussed in the following section. Noise terms of the above two equations are distributed as following:

$$\upsilon_1 \sim N(0, \sigma)$$

$$\upsilon_2 \sim N(0, 1)$$

$$corr(\upsilon_1, \upsilon_2) = \rho$$

When noise terms of the two equations are related, $\rho \neq 0$, OLS estimation coefficients are biased. In this case, the Heckman selection model estimators are consistent and asymptotically efficient. The log likelihood function of migrant j is $lnL_j = l_j$, where:

$$l_j = \begin{cases} w_j ln\Phi\left\{\frac{z_j\gamma + (y_j - x_j\beta)\rho/\sigma)}{\sqrt{1-\rho^2}}\right\} - \frac{w_j}{2}(\frac{y_j - x_j\beta}{\sigma})^2 - w_j ln(\sqrt{2\Pi\sigma}) & Y_j = observed \\ w_j ln\Phi(-z_j\gamma) & Y_j = unobserved \end{cases}$$

where $\Phi(\cdot)$ is the standard cumulative normal and w_j is an optional weight for observation j.

Probit estimates of the selection equation follows:

$$Prob(Y_j \quad obseved|Z_j) = \Phi(Z_j\gamma)$$

This computes the inverse of the Mills' ratio, m_j, for each observation j as following:

$$m_j = \frac{\phi(Z_j\hat{\gamma})}{\Phi(Z_j\hat{\gamma})}$$

where ϕ is the normal density. We then define:

$$\delta_j = m_j(m_j + \hat{\gamma} Z_j)$$

The estimation model performs regression only for the migrants who have remitted a definite amount, (when $R_j = 1$). The selection bias is initially considered as a missing observation of the dependent variable problem and reformulated as an ordinary omitted explanatory variable. The Heckman procedure has two steps: first, it estimates the decision to send remittance by probit estimation and then calculates an inverse Mill's ratio and second, it includes the inverse Mill's ratio as an additional regressor in the regression equation to control for the bias due to missing observation non-randomly.

Heckman selection estimation generates an additional parameter β_m on the Mills' ratio. A consistent estimate of variance is obtained using residuals from the augmented regression and the parameter on the Mills' ratio,

$$\hat{\sigma^2} = \frac{e'e + \beta_m^2 \Sigma_{j=1}^{N} \delta_j}{N}$$

The Heckman estimate of ρ is

$$\hat{\rho} = \frac{\beta_m}{\hat{\sigma}}$$

3.3 Data and Summary Statistics

This section first discusses the source of the data and how the sample of potential migrants is selected then, discusses how the variables of interest generated. Finally, it presents summary statistics of all the variables of interest of all households, the households with internal migrant member and households with the international migrant member.

3.3.1 Data Source and Selection Criteria

We use the Household Income and Expenditure Survey (HIES) data from Bangladesh, managed and developed by Bangladesh Bureau of Statistics (BBS) to examine the motivation for sending remittance by migrants (both internal and international). HIES is available for the following years 1995, 2000, 2005 and 2010 providing an opportunity to do panel analysis. But, there are two

significant limitations of the survey over the periods, which hinders incorporation of the time dimension in this study. First, there is no indicator to identify households over study periods. Second and more importantly, HIES of Bangladesh reports migration related detail information of households only for 2010.

Due to data limitation, this study examines the decision of migrants sending remittance as a utility maximization problem motivated by insurance or altruism, using cross-section data. One of the advantages of this data set is that HIES data provides detailed information on whether households have any members migrating to other location within country or outside the country, total number of migrant members, whether they receive cash remittances, and if so how much, where they invest remittance received, total tangible assets, income from different sources, household's location of origin, place of migrant's destination, location-specific attributes, other household and migrant specific attributes. Allowing us to do a micro-level analysis of the decision of migrants to send remittance to household motivated by insurance or altruism.

The HIES 2010 reports a total of 12,240 households out of which 7,840 live in different rural areas. This study examines the motive of migrants (both inter-country and international) sending remittance. There is a total of 2,100 migrants within the households, and some households have multiple migrants. Out of this 2,100 migrants, 728 migrate within the country, and 1,372 migrate outside the country. Out of 1,372 international migrants, 123 have reported their destination of migration as other. Due to missing information, we have to exclude them from this study. We examine the motivation of sending remittance based on 728 internal migrants and 1,249 international migrants. 695 of the 728 internal migrants and 1,217 of the 1,249 international migrants send remittance to their household.

In Bangladesh, there are seven administrative regions each containing disjointed rural and urban locations. Further Bangladesh is divided into sixty-four small administrative areas know as districts. To capture origin specific attributes we include district level population density for both internal and international remittance models. BBS also provides the population density of Bangladesh by the district. As unobserved characteristics play a role in migration decision, we include origin specific fixed effect latent variables. For the international remittance model, we include one source location specific, international migration rate of households and two international destination specific variables, employment to population ration over age 15 and labor force participation rate.

International destination specific variables are obtained from the World Development Indicators, reported by the World Bank.

3.3.2 Variables of Interest

In the model, the amount remitted by a migrant depends on the income level of both households and migrants, number of total members in the household, number of migrant members, additional remittance received by the household from other migrant members of the household, altruistic weight of migrant on household, and probability of a bad state occurring in the second period. HIES 2010 of Bangladesh reports household incomes from various sources: wage, salary, agricultural activity and business profit. It reports the amount of money sent by each migrant to their household as remittance but not their income. We can use migrants' observed characteristics as a determinant of their income level following the standard human capital model.

HIES 2010 not only reports migrant's gender and location, but years of education and migration. In particular, income depends on the migrant's skill level. All these factors are incorporated in the model using some latent variables. We proxy the skill level of the migrant using four education level latent variables, $Edu1$, takes one if migrant have not attended school at all and 0 otherwise, $Edu2$, takes one if migrant has attended school between grade 1 and 5 inclusive, and 0 otherwise, $Edu3$, takes one if migrant has education between grade 6 and 12 inclusive, and 0 otherwise, $Edu4$, takes one if migrant has education beyond grade 12 and 0 otherwise. We proxy the experience of the migrant using two years of migration latent variables, $Yearsm > 1$, takes one if the migrant migrated more than a year ago and 0 otherwise, $Yearsm > 5$, takes one if the migrant relocated more than five years ago and 0 otherwise. Typically, gender also affects the level of income through a variety of channels. *Gender* takes one if the migrant member is a male and 0 otherwise.

Beyond the migrant income proxies, we also include some origin specific variables. *lnpopd*, is a natural log of population per square kilometers by district, $Intmig$ is a ratio of number of households having at least one migrant member over total number of households in each region by rural and urban locations, *Rural*, equal to one if the migrant's household origin is rural, zero otherwise and origin-specific fixed effect to capture unobserved factors associated with the origin. Migrant's expected level of income and risk also depends on the destination of migration. To obtain the variable for risk we include employment to population ratio over age 15, $ETPR$, and labor force

participation rate, $LFPR$, of migrant's international destination is included.

When migrants are sending remittance to households for altruistic motives, the amount of remittance also depends on household specific attributes. Household-specific variables included as follows; natural log of household's per-capita income, $lnhpcinc$, is generated by adding income of a household from all different sources then divided by the number of total members in the household and taking the natural log of it. The natural log of household's total land owned, $lnland$, number of total members migrated, $Nmig$, number of children, below age 5, $Ncb5$, average age of all children of the household age between 6 and 15 inclusive, $CAage$, ratio of children attending school to total number of children between 5 and 15 inclusive, $Schooling$, this can take a value between 0 and 1, number of male members above age 15, $Nmg15$ and household age, $HHage$. We also include a number of latent variables to take into account how the household uses the remittance sent by the migrant member; $Riconst$, takes one if household use the remittance for construction, $Rimarri$, takes one if household uses the remittance for the expense of a member's marriage, $Riconsu$, takes one if household uses the remittance for consumption and zero otherwise.

Notably, not all the variables are used in all specifications. Household-specific variables are used only for altruistic models because the insurance motive of remittance does not depend on household specific attributes. Similarly, international location specific variables and ratio of households with international migrant members are used only for international remittance models. In the first step, the dependent variable, R_j, is a latent variable which takes value one if the migrant member sends remittance to the household and zero otherwise. In the second step, the dependent variable, Y_j, is the natural log of remittance sent by the migrant member. For computational convenience, we add one to the amount of remittance and then take the natural log. For the international remittance model, these two variables based on international migrant's information. Similarly, for internal remittance model these two variables based on only internal migrant's information.

3.3.3 Descriptive Statistics

In this section, we discuss the descriptive statistics of all the variables of interest. Table 3.1 reports descriptive statistics of all the concerned household specific and migrant specific variables for all households. Table 3.2 presents district specific population density. Table 3.3 presents international migration rate of households by rural and urban locations of seven regions of Bangladesh.

Table 3.4 presents international destination specific variables.

Household and Migrant Specific Variables

Household and Migrant Specific Variables are shown in Table 3.1. The first column includes all the households with and without migrants and the second column includes only the households without migrants. There are some households with multiple migrants. For convenience, households with multiple migrants considered as multiple households. Initially, there were 12,240 households and after conversion, it becomes 12,652 households. The last four columns report attributes of the household as well as the attributes of the migrant who, at the time of the survey, had lived away from the household and is reported as a migrant by the household. Third and fourth columns are the internal migrants, and last two columns are for the international migrants. Fourth and sixth columns are the migrants who send remittance to the household.

Note that only 5.49% of the households receive remittances from internal migrants among 12,652 households, 79.1% of which are rural households. Compared to that 10.57% of the households receive remittance from abroad, 69.9% of which are rural households. Almost 65% of the household in the entire sample live in the countryside, and more than 70% of the remittance receiving households live in the rural area. The average value of the natural log of remittance sent by internal migrants and international migrants are respectively 5.514 and 7.074, indicating that international migrants send more remittance to households compared to the internal migrants. An average number of migrant members are 1.577 and 1.433 respectively for households with internal migrants and households with international migrants. On average, more members migrate within the country. Households with no transient members on average earn higher per-capita income than both the households receiving remittance from internal migrants and international migrants, but these households own less land.

8.1% of total households, 21.7% of within country remittance receiving households and 5.0% of outside the country remittance receiving households live in Barisal region, which indicates that households residing in Barisal receive remittances relatively more from internal migrants. Further, can be explained by the fact that on average households living in Barisal region are less wealthy and subject to an environmental risk. Which encourages them to migrate within the country in search of better livelihood. At the same time, higher cost of international migration and their

resource constraint does not allow them to migrate to a foreign country. 7.1% of total households, 2.9% of within country remittance receiving households and 9.5% of outside the country remittance receiving households live in Sylhet region indicating that households living Sylhet region receive remittance relatively more from outside the country. Relatively higher number of households living Dhaka and Chittagong receive remittance from both within and outside the country. Whereas the relatively lower number of households live in Khulna, Rajshahi and Rangpur receive remittance from both within and outside the country.

37.3% of within country remittance receiving households and 31.9% out of state remittance receiving households invest the remittance received from the migrant for consumption. Compared to that, 2.9% of within country remittance receiving households and 4.3% out of state remittance receiving households invest the remittance received from the migrant for construction. On the other hand, only 0.3% of within country remittance receiving households and 0.6% of international remittance receiving households invest the remittance received from the migrant for marriage which indicates that households with migrants within the country use the remittance received from the migrant members relatively more on necessity.

The ratio of school-going children to a total number of children is lower for households with internal migrants compare to the households with international migrants indicating that households with international migrants are sending more children to school. The number of male members aged greater than 15 are lower for both households with internal migrants, and international migrants compare to the households with no migrants explaining the fact that adult males migrate more compare to adult females. Other households specific characteristics that may affect the level of remittance are the number children below age 5, the average age of children between 6 and 15 inclusive and age of household head.

Finally, we have used some latent variables unique to migrant attributes. 78.0% of the internal and 77.0% of international migrants migrated more than a year ago. 32.1% of the internal and 28.6% of international migrants migrated more than five years ago. 94.4% of internal and 98.0% of international migrants are male. Among internal migrants 9.6% have no education, 26.4% have education grade between 1 and 5, 50.5% between grade 6 and 12 and 13.5% above grade 12. Among international migrants 9.5% have no education, 25.7% have education between grade 1 and 5, 60.5% between grade 6 and 12 and 4.3% above grade 12 showing that semi-skilled individuals

tend to migrate more outside the country, and high-skilled individuals tend to migrate more within the country.

Within Country Location and International Destination Specific Variables

To capture the origin-specific effect on the decision to send remittances by migrants, we include district level population density per square kilometers by taking its natural log. Table 3.2 presents the level of population density per sqr km by the district. There are 64 districts in Bangladesh, and on average population density per district per square kilometer is 1,108. The capital city of Bangladesh, Dhaka and it's the nearest district Narayanganj are mostly populated respectively by 8,111 and 4,139 persons per square kilometer.These two are the most populated districts in Bangladesh. Khagrachhari, Rangamati, and Bandarban are three hill track districts of Bangladesh with the lowest population density per square kilometer, 225, 97 and 86 respectively.

We include three more location specific explanatory variables to estimate the decision to send remittance of international migrants. International migration rates of households by rural and urban areas of seven regions of Bangladesh, $Intmigr$, is presented in Table 3.3. 25.5% of Chittagong's rural households and 20.3% of Chittagong's urban households have at least one international migrant, by far the highest rate among all regions. In contrast, only 1.0% of rural Rangpur and 1.6% of urban Rangpur households have at least one international migrant.

For those over the age of 15, employment to population ratio, $ETPR$, and labor force participation rate, $LFPR$, of foreign destination country of migrants are presented in Table 3.4. In the sample, out of 1,372 international migrants, 1,249 migrants reported twenty different destinations of countries and rest of them reported other as their destination. To study the decision to remit by international migrants we only consider 1,249 migrants who specifically mentioned their destination of migration. Average of $ETPR$ and $LFPR$ by country is respectively 56.78 and 61.11. Among these twenty countries Qatar has the highest $ETPR$ of 86.3 and $LFPR$ of 86.7. Iraq has the lowest $ETPR$ of 35.8 and $LFPR$ of 42.2.

3.4 Empirical Results

This section first presents empirical results of Heckman selection estimation of the decision to sent remittance by internal migrants for both insurance and altruistic motives. Then, it presents the results for estimation for international migrants again for both insurance and altruistic motives.

3.4.1 Motivation for Sending Remittance by internal Migrants

The Heckman selection estimation results for internal migrants decision to send remittance based on insurance and altruism are presented in Table 3.5. The first two columns report results for the insurance model and last two columns report results for the altruistic model of remittance sent by internal migrants to the household. Both the models are estimated using two equations. First, for the decision to remit and the second for the amount of remittance. The second and fourth columns report results for the probit estimation of the decision to remit. The dependent variable is R_j, which takes one if the migrant sent remittance to the household and 0 otherwise. Column one and three report remittance equation results, where the dependent variable is Y_j, the natural log of one plus the amount of remittance sent by the migrant to the household. Here remittance equation is central in this study.

We examine the internal migrant's insurance motive for sending remittance to the household. If a migrant's sole purpose for sending remittance is insurance, the amount of remittance sent by a migrant depends only on her particular attributes. Variables related to household specific attributes are not included in the model under insurance estimation. All the coefficients of the remittance equation are positive as expected and statistically significant at 1%, except for the no education latent variable, $Edu1$. In line with the theory, estimation results indicate that being male, having higher education and having migrated for more than a year positively affects the amount of remittance sent by the migrant to the household.

As discussed in the last chapter, male individuals earn more than their female counterpart in Bangladesh irrespective of age, education or employment sector which suggests that if there are two migrants identical on all their observed attributes except gender, then the male migrant will send more remittance than the female migrant. Higher education and years of migration indicates better skill and experience of a migrant. Migrants with better skills and expertise are likely to earn more

and send more remittance, compared to the less educated and less experienced migrants. Though the coefficient of $Edu1$, no education, is positive but not statistically significant. Origin-specific factor, *lnpopd*, also plays a vital role in the remittance decision. Higher population density indicates the higher cost of livings at the origin. If a migrant is from a location with higher population density, they will send more remittance to the household. That can explain by the fact that if the migrant decides to go back to the origin in future, they would need more resources to live there.

Next, we examine the internal migrants altruistic motives for sending remittance. If a migrant's reason for sending remittance is purely altruistic, the amount of remittance sent by a migrant depends not only on migrant-specific attributes, but also on the household-specific characteristics. The sign of the coefficients of the remittance equation as expected and most of them are statistically significant at 1%. Consistent with the insurance motive, being male, highly educated, having migrated for more than a year and the population density of origin of the migrant has a positive effect on the amount of remittance sent by a migrant to the household.

With the increase in the number of migrant members, per-capita income and household head's age, the amount of remittance send by migrants reduced. The altruistic motive model of remittance, can be explained by the fact that when a household has multiple migrants, and all the migrants are altruistically motivated, then the household receives remittance from all the migrants which will increase household income and standard of living, but then reduces the motivation for sending remittance by each migrant member. Similarly, when household income is higher, migrants have less incentive to send remittance to the household. Intuitively, the effect of household head age on remittance is ambiguous. The increase in the age of household head age may imply that they are becoming dependent on other members. On the other hand, one may also argue that elder household head has more adult members to support them. The first argument implies that age of household head should have a positive effect on the amount of remittance received, but the latter effect goes the other way. The result of our study suggests that the second effect is dominant.

The natural log of land owned by households, *lnland*, the number of children under age 5, $Ncb5$ and remittance invested for consumption, $Riconsu$, encourage migrants to send more remittance which can be explained by the fact that if a household has more land than they may need more money to develop or utilize those properties. For example, assume that we have two identical households regarding observed attributes with low income. The only difference between these two

households is that one of them has more land than the other. The household with more land may need more money to utilize their land for agricultural, commercial or construction projects. When a household has more children, they need more resources for child care, reducing resources available for other essential needs, therefore migrants are motivated to send more remittances to the household. The former two factors, remittance invested for construction and marriage hurt the amount of remittance sent by a migrant member but are statistically insignificant.

As explained earlier, there is a potential selection bias problem in estimating this type of model by OLS. The Heckman selection estimation provides consistent and asymptotically efficient estimates if noise terms of the two equations are correlated, $\rho \neq 0$. The bottom part of Table 3.5 report *athrho* for pure insurance and altruistic model respectively as -1.310 and -1.150, both statistically significant at 1% which indicates that standard OLS would produce biased estimates. The first likelihood-ratio test statistics reported at the bottom part of Table 3.5, compare the joint likelihood of an independent probit model for the selection equation and a regression model on the remittance sent by the migrants against the Heckman model likelihood. The $LR\chi^2$ is 36.51 and 11.57 respectively for pure insurance and pure altruistic model, both statistically significant at 1%. That justifies the use of Heckman selection model rather than OLS for both models.

Finally, we perform another likelihood ratio test on the altruistic model with restrictions implied by the insurance model. The second likelihood-ratio test statistics reported at the bottom part of Table 3.5, compares the joint likelihood of altruistic and insurance model. The $LR\chi^2$ is 154.78 and statistically significant at 1%, which demonstrates that altruistic model outperforms insurance model. Here we are not rejecting the pure insurance motive of remittance model rather claiming that insurance model nested in the altruistic model. This is in line with Stark & Lucas (1988), Sana & Massey (2005) and Van Dalen *et al.* (2005) which show both altruistic and insurance motive simultaneously determine remittance sending behavior.

3.4.2 Motivation for Sending Remittance by International Migrants

The Heckman selection estimation results of international migrants decision to send remittance based on insurance and altruism presented in Table 3.6. First, two columns report results for the insurance motive and last two columns report results for the altruistic model of remittance by an international migrant to households. As before, both the models are estimated using two equations.

First, for the decision to remit and second for the amount of remittances. The second and fourth column report results for the probit estimation of the decision to remit. The dependent variable is R_j, which takes the value one if the international migrant sends remittance to the household and 0 otherwise. Column one and three report remittance equation results, where the dependent variable is Y_j, natural log of one plus the amount of remittances sent by the international migrant to the household.

We examine the international migrants' insurance motive for sending remittance to the household. If a migrant's sole purpose for sending remittance is insurance, the amount of remittance sent by a migrant depends only on migrant specific attributes. Variables related to household specific attributes ate not included in the model under insurance estimation. We drop $Male$ and $Edu4$ indicator variables from the international migrant's models because respectively 98% and 4.1% of the international migrants are male and with an education higher than grade 12. These are extreme numbers which may cause perfect collinearity with the constant term, and the model can not be estimated. We add two migrant specific variables, time after migration of more than five years, $Yearsm > 5$, and migrant level of education between grade 1 and 5, $Edu2$, for both selection and remittance equations. We include three more location specific variables; ratio of number of households having at least one migrant member over total number of households in each region by rural and urban locations, $Intmig$, employment to population ratio over age 15, $ETPR$, and labor force participation rate, $LFPR$, for only selection equation. Out of these three variables $Intmig$ is origin location specific, and other two $ETPR$ and $LFPR$ are international destination specific.

Consistent with the internal insurance motive estimation results, coefficients of *lpopd*, $Yearsm > 1$ and $Yearsm > 5$ are positive as expected and statistically significant at 1%. The coefficients of $Edu1$ and $Edu2$ are opposite in sign to each other with latter one being negative. Though we expect an adverse effect on the amount of remittance sent by lower education, the coefficient of $Edu1$ is positive but statistically not significant. In line with the theory, estimation results indicate that less educated migrants send the lower amount of remittance to the households. Time after migration of more than a year and more than five years both have a positive effect on the amount of remittance sent by the migrant to the household. As in the case of internal migrants, origin specific factor, *lnpopd*, plays a vital role in the decision to send remittance by international migrants. If a migrant is from a location with high population density, they send more remittance to the household.

Next, we examine the international migrants altruistic motive for sending remittance to households. If migrant's reason for sending remittance is purely altruistic, the amount of remittance sent by a migrant depends not only on migrant specific attributes but also on the household specific characteristics. In addition to the variables in the insurance model here, we add a number of household specific variables. The sign of the coefficients of remittance equation is as expected and in most cases statistically significant at 1%. With the increase in the number of migrant members, $Nmig$, the number of male members age above 15, $Nmg15$, and natural log of household per-capita income, *lnhpcinc*, the amount of remittance sent by migrants falls but increases with natural log of total land owned by the household. These coefficients are statistically significant at 1%, except for *lnhpcinc*. The same argument can explain these as for internal migrants. Consistent with the insurance model, time of migration more than a year and more than five years have a positive effect on the amount of remittance sent by a migrant to the household. Migrant's with a less education send less remittance compared to the educated migrants.

The bottom part of Table 3.6 reports *athrho* for insurance and altruistic model respectively as 0.288 and 0.345. Both are statistically significant at 1%. That indicates that standard OLS would produce biased estimates. The first likelihood-ratio test statistics reported in the bottom part of Table 3.6, compares the joint likelihood of an independent probit model for the selection equation and a regression model on the remittance sent by the international migrants against the Heckman model likelihood. $LR\chi^2$, of pure insurance motive of sending remittance model, is 5.069, statistically significant at 5% and of the pure altruistic motive of sending remittance model is 6.696, statistically significant at 1%. That again justifies the use of Heckman selection model compared to the standard OLS for both insurance and altruistic motive for remittance by international migrants.

As in the internal migrant model, we perform another likelihood ratio test on the altruistic model with restrictions implied by the model under insurance motive. The second likelihood-ratio test statistics reported in the bottom part of Table 3.6, compares the joint likelihood of altruistic and insurance model. $LR\chi^2$ is 126.94 and statistically significant at 1%. Once again, this indicates that the altruistic motive for sending remittance outperforms the insurance model. These results suggest that pure insurance model nested in the altruistic model.

3.5 Summary

In this chapter, we examine the motivation for sending remittance. Two competing theories of remittances flow are the altruistic and insurance models. In this chapter, we discuss a simple and intuitive theoretical model of remittance, where insurance motive is a special case of the altruistic model. The theoretical discussion has followed by giving an empirical specification. Here we argued and showed that standard OLS estimator is a biased estimator for these types of models. Therefore, we use a two-step Heckman selection estimation, where probit estimation has used in the first stage of the selection equation, to get the inverse mill's ratio and then we use the inverse mill's ratio in the second stage on the remittance equation to get an asymptotically consistent estimator.

The model predicts that under pure altruism, an increase in the number of migrant members and total household income reduces the individual migrant's level of remittance sent to the household. By contrast, under insurance, the level of remittance sent by a migrant is independent of the number of total migrant members in the household and total household income. The model also predicts that the effect of a total number of households on the amount of remittance is ambiguous under pure altruistic and neutral under pure insurance. Migrant's incomes are proxied by their observed attributes: gender, location, and years of migration and education. Being male, more educated and greater years of migration are expected to effect a migrant's level of earnings positively.

3.6 Tables

Table 3.1: Household and Migrant Specific Variables

	All	HHs No	Intra -Country		International	
Variables	HHs	Migrant	Migrant	Remittance	Migrant	Remittance
lndremi			5.264	5.514		
lniremi					6.893	7.074
Nmig			1.577	1.574	1.433	1.433
lnland	2.790	2.644	3.558	3.564	3.505	3.511
lnhpcinc	4.425	4.617	3.946	3.920	3.208	3.208
Rural	0.644	0.627	0.787	0.791	0.699	0.699
Barisal	0.081	0.076	0.210	0.217	0.049	0.050
Chittagong	0.188	0.156	0.235	0.239	0.410	0.416
Dhaka	0.288	0.286	0.287	0.283	0.311	0.309
Khulna	0.144	0.158	0.093	0.094	0.065	0.064
Rajshahi	0.126	0.139	0.065	0.056	0.054	0.055
Rangpur	0.102	0.116	0.080	0.082	0.011	0.011
Sylhet	0.071	0.070	0.030	0.029	0.100	0.095
Riconst			0.027	0.029	0.042	0.043
Rimarri			0.003	0.003	0.006	0.006
Riconsu			0.365	0.373	0.313	0.319
$Ncb5$	0.470	0.464	0.346	0.345	0.583	0.586
Caage	6.596	6.590	5.946	5.963	6.985	6.995
Schooling	0.533	0.531	0.472	0.474	0.587	0.589
$Nmg15$	1.388	1.433	1.140	1.142	1.178	1.165
HHage	46.401	45.442	54.488	54.544	49.483	49.370
$Yearsm > 1$			0.780	0.796	0.770	0.784
$Yearsm > 5$			0.321	0.332	0.286	0.291
Male			0.944	0.950	0.980	0.981
$Edu1$			0.096	0.099	0.095	0.096
$Edu2$			0.264	0.260	0.257	0.257
$Edu3$			0.505	0.506	0.605	0.607
$Edu4$			0.135	0.134	0.043	0.041
Observations	12,652	10,552	728	695	1,372	1,337

Table 3.2: District Specific Population Density

District	**Popd**	**District**	**Popd**
Bagerhat	369	*Madaripur*	1,004
Bandarban	86	*Magura*	871
Barguna	481	*Manikganj*	1,000
Barisal	823	*Meherpur*	910
Bhola	517	*Moulvibazar*	679
Bogra	1,154	*Munshiganj*	1,487
Brahmanbaria	1,457	*Mymensingh*	1,156
Chandpur	1,404	*Naogaon*	750
Chittagong	1,421	*Narail*	722
Chuadanga	954	*Narayanganj*	4,139
Comilla	1,719	*Narsingdi*	1,930
Cox'sBazar	913	*Natore*	894
Dhaka	8,111	*Nawabganj*	960
Dinajpur	864	*Netrakona*	786
Faridpur	901	*Nilphamari*	1,152
Feni	1,530	*Noakhali*	853
Gaibandha	1,078	*Pabna*	1,053
Gazipur	1,852	*Panchagarh*	698
Gopalganj	771	*Patuakhali*	471
Habiganj	781	*Pirojpur*	844
Joypurhat	942	*Rajshahi*	1,069
Jamalpur	1,115	*Rajbari*	929
Jessore	1,068	*Rangamati*	97
Jhalokati	795	*Rangpur*	1,210
Jhenaidah	895	*Shariatpur*	970
Khagrachhari	225	*Satkhira*	511
Khulna	522	*Sirajganj*	1,230
Kishoreganj	1,061	*Sherpur*	978
Kurigram	893	*Sunamganj*	666
Kushtia	1,207	*Sylhet*	975
Lakshmipur	1,175	*Tangail*	1,046
Lalmonirhat	1,006	*Thakurgaon*	762

Table 3.3: International Migration Rate of Households

	Rural	*Urban*
Barisal	0.067	0.062
Chittagong	0.255	0.203
Dhaka	0.131	0.096
Khulna	0.053	0.042
Rajshahi	0.057	0.030
Rangpur	0.010	0.016
Sylhet	0.154	0.150

Table 3.4: International Destination Specific Variables

Code	*ETPR*	*LFPR*
Australia	61.90	65.30
Brunei	61.90	64.30
Canada	61.50	66.30
Iran	39.00	44.80
Iraq	35.80	42.20
Italy	43.80	49.00
Japan	56.30	58.90
Korea	58.90	60.80
Kuwait	65.80	68.10
Libya	42.90	53.10
Malaysia	57.50	59.30
Oman	58.80	63.50
Qatar	86.30	86.70
Russia	60.00	63.50
SaudiArabia	49.30	52.20
Singapore	66.10	68.10
SouthAfrica	38.80	51.80
UnitedArabEmirates	76.10	79.30
UnitedKingdom	57.10	62.10
UnitedStates	57.70	62.90

Note: ETPR-Employment to Population Ratio over 15
LFPR-Labor Force Participation Rate

Table 3.5: Heckman Selection Estimation of Remittance sending by internal Migrant's

	Insurance		**Altruistic**	
Coefficient	**Y**	**R**	**Y**	**R**
$Nmig$			-0.166***	-0.123
$lnland$			0.109***	0.0306
$lnhpcinc$			-0.0382*	-0.032
$Yearsm > 1$	0.656***	0.527**	0.731***	0.540**
$Gender$	0.522***	0.823***	0.408*	0.779***
$Edu1$	0.0289	0.893*	-0.133	0.852
$Edu4$	0.442***	-0.425	0.580***	-0.183
$lnpopd$	0.272***	-0.138	0.253***	-0.203
$Riconst$			-0.21	4.602***
$Rimarri$			-0.803	4.073***
$Riconsu$			0.305***	0.209
$Ncb5$			0.205***	-0.119
$HHage$			-0.0143***	-0.000301
$Rural$		-0.22		-0.106
$Chittagong$		0.436*		0.476*
$Dhaka$		-0.0633		-0.0161
$Rajshahi$		-1.061***		-1.031***
$Constant$	2.654***	1.756**	3.476***	2.290**
$Observations$	728		728	
$Athrho$	-1.310***		-1.150***	
$lnsigma$	0.164***		0.132***	
$Lambda$	-1.018***		-0.933***	
$Wald\chi^2$	73.41***		167.7***	
$LR\chi^2$	36.51***		11.57***	
$LR\chi^2(12)$	154.78***			

*** p<0.01, ** p<0.05, * p<0.1

Table 3.6: Heckman Selection Estimation of Remittance sending by International Migrant's

	Insurance		**Altruistic**	
Coefficient	**Y**	**R**	**Y**	**R**
Nmig			-0.160***	-0.166
lnland			0.0799***	0.0637
lnhpcinc			-0.005	0.0235
lnpopd	0.227***	0.0747	0.279***	0.11
$Yearsm > 1$	0.218***	1.162***	0.211***	1.306***
$Yearsm > 5$	0.257***	-0.0707	0.242***	-0.158
*Edu*1	0.029	0.588		0.173
*Edu*2	-0.131*	0.11	-0.167**	-0.194
*Edu*3		0.296		
Rural		0.211		0.197
Chittagong		1.830***		1.752***
Dhaka		-0.169		-0.157
Rajshahi		-0.0497		-0.0682
Intmig		-11.03***		-10.53**
ETPR		0.100**		0.0874**
LFPR		-0.0997**		-0.0859*
Caage			0.00811	-0.0082
*Nmg*15			-0.0520*	-0.116
Riconst				9.069***
Rimarri				6.963***
Riconsu				0.793***
Schooling				0.281
HHage				-0.00215
Constant	5.234***	1.915*	4.837***	1.703
Observations	1,249		1,249	
Athrho	0.288**		0.345***	
lnsigma	-0.0409		-0.0542	
Lambda	0.269**		0.315***	
Wald χ^2	87.02***		129.2***	
LR χ^2	5.069**		6.696***	
LR $\chi^2(8)$	126.94***			

*** p<0.01, ** p<0.05, * p<0.1

Chapter 4

Impact of Remittance on Household's Consumption, Production and Investment Decision: Evidence from Bangladesh

Remittance plays a major role in households' decisions on labor supply, consumption and agricultural production, as well as investments in physical and human capital and schooling. Depending on who receives the remittance it may escalate or diminish economic inequality and play a vital role in economic growth. In this chapter, we investigate the effect of remittance (internal and international) on not only Bangladeshi households' consumption and agricultural production but also investments in human capital and choice of schools.

The rest of the chapter proceeds as follows: Section 4.1 discusses the household-farm theoretical model based on households utility maximization and agricultural production maximization to analyze the effect of remittance on consumption, human capital investment, and production; Section 4.2 explains the empirical model and estimation technique; Section 4.3 describes the data source, defines variables of interest and provides descriptive statistics of household head specific, household-specific, migrant-specific, child specific and crop production variables. Section 4.4 presents and discusses empirical results of the impact of remittance on consumption, human capital investment,

choice of schooling and production and finally, section 4.5 summarizes the chapter.

4.1 Theoretical Model

In this section we extend a general but simple household-farm model developed by Taylor & Adelman (2003) and Singh *et al.* (1986) to investigate the behavior of households receiving remittance. Our study extends to the existing literate in two ways: first, we allow household members to move from the origin to other destinations both internally and externally from the country; and second, we also allow households to invest in both physical and human capital. In our model, unlike previous studies, capital is not exogenous. Closer to reality, we assume households may face missing markets for some of the final goods or factors of production, however not for others, resulting in a mixture of traded and non-traded goods at the household level. When the cost of participating in a market is too high, the household's optimal strategy is self-sufficiency or autarky.

In a three good household-farm economy, households obtain utility by consuming staples C_s, other market goods C_m and leisure C_l, given by a utility function of the form $U(C_s, C_m, C_l; Z_h)$, where Z_h stands for household specific attributes. Household specific characteristics determining the preference for different goods and the utility function is assumed to be well-behaved.

Factors of production used in the production of final goods are labor, L, and capital, K. The production function for both staple and other market goods follows $Q_i = Q_i(L_i, K_i)$, assumed to be increasing at a decreasing rate for each factor of production given the other factor remain constant. Leisure is simply the households time not allocated to production or wage work. Labor in productions not influenced by the household's time endowment rather can be hired from the factor market, which reveals that there is no constraint on work and leisure. The households can produce goods at any point given their profit maximization condition while demanding any level of leisure.

When households participate in a market for either final goods or factors of production, prices exogenously determined in those markets, so they are price takers. A households' optimal decision to produce and consume is separate from each other. Production occurs at a point where marginal rate of transformation equals the ratio of the of labor wage to rental price of capital. Then, the

households participate in the final goods market to trade and reach its optimal consumption point at which marginal rate of substitution between staple, other market goods, and leisure is equal to their respective price ratios. If production exceeds household consumption demand, the surplus sold, and profits are used to pay wage and rental price of capital.

Net labor hired is equal to the amount of labor, L^*, required to produce the profit-maximizing level of output minus the household's labor supply, $T - C_l$, the difference between total time and leisure. Net capital hired is equal to the amount of capital required to produce the profit maximizing level of output, K^*, minus the household's current level of capital stock, K. Households can rent the difference between K^* and K at a market rate. At the same time, they can use their savings to invest in physical and human capital. It has been assumed that capital is an increasing function of investment at a decreasing rate; $K'(I^h) > 0$ and $K''(I^h) < 0$.

In the household-farm model each household has at least two sets of equations: one for production inputs, which includes labor and capital demanded to produce final goods, and the other for consumption demands for end products, including staple, other market goods, and leisure. From the production side, profit maximization condition yields labor and capital demand as follows:

$$L_i = L_i(P, K_i)$$

$$K_i = K_i(P, L_i)$$

where L_i and K_i represents the demand for labor and capital respectively for production of good i (staple or other marketable goods) and P is a vector of input and output prices. These relationships come directly from the profit maximization conditions:

$$p_i \frac{\partial Q_i}{\delta L_i} = w$$

$$p_i \frac{\partial Q_i}{\delta K_i} = r$$

where p_i is the output price for commodity i, w is the wage rate, and r is the rental price of capital.

Given the optimal inputs and production function, we can obtain the optimal level of output and profit for each final goods and overall level of income for a household as follows:

$$Q_i^* = Q_i(L_i^*, K_i^*)$$

$$\Pi_i^* = p_i Q_i^* - wL_i^* - rK_i^*$$

$$Y^* = \sum_i \Pi_i^* + wT + rK + R$$

where Π_i^* stands for optimal profit from producing commodity i and Y^* is total income, the sum of the benefits from the production of all the products, the value of the household's time and capital endowments and remittance, R, received from the members resident outside the household location.

As a consumer, the household selects a bundle of commodities that maximizes their utility subject to the budget constraint. Budget constraint of a household can be written as:

$$Y^* = \sum_i p_i C_i + I$$

Utility maximization level of consumption for each commodities are:

$$C_i^* = C_i(P, Y^*)$$

As is standard in consumer theory, the demand for each commodity depends on its price, the price of other related goods and household's overall level of income. In contrast to standard consumer theory, under the household-farm model, overall income is endogenous, and depends on upon production decisions. Moreover, the inclusion of remittance and investment in the model allows us to investigate channels through which remittance affects household's choice of consumption, physical and human capital investment and production.

$$\frac{\partial Y^*}{\partial R} > 1$$

$$\frac{\partial C_i^*}{\partial Y^*}\frac{\partial Y^*}{\partial R} > 0$$

$$\frac{\partial I}{\partial Y^*}\frac{\partial Y^*}{\partial R} > 0$$

$$\frac{\partial Q^*}{\partial K^*}\frac{\partial K^*}{\partial I}\frac{\partial I}{\partial Y^*}\frac{\partial Y^*}{\partial R} > 0$$

There is a multiplicative impact of remittance on household's overall income. When a household receives more remittance from internal or international migrants their total income increases through three channels: first, there is the direct positive effect on income, additional income will increase capital via investment hence income from the capital endowment. Finally, capital will increase production and optimal profit. Thus, the impact of remittance on income is at an increasing rate. Though according to the standard consumer theory marginal propensity of consumption is less than one, under household-farm model marginal propensity of consumption is positive and also can be greater than one, indicating that an increase in remittance received by a household will increase demand for final goods, C_i, and physical and human capital investment, I and production of the staple products.

4.2 Empirical Specification

In this study, we examine the impact of remittance on a household's consumption behavior, human capital investment, schooling choice and agricultural production. Controlling for selection bias we use Heckman selection procedure to estimate the impact of remittance on consumption of different goods and human capital. To investigate the impact of remittance on the choice of schooling we use multinomial logit estimation. Finally, to examine the impact on household's agricultural production, a three-stage least square estimation has been used. In the following sub-sections, we are presenting the empirical specification of these estimations.

4.2.1 Remittance Impact on Households Consumption Behavior

If the households' that receive remittance randomly are chosen from the population, ordinary least squared estimation would be unbiased. But, if they are selected based on their unobserved attributes, the OLS estimator will be inconsistent and biased. Using the Heckman (1976) selection model we can obtain consistent estimates. The Heckman selection model assumes that there exists an underlying regression relationship:

$$lnC_j = X_{jk}\beta_k + \upsilon_{1j} \tag{4.1}$$

where lnC_j is a vector containing a log of consumption of different goods by the j^{th} household.

For computational purposes we add one to the level of consumption by the migrant then take natural log. X_k consists of a k number of household specific independent variables, β_k is a vector of parameters and $\upsilon_1 j$ is noise term.

All of the households do not necessarily receive remittance. In the first stage, the probability of receiving remittance is estimated using the probit estimation. The probability of receiving remittance by a household is captured by the following selection equation:

$$\begin{aligned} R_j^\star &= Z_{jl}\gamma + \upsilon_{2j} \\ R_j &= \begin{cases} 1 & if \quad R_j^\star > 0; \\ 0 & otherwise \end{cases} \end{aligned} \tag{4.2}$$

where $R_j^\star$ is a latent variable that is positive when a household receives a positive amount of remittance and 0 otherwise. Z_l consists of l number of independent variables in the selection equation. One notable comment is that X_k variables are a subset of the Z_k variables. Variables of interest are discussed in the following section. Noise terms of the above two equations are distributed as following:

$$\upsilon_{1j} \sim N(0, \sigma)$$

$$\upsilon_{2j} \sim N(0, 1)$$

$$corr(\upsilon_{1j}, \upsilon_{2j}) = \rho$$

When noise terms of the two equations are related, $\rho \neq 0$, the OLS estimation coefficients are biased. In this case, the Heckman selection model estimators are consistent and asymptotically efficient. The log likelihood function of household j is $lnL_j = l_j$, where:

$$l_j = \begin{cases} w_j ln\Phi\left\{\frac{z_j\gamma + (y_j - x_j\beta)\rho/\sigma)}{\sqrt{1-\rho^2}}\right\} - \frac{w_j}{2}(\frac{y_j - x_j\beta}{\sigma})^2 - w_j ln(\sqrt{2\pi\sigma}) & C_j = receive \\ w_j ln\Phi(-z_j\gamma) & C_j = notreceive \end{cases}$$

where $\Phi(\cdot)$ is the standard cumulative normal and w_j is an optional weight for observation j.

Probit estimates of the selection equation follows:

$$Prob(C_j \quad received \quad remittance|Z_j) = \Phi(Z_j\gamma)$$

This computes the inverse of the Mills' ratio, m_j, for each observation j as following:

$$m_j = \frac{\phi(Z_j\hat{\gamma})}{\Phi(Z_j\hat{\gamma})}$$

where ϕ is the normal density. We then define:

$$\delta_j = m_j(m_j + \hat{\gamma}Z_j)$$

The estimation performs regression only for the households who are receiving a definite amount, (when $R_j = 1$). The selection bias is initially considered as a missing observation of the dependent variable problem and reformulated as an ordinary omitted explanatory variable. The Heckman procedure has two steps. The first step estimates the decision to send remittance by probit estimation and calculates an inverse Mill's ratio. The second step incorporates the inverse Mill's ratio as an additional regressor in the regression equation to control the bias due to missing observation non-randomly.

The Heckman selection estimation generates an additional parameter β_m on the Mills' ratio. A consistent estimate of variance is obtained using residuals from the augmented regression and the parameter on the Mills' ratio,

$$\hat{\sigma^2} = \frac{e'e + \beta_m^2\Sigma_{j=1}^N\delta_j}{N}$$

The Heckman estimate of ρ is

$$\hat{\rho} = \frac{\beta_m}{\hat{\sigma}}$$

The Heckman selection model reports two χ^2 values. The Wald χ^2 test statistic used to verify if all coefficients in the regression model are zero except the constant. The likelihood-ratio χ^2 test is an equivalent test for $\rho = 0$ and compares the joint likelihood of an independent probit model for the selection equation and a regression model on the observed data against the Heckman model

likelihood.

Initially, we use a latent variable, $Iremi$, is equal to one if the household receives international remittance and zero otherwise; or $Dremi$ is equal to one if the household receives internal remittance and zero otherwise as the dependent variable in the first stage. In the second stage, we use lnC_i, natural log of households expenditure on different goods, i is an index of the consumption category. If the estimation reports, that the $LR - \chi^2$ statistic is statistically significantly different from zero it indicates that the errors of the two equations are positively correlated which implies that remittance-receiving households positively selected in their unobserved characteristics.

Then, to examine the impact of remittance on a household's expenditures in a more direct approach we first estimate Heckman two-stage selection model using a latent $Iremi$ and $Dremi$ as first stage dependent variables and $lniremi$ and $lndremi$ as second stage dependent variables with some other control variables. Then, we estimate lnC_i, household's different expenditure variables taking the natural log, on $lniremi$ and $lndremi$ separately, by OLS and 3 stage estimation. For 3 stage estimation, we replace $lniremi$ and $lndremi$ with the fitted values of the Heckman two-stage selection models. Finally, we perform Hausman χ^2 test to compare the efficiency of OLS and 3 stage for every expenditure categories and both type of remittance.

4.2.2 Impact of Remittance on Human Capital Investment

To examine the impact of remittance on human capital investment we consider only the household with at least one member under 20 years old. We estimate the elasticity of education expenditures, $lnedu$, on remittance variables $lndremi$ and $lniremit$ using ordinary least square (OLS), instrumental variables (IV), jackknife instrumental variable (JIV), two-stage least squares (2SLS) and three-stage least squares (3 stage). In addition to the remittance variables, in every estimation, we use a number of household head specific, household-specific and household origin location-specific fixed effect variables. For the 2SLS and 3 stage estimation, we first estimate both $lniremi$ and $lndremi$ with OLS and Heckman two-step selection model using the household head, household, migrant, household's origin location and migrant's destination location specific explanatory variables. We also perform Hausman χ^2 tests to compare the efficiency of the estimators in the models.

4.2.3 Remittance Impact on Choice of School

To examine the effect of remittance on choice of school, we consider all the members in a household between 5 and 24. There are 23,742 potential individuals who can go to school. Each individual has 5 options: not attending, attending government school, attending private school with government grant, attending private and other (includes NGO, madrasa) schools. The multinomial logit model for school choice is, Greene (2003):

$$Prob(SC_i = j) = \frac{e^{\beta_j' x_i}}{1 + \sum_{k=0}^{4} e^{\beta_k' x_i}} \tag{4.3}$$

where SC_i is the choice of school of an individual i and x_i includes internal and international remittance received by a household, household, migrant, child and household's origin location location specific variables. The log-likelihood function of the model is as following:

$$lnL = \sum_{i=1}^{n} \sum_{j=0}^{J} d_{ij} lnProb(SC_i = j) \tag{4.4}$$

where d_{ij} is equal to 1 if alternative j is chosen by individual i, and 0 otherwise.

Considering not attending school as a base option we estimate a multinomial logit model on the choice of school with a sample of individuals age between 5 and 24. To check the robustness of the estimators, we also estimate the model with different sub-samples on age, gender, whether they live in rural or urban location, the level of land ownership of the households and the level of property operated by the households.

4.2.4 Remittance Impact on Level of Agricultural Production

If agricultural production, Q, is constrained by migration, M, and remittance, R, output level depends on both migration and remittance. Output function can be written as follows:

$$Q = \alpha_0 + \alpha_1 M + \alpha_2 R + \alpha_3 Z_Y + \varphi_Y \tag{4.5}$$

Following the new economics of migration the null hypothesis is that neither migration nor remittance have a role in determining the level of agricultural production (i.e., $\alpha_1 = \alpha_2 = 0$).

Households receive remittance by sending family members to work outside their home location; given there is a migrant member in the household, household characteristics, and migrant member's characteristics determine the motivation and level of remittance sent:

$$R = \beta_0 + \beta_1 M + \beta_2 Z_R + \varphi_R \tag{4.6}$$

$$M = \gamma_0 + \gamma_1 Z_M + \varphi_M \tag{4.7}$$

Equations (5) through (7) constitute a recursive system where migration, remittance and level of agricultural production endogenously determined. The number of individuals migrating, M, is a function of migrant destinations as well as household human capital variables. The number of variables in Z_R and Z_M is included as instruments to identify the system and control the endogeneity issue of M and R in equation 5. The international migration rates and distance of origin from the capital city Dhaka are used to identify the migration equation. To capture the heterogeneous effect of international migration rate and distance on household we multiply household age with the value of those variables. Remittance spent on business, construction, education, consumption; and natural log of total expenditure is used to identify the remittance equation.

As a standard, the stochastic terms φ_i, $i = Y, R, M$ are assumed to be normally and independently distributed with variance σ_i^2. But, there is a high possibility that migration, remittance, and production are subject to the same exogenous shocks and cross equations correlated. To control the contemporaneous correlation, we estimate the model using iterative three-stage least squares. The variables Z_i, $i = Y, R, M$, include household, migrant, household's origin location and migrant's destination specific variables. All equations include division-fixed-effects variables.

4.3 Data and Summary Statistics

This section discusses the source of the data and how the samples are selected to examine the effect of remittance on households consumption behavior, human capital investment, school decision and agricultural production levels. Then, there is an explanation of how variables of interest are generated. Finally, summary statistics of all the variables of interest are presented.

4.3.1 Data Source and Selection Criteria

To examine the impact of remittance (both internal and international) on recipient households, we use the Household Income and Expenditure Survey (HIES-2010) data from Bangladesh, managed and developed by Bangladesh Bureau of Statistics (BBS). HIES is available for the following years 1995, 2000, 2005 and 2010. This provides an opportunity to do panel analysis. But there are two significant limitations of the survey over the periods, which hinders incorporation of the time dimension in this study. First, there is no indicator to identify households over survey periods. Second and more importantly, HIES of Bangladesh reports migration specific detail information of households only for 2010. Due to data limitation, this study examines the impact of remittance on recipient household's consumption behavior, human capital investment, choice of schooling and level of agricultural production; using a cross section data.

One of the advantages of this data set is that HIES data provides detailed information on households, internal migrant and international migrant. Does a household receive cash remittance or not? If so, then what is the amount and where do they invest the remittance received? Does a household participate in the agricultural production? If so, what and how much? The data sets also provide household's total tangible assets, income, expenditure on different commodities, location of origin, the migrant's destination, location-specific attributes, the number of children with detailed schooling information and other household and migrant-specific attributes. Rich data sets like these allow us to undertake a micro-level analysis of the impact of remittance on households.

The HIES 2010 reports a total of 12,240 households out of which 7,840 live in different rural areas. There is a total of 2,100 migrants within the households, and some households have multiple migrants. Out of this 2,100 migrants, 728 migrated within the country, and 1,372 migrated outside the country. Out of 728 internal migrants 695 and out of 1,372 international migrants 1,337 send remittance to their household. Based on 695 domestic remittances receiving and 1,337 international remittances receiving households using The Heckman selection model we analyze the impact of remittance on households consumption behavior compared to households receiving no remittance.

To investigate the impact of remittance on household's human capital investment we consider a sub-sample of 10,939 households having at least one member with age below 20, which is the average age of passing higher secondary certificate exam in Bangladesh. Out of 10,939 households,

526 receives internal remittance, and 1,202 receives international remittance. We examine the choice of type of schools by an individual rather than a household. For that, we consider 23,742 persons in the sample age between 5 and 24 inclusive. There are different types of educational institutions in Bangladesh; such as government, private and private with government grant. Other types of schooling include NGO-run institutions and madrasas (Islamic religious school). Each can attend one of the educational institutions or choose not to participate. To check the robustness of the results, we estimate multinomial logit on different sub-samples base of age, gender, the location of household (rural or urban), the amount of land holding by the household and the relationship of the migrant with the household head.

Finally, to examine the impact of remittance on the level of agricultural production by households we consider only 5,634 households who produce crops (includes different types of rice (Aus, Amon, Boro), wheat, jute, oilseed, and potato). Out of 5,634 crop producing households only 369 receive remittance from internal migrants and 641 receive remittance from international migrants. To analyze the impact of remittance on agricultural production controlling cross endogeneity between migration, remittance, and agricultural production equations we use a three-stage least square (3SLS) iterative estimation. We also estimate agricultural production of households with all the variables in the system of equations including the number of migrants and natural log of remittance by ordinary least squares. Then, we perform a Hausman specification test on OLS and 3SLS.

In Bangladesh, there are seven administrative regions each containing disjoint rural and urban locations. Further, Bangladesh is divided into sixty-four small administrative areas known as districts. To capture origin-specific attributes, we include district level population density, also provided by BBS. As unobserved characteristics play a role in remittance decision, we include origin specific fixed effect latent variables for each region. To capture the effect of international migration we include source-specific international migration rate of households calculated from the data set.

4.3.2 Variables of Interest

The empirical part of the study has four different segments analyzing the impact of remittance on household consumption behavior, human capital investment, school choices and agricultural production. In the following subsections, we describe the variables of interest for each segment

separately.

Consumption Behavior

In the first part, we analyze the impact of remittance (internal, *lndremi* and international, *lniremi*) on households expenditure on food, $lnfe$, durable goods, *lndue*, housing, *lnhoe*, education, *lnee*, health, *lnhee*, and other commodities, *lnoe*. For computational convenience, we add one and then take natural log on all the variables. Household's specific variables such as the size of a household, $Number$, household head age, $HHAage$, household head is male, $HHMale$. Household head's level of education, $HHEdu1$, no education, $HHEdu2$, primary education, $HHEdu2$, secondary or higher secondary education used for controlling the household level of preference and heterogeneity.

We also use the migrant's demographic information, $Age1$, is equal to one if age of the migrant is below 26, $Age2$, is equal to one if age is between 26 and 40 inclusive, and $Age3$, is equal to one if age is between 41 and 56 inclusive for controlling their preferences. For controlling location specific effects, we use $Intmigr$, international migration rates from the site of household's, which is the ratio of the number of households having at least one international migrant member to the total number of household in that area and $Popden$, the population density of household's location. Finally, to capture the location-specific unobserved factors effect we use division-level, origin- specific fixed effect and an indicator variable if household lives in a rural location.

To examine the impact of remittance on households' consumption behavior using a direct approach, we estimate the model using Heckman two-stage selection estimation. At the first stage selection equation, we estimate both *lniremi* and *lndremi* as dependent variables. At the second stage regression equation, we estimate the respective indicator variables as dependent variables. We use the household head's demographic, level of education, size of the household, natural log of household's total expenditure, natural log of household's land ownership, number of children below age 5, population density of household's resident location, international migration rate, whether a household lives in a rural or urban location, and household's resident location specific fixed effect as explanatory variables for these two stages. Next, we estimate all the consumption equations using OLS for internal remittance and international remittance separately with number of household-specific variables and location-specific fixed effects. We also re-estimate all the

consumption equations using 2SLS by replacing domestic remittance and foreign remittance with fitted values of the Heckman, selection model. We also perform the Hausman χ^2 test to compare the efficiency of the OLS and 3 stage estimators.

Human Capital Investment

In the second part of the empirical section, we analyze the impact of remittance (internal, *lndremi*, and international, *lniremit*) on a household's human capital investment, *lnedu*, natural log of total expenditure on education of the household plus one. In this section, we only consider households with school-age children. To check the robustness of the estimators, we estimate the model using OLS, IV, JIV, 2SLS and 3 stage. For 2SLS we first estimate both *lniremi* and *lndremi* separately with household head, household, migrant's demographic, household's resident location and migrant's destination location specific variables. For 3 Stage we estimate both the remittance variables using the corresponding remittance- receiving indicator variable as the dependent variable for selection equation and natural log of the corresponding amount of remittance as the dependent variable for the regression equation. We then use the fitted values of this two estimation of human capital investment with other household-specific and location-specific variables.

In the first stage, we use household head age, $HHAge$, squared of household head age, $HHAge^2$, natural log of total household expenditure, $lnexp$, and $Nmig$, the number of migrant members in the household, indicates the composition of a household, and it's demand for remittance. Households with a higher level of expenditure require more remittance and households with greater number of migrant members demand less remittance from an individual migrant member. The effect of the household head age is ambiguous. One may argue it is positive as $HHAge$ increases they get more dependent and need more support. On the other hand, it is also possible that they have more members to take care of them and do not require remittance from each migrant.

Migrant-specific variables indicate the ability of a migrant, and it's bonding with the household. These variables play a major role in taking the decision to send remittance and the amount of remittance. Variables are defined as following: $Yearsm$, individual, has migrated more than a year, $Mspouse$, migrant member, is the spouse of household head, $Age1$, a latent variable indicating migrant's age is below 26, $Age2$, indicates migrant's age is between 26 and 45, $Age3$, migrant's age is between 46 and 55, $Edu3$, migrant has a secondary or higher level of secondary level of education;

variables specific to a household's location of residence are $Popden$, population density per square kilometer and $Intmigr$, international migration rate, which is a ratio of number of households who have at least one migrant member over the number of total households in that location. We also include two of the most popular international migrant's destination- specific latent variables $Saudi$ and $Malaysia$. These location-specific variables captures observed and unobserved location-specific effects.

Finally, we estimate the natural log of education expenditure of households with both remittance variables, household, household head and household's location-specific fixed effects using OLS, IV, JIV, 2SLS, and 3 stage. For OLS we use $lniremi$ and $lndremi$ with all the other variables. For IV and JIV, we use $lniremi$ and $lndremi$ with all the other variables and also use the variables employed in the first stage for 2SLS and 3 Stage as endogenous to the remittance variables. For 2SLS we replace $lniremi$ and $lndremi$ with the fitted values of first stage OLS estimations $\widehat{lniremi}_O$ and $\widehat{lndremi}_O$. Similarly, for 3 Stage we replace $lniremi$ and $lndremi$ with the fitted values of first stage Heckman two-stage selection model estimations $\widehat{lniremi}_H$ and $\widehat{lndremi}_H$.

Other variables included in the second stage are household head with no education, $HHEdu1$, household head with primary schooling, $HHEdu2$, household head with secondary or higher secondary education, $HHEdu3$, three more indicator variables are number of children below 5, $Children$, number of primary school going age children, $Primary$, number of secondary school going age children, $Secondary$, highest level of education of a member of the household, $Maxedu$. Intuitively, we can say that the higher the level of education of the household head or any member of the household the more they will invest in human capital. Households with more $Primary$ and $Secondary$ age children will spend more in human capital.

We also include other variables including a household's religion. These are: $Islam$, if they follow Islam, whether household spends their remittance income on education, $RIEdu$, on consumption, $RIConsu$, natural log of household's total land ownership, $lnland$, natural log of household's income from all the sources except remittance, $lnhpcinc$. The effect of a household's income on human capital is ambiguous because it depends on their initial level of income. If the initial level of income is too low, they need to use the remittance on basic consumption goods. If the initial level of income is high enough that basic consumption needs to be met, then an increase in income through remittance will encourage them to invest more in human capital. To capture all the location-specific

unobserved effects, we also use household's resident location specific fixed effects variables.

Choice of School

To examine the impact of remittance on individual choice of schooling we use a multinomial logit estimation. Each child may choose to go to a government school, a private school with or without government grant or other (NGO or Madrasa) and they may also choose not to attend school. Considering not attending school as a base we estimate the multinomial logit model for the individuals between 5 and 24 inclusive.[1]

In addition to two remittance variables *lniremi* and *lndremi*, we also add a number of household-specific variables. These are: *lnland*, natural log of total land own by household, *lnexp*, natural log of total expenditure of the household, $RIEdu$, equal to one if household invest remittance on education, zero otherwise , $HHMale$, household head is a male, $NM15$, number of male members over age 15, $NF15$, number of female members over 15 years old, $Maxedu$, maximum level of education attended by a member of a household, $Child$, migrant member is a child of the household head, *Spochi*, migrant member is a spouse of a child of the household head, $GChild$, migrant member is a grandchild of the household head. We also use the child's demographic information such as $CAge$, child age, $CAge^2$, squared of child age and *work* if the child works part time or full time in the estimation. To capture location specific unobserved effects we use, $Rural$, an indicator whether the child lives in rural area or urban area, $Totalroad$, the total length of road in the district of residence and $Distance$, a distance of district headquarter from capital city Dhaka.

Agricultural Production

To control for cross endogeneity between migration, remittance and agricultural production we use 3SLS estimation to analyze the impact of remittance on household agricultural production. Here, we only use the households who undertake agricultural production. In the first stage, both international migration indicator, $IMig$, and internal migration indicator, $DMig$, are estimated on number of household members age greater than 15, $Ng15$, number of dependent young members, $Yongd$, household head's gender, age and education indicator, natural log of household's per-capita income from all sources except remittance, *lnhpcinc*, natural log of total land own by the household,

[1]We estimate the model for entire sample and number of sub-samples by individual and household attributes.

lnland and to capture location specific factor use, $Popd * HA$, population density of household's resident location multiplied by the household head age to get household level heterogeneous effect. We also add two more variables as instruments to the equations, which are international migration rate, $Intmigr$, and distance, $Distance$ of household's resident district headquarter to capital city Dhaka, multiplied by household head age.

In the second stage, *lniremi* and *lndremi* are estimated with a number of international migrant members of the household, $NIMig$, number of internal migrant members of the household, $NDMig$, child average age, $CAAge$, squared of child average age, $CAAge^2$, ratio of number of child attending school to total number of school age child, $Schooling$, loss of household's food production due to environmental shock, FPD, and $Ng15$ and *lnhpcinc* from the first equation. Also, we use a few variables as an instrument to the equations. These are *lnexp*, natural log of total household expenditure; remittance invested in construction, business, marriage, education are $RIConst$, $RIBus$, $RIMarri$ and $RIEdu$ respectively.

In the final stage, we estimate the value of total crop production per decimal area taking natural log on *lniremi*, *lndremi*, $NIMig$, $NDMig$, $NIMig$ with other variables as $Ng15$, $HHAge1$, $HHAge2$, $Islam$ and *lnoptl*, natural log of total operating land by the household. We also estimate the value of total crop production per decimal with all the variables used in the three stages using OLS and do Housman test to compare the estimators for efficiency.

4.3.3 Descriptive Statistics

In this section, we discuss the descriptive statistics of all the important variables of the study. Descriptive statistics of household, household head, children, asset, income, agricultural production and migrant specific variables are used to examine the impact of remittance on household's consumption behavior, human capital investment, choice of school and agricultural production presented in Table 4.1. The first part of Table 4.1 presents statistics for all households in the sample. The second part of the table presents statistics for all the households with at least one child age below 20. The third part of the table presents all the households who produce a crop. The final part of the table presents statistics for children between 5 and 24 years old inclusive. There are four columns in the table, first, represents all the households within the respective group, the second one is for all the households who receive no remittance, the third one is for all the households who

receive internal remittance, and the last one is for the households who receive international remittance. Table 4.2 presents a choice of school by children age, gender, the location of households, the amount of land owned by the household and the relationship of a migrant with the household head.

In the sample there is a total of 12,652 households, with 10,620 not receiving any remittance, 695 receiving internal remittance and 1,337 receiving international remittance. 64.44% of all households, 62.82% of non-remittance recipient households, 79.14% of internal-remittance recipient households and 69.86% of foreign remittance recipient households lives in rural areas. In the sample of households with at least on child age below 20, there is a total of 10,939 households, with 9,214 not receiving any remittance, 523 receiving internal remittance and 1,202 receiving international remittance. In the sample of households who produce a crops, there is a total of 5,638 households, with 4,27 not receiving any remittance, 369 receiving internal remittance and 642 receiving international remittance.

Household Specific Variables

Table 4.1 shows that on average households with foreign migrant receive more (ln of remittance) remittance, 7.07, than the households with internal migrants, 5.51. These are values after taking a natural log. We find that all the households receiving domestic and international remittance spent more on food, durable goods, housing, education, health and other commodities compared to the non-remittance receiving households. The difference between non-remittance recipient and internal-remittance recipient households are not significantly different. Households receiving internal and international remittance own higher amount of land compared to the non-remittance receiving households, 3.56, 3.51 and 2.65 respectively. One interesting finding is that for households receiving no remittance, the natural log of per-capita income is higher than the internal remittance recipient households followed by the international remittance recipient households, 4.64, 3.92 and 3.21 respectively. Household income includes all the sources of income except remittance.

Within non-remittance recipient households, 90.64% have a male household head. Corresponding values for household receiving internal and international remittances are 61.58% and 51.83% respectively which can explain by the fact that male head of households are often migrants themselves. Analyzing a household head's education specific latent variables, we can unambiguously

conclude that the head of households with an international remittance recipient is on average more educated compared to the internal remittance recipient households followed by non- remittance recipient.

Migrant Specific Variables

Individuals who have migrated to either internal or international locations are predominantly male, 94.96% and 98.13% respectively. Analyzing migrant's demographic attributes indicate that relatively younger members tend to migrate more within the country. 36.98% of internal migrants are below 26 compared to 25.21% of international migrants at a similar age. Whereas 45.90% of internal migrants aged between 25 and 45 inclusive compared to 55.57% of international migrants are of similar age. Inspecting migrant members education specific latent variables it is clear that relatively higher educated members tend to migrate more outside the country. 26.04% of internal migrants have primary education compared to 25.65% of international migrants. 50.69% of internal migrants have secondary or higher secondary education compared to 60.66% of international migrants.

Human Capital Variables

To examine the impact of internal and international remittance on households investment on human capital, we use a few additional variables. The second part of Table 4.1 presents descriptive statistics for primary school aged child, secondary school going aged child and the maximum level of education of a member of the household. On average, a primary school age child is very close to non-remittance receiving, internal-remittance receiving and international remittance receiving households; 1.07, 0.98 and 1.06 respectively.

On average, a secondary school age child is lowest among non remittance recipient household followed by internal remittance recipient and international remittance recipient households; 0.61, 0.73 and 0.76 respectively. Supporting the statement from an earlier section that relatively higher educated members tend to migrate more outside the country, the maximum level of education of a member of the household indicates that a member of the relatively highly educated household is more likely to migrate outside the country.

Crop Production Variables

To study the impact of internal and international remittance on household agricultural production, we include some additional variables. The third part of Table 4.1 presents, the natural log of total crop production per decimal, the natural log of total land owned by the household and the number of household member above age 15 for only the households who produce a crop. There is no such difference between non remittance recipient households and internal remittance recipient households regarding the value of crop production per decimal, although international remittance recipient households produce a higher value of crop per decimal: 5.696, 5.693 and 5.735, correspondingly. The higher value of crop production by international remittance recipient households may be due to two reasons. They may produce a higher quality crop or have higher productivity due to the level of capital, information or technology available through their migrant members.

On average, the natural log of land owned by the households who produce crops are 4.17, 4.21 and 4.24 respectively for non remittance, internal remittance, and international remittance-receiving households. It is possible that there is a two-way relationship between land ownership and sending a member to other locations. A higher level of the property indicates a wealthier household, who can afford the cost of migration to send a member to other places. It is also possible that households buy new land using remittance from the migrant members. Household members above 15 years old are 3.07, 3.08 and 3.49 for non-remittance recipient households, internal-remittance households, and international remittance households, respectively.

Children Age between 5 and 24 Variables

We now examine the impact of remittance on the choice of school at individual child's level. In the sample, there is a total of 23,048 children within all households. Households of 22,923 children receive non-remittance, but households of 892 and 2,399 children receive internal remittance and international remittance respectively. The bottom part of Table 4.1 presents two more child level-variables. On average, only 1.27% of a household's total budget is spent on education. Education spending is even lower, 1.099%, for the households with internal remittance, but higher, 10459%, for the households with international remittance, compared to the households with non-remittance. 13.69% of total children aged between 5 and 24 work part-time or full-time. For both internal and

international remittance recipients households money spent on schools is lower, 11.32% and 8.50%, respectively.

Households may or may not choose to send an individual aged between 5 and 24 to school. There are four types of school in Bangladesh: a government, private with or without a government grant and other, which includes NGO's run institutions and Islamic religious institutions. Each child has a total of five options including not attending any school. Table 4.2 reports the percentage of children attending different types of school within non-remittance, internal remittance, and international remittance recipient households.

The table shows that 36.22%, 31.62% and 28.66% of the children do not attend any educational institution within non remittance, internal remittance, and international remittance-receiving households. Apparently, more children from remittance recipient households' attend schools. Within this group, school attendance is the highest for international remittance recipient households. However, overall the percentage of children not attending any types of school really high due to a large number of children and young adults study only up to secondary or higher secondary school and the children are defined as such until the age of 24.

The percentage of children attending government schools from households not receiving any remittance is 27.68%, receiving internal remittance is 23.84% and receiving international remittance is 23.36%. Table 4.2 indicates that a higher percentage of children within remittance recipient households goes to private schools with government grants compared to the non-recipient households. 30.17%, 35.82% and 40.12% of children attend private schools with government grant from non remittance, internal remittance, and international remittance households respectively.

Among the households, children of international remittance recipients attend private schools at a higher rate of 3.16%. This statistic is similar in both internal remittance recipients, 1.79% and non-remittance recipient households, 1.97%. By contrast, children of internal remittance recipient households attend informal education institutions at the most at 6.93%. It is evident from Table 4.2 that a remittance received by a household is a major factor determining the choice of school.

4.4 Empirical Results

As we have already mentioned, in this study we examine the impact of remittance on household consumption behavior, human capital investment, children's choice of school and agricultural production. In this section, we present empirical results of our analysis. The results are reported under four subsections as follows.

4.4.1 Remittance Impact on Households' Consumption Behavior

In this section, we first present results of the two-stage Heckman selection model for both internal remittance and international remittance. In the first stage selection equation, the dependent variable is $Dremi$, equal to one if the household receives domestic remittance, and $Iremi$, equal to one if the household receives international remittance. In the second stage, different consumption variables used as a dependent variable for both internal and international remittance. After discussing the two-stage Heckman selection model in this section, we present estimation of all the consumption variables on both domestic remittance and foreign remittance using OLS and 3 stage. For 3 stage, we estimate the domestic and international remittance using two-stage Heckman selection model and then, use the fitted values of this estimation to predict different consumption variables. We also perform the Hausman test to compare the efficiency of the estimators between OLS and 3 stage.

Two Stage Heckman Selection Estimation

Table 4.3 and Table 4.4 present the results of the second stage, of two-stage Heckman selection model for each consumption categories; Table 4.3 for internal remittance recipient and Table 4.4 for international remittance recipient. The first thing to observe is the $LR - \chi^2$ at the bottom of the table. In Table 4.6, $LR - \chi^2$ for food consumption, durable goods, housing and education are not statistically significant, but significant for households health expenditures and other expenditures. The results show that errors of the two equations are correlated, and estimation of these two consumption equations with OLS would produce biased estimator for internal remittance. Moreover, the *athroh* statistics for household health expenditure and other expenditure estimations are -0.298 and -0.328, respectively and statistically significant at 1%. That implies that remittance-receiving

households negatively selected in their unobserved characteristics and estimation, which does not take selection into account, will underestimate the positive effect of remittance on households health expenditures and other expenditures. Negative selection into internal remittance is consistent with the finding by Acosta *et al.* (2008), Beyene (2014) and Gubert (2002)

In Table 4.4, $LR - \chi^2$ for food consumption and education are statistically significant, but not significant for durable goods, housing, health, and other expenditures. The errors of the two equations are, once again, correlated, and estimation of these two consumption equations with OLS would produce biased estimator for international remittance. Moreover, the *athroh* statistics for food consumption and education expenditure estimates are -1.758 and 0.231 respectively and statistically significant at 1% which implies that remittance-receiving households are negatively selected in their unobserved characteristics for food consumption estimation but positively selected for education expenditure estimation. Estimation that does not take selection into account will underestimate the positive effect of remittance on households food consumption, and as a consequence will overestimate the impact of remittance on household education expenditures.

OLS and 3 stage Estimation

In Table 4.5 we present results of the two-stage Heckman Selection model for both internal and international remittance. The natural log of the amount of remittance received by a household has been used as the dependent variable of the second stage and an indicator variable of whether the household receives remittance or not as the dependent variable for the first stage. The first two columns report results for the international remittance and last two columns are for the internal remittance. The second and fourth columns provide results for the probit model estimating the decision to remit with the indicator variable as the dependent variable. The first and third columns report results for remittance equations.

We first analyze the internal remittance estimation results. All the explanatory variables of the decision to remit equation are significant at 1% or 5% significance level except the coefficient of location specific latent variable Dhaka. Similarly, most of the coefficients of regression equation are also statistically significant. The elasticity of internal remittance with respect of total household expenditure indicate that if a household's overall spending increase by 1%, domestic remittance receive increases by 0.639%. The amount of land ownership has a negative effect on domestic

remittance, -0.0179, but statistically not significant. If a household is in a rural location, the amount of domestic remittance received decline by 51.1%. If a household head's age increases by a year, the amount of domestic remittance receive falls by 2.30%.

Next, we examine the international remittance estimation results. Like the internal remittance results, all the explanatory variables of the decision to remit equation is significant at a 1% significance level. Similarly, most of the coefficients of regression equation are also statistically significant. The elasticity of international remittance with respect of the total household expenditures indicate that if a household's overall spending increases by 1%, international remittance receive increases by 0.252%. However, the amount of land ownership has a positive and significant effect on the inflow of foreign remittance, 0.0467. If a household is in a rural location, the amount of foreign remittance declines by 12.6%. If a household head's age increases by a year, the amount of internal remittance falls by 0.56%.

Most importantly, $LR - \chi^2$ for both domestic and international remittance are statistically significant at a 1% revels that errors of the selection and regression equations correlated for both domestic and international remittance. The estimation which does not take selection into account would again produce biased results.

Tables 4.6-4.11 presents results of the OLS and 3 stage for each expenditure category for both internal and international remittance. Former two columns report results of domestic remittance and latter two columns report results of foreign remittance. The first and third columns are for the OLS estimation; second and fourth columns are for 3 stage estimation. All the explanatory variables are statistically highly significant for most of the expenditure categories for both internal and international remittance under OLS and 3 stage. But, the magnitude of the coefficients is significantly different between OLS and 3 stage estimation.

In these tables, our primary variable of interest is the remittance variable. In Table 4.6, the first column, the coefficient of the natural log of internal remittance is negative but insignificant. In the second column under 3 stage, it becomes positive and significant indicating that if a household receives 1% more internal remittance their food consumption increases by 0.538%. For international remittance, this coefficient is positive and significant for both OLS and 3 stage, but the magnitude under 3 stage is significantly higher, 0.0328 and 2.190, respectively. To compare the consistency of the estimator between OLS and 3 stage we do the Hausman test and the statistic is reported

at the bottom of the tables. For internal remittance, $Hausman - \chi^2$ is 46,272.3 and statistically significant at 1% indicating that 3 stage is an efficient estimator compared to the OLS. But for international remittance $Hausman - \chi^2$ is -26,492.67 and not statistically significant implying that under international remittance, there is no statistical difference between OLS and 3 stage estimators for the food consumption.

In Table 4.7-4.11 the coefficients of the natural log of remittance are positive and highly significant under OLS and 3 stage. Like Table 4.6, the magnitude of 3 stage is higher than the OLS estimations for all the expenditure categories and both types of remittances, confirming that increases in both internal and international remittances dominoes into increased households expenditures of all categories. Moreover, all the $Hausman - \chi^2$ test statistics are statistically significant at 1%. 11 out of 12 $Hausman - \chi^2$ test statistics are significant and confirms that our 3 stage estimation is efficient compared to the OLS.

4.4.2 Remittance Impact on Human Capital Investment

In this section, we present results on the impact of remittance on household human capital investment. To examine the impact of remittance on human capital investment we only consider households with at least one child aged below 20. In Table 4.12, the first column presents OLS estimation of education expenditures on the amount of remittance a household receives. To control possible endogeneity in the model, we estimate the education expenditure of households with IV, JIV and 2SLS estimation and results are presented in Table 4.12 columns 2-4. We also estimate the spending on education of the households with 3 stage using fitted value of two-stage Heckman selection estimation of internal and international remittance and results presented in Table 4.12 column 5. Finally, we perform the Hausman test between estimations to confirm 3 stage estimation provides consistent estimators.

First Stage Results

We present OLS and two-stage Heckman selection estimation of international and internal remittance. Fitted values of these estimations then used for 2SLS and 3 stage of education expenditure estimation. In Table 4.13, the former two columns present OLS estimation for international and internal remittance. The third and fourth columns present the two-stage Heckman selection esti-

mation for international remittance followed by internal remittance in the final two columns. The fourth and sixth columns present remittance decision results. The third and fifth columns present second stage amount of remittance sent estimation results.

The most important result in Table 4.13 is the $LR-\chi^2$ test statistics presented at the bottom of the table. $LR-\chi^2$ test statistics for international and internal remittances are 6.428 and 4.763 respectively and are statistically significant at a 5%, confirming that there is a correlation between the error terms of remittance decision and regression equations. An estimation that ignores the selection issue would produce biased estimators of the coefficients. Comparing the first and third columns of Table 4.13 shows that OLS estimators are either underestimating or overestimating the household-specific factors and migrant-specific factors compared to the Heckman selection estimation for international remittance. Similar results are reported in second and fifth columns of Table 4.13 for internal remittance.

Final Stage Results

Table 4.12 presents remittance impact on human capital investment of households for different specifications. All the household head's, households and location specific dummy variables are statistically significant irrespective of the specification of the estimation. The exceptions are for religious beliefs, $Islam$, location-specific indicators; $Barisal$ and $Rangpur$. $Islam$ and $Barisal$ are significant for 3 stage estimation only and $Rangpur$ in only insignificant for 3 stage. Moreover, all the estimators of OLS, IV, JIV and 2SLS are consistent between estimations. But compared to 3 stage, these estimators are either underestimated or overestimated for different variables.

The most important variables in this section are $lniremi$ and $lndremi$. For all the specifications, the coefficient of $lniremi$ is positive and statistically significant at 1%, but the coefficient of $lndremi$ is only significant for 3 stage and moreover it is negative for OLS. After controlling the endogeneity issue of the model, IV, JIV and 2SLS produce a consistent parameter for $lniremi$ among the specifications. The values are 0.0754, 0.0753 and 0.0657 respectively which also indicates that OLS estimation of the model, 0.0513, underestimated the effect of international remittance on household education expenditure. Although 2SLS produces a higher estimate for $lndremi$, it is statistically insignificant for both the instrumental estimations and 2SLS.

After controlling for the possible self-selection bias of the model, 3 stage produces higher mag-

nitude and positive coefficients for both *lniremi* and *lndremi* with statistically significant at 1%. Results show that 1% rises in international and internal remittance increases households' education expenditures by 1.142% and 0.506%, respectively indicating that the effect of foreign remittance is dominant compared to the domestic remittance on households human capital investment.

Finally, to confirm that 3 stage produces the most consistent estimator, we conduct Hausman tests between 3 stage and the rest of the estimations. 3 stage established as consistent under H_o and H_a and rest of the estimations are inconsistent under H_a but efficient under H_o. The null hypothesis of the Hausman test is that the difference in coefficients is not systematic. The bottom part of Table 4.12 reports the Hausman test statistics for respective column's estimation compared to the 3 stage. The $Hausman - \chi^2$ test statistics for OLS, IV, JIV and 2SLS estimations on 3 stage are 174.58, 181.24, 154.04 and 190.94, respectively, and all are statistically significant at 1% confirming that 3 stage estimator is unbiased and efficient among all estimators.

Robustness Check for 3 stage Estimation

To check the robustness of the 3 stage estimator, we estimate the model for different sub-samples. Results of the estimation with different sub-samples are presented in Table 4.14. The first and second columns of Table 4.14 report results only for households with at least one primary school age child and at least one secondary school age child, respectively. The third and fourth column of the table report results only for households who live in rural and urban locations, respectively. The fifth and sixth column of the table reports results only for a household with low per-apita and household with high per-capita income. For simplicity, we consider the midpoint of the per-capita income as the cutoff point.

The coefficients of a household head's education indicator, religious beliefs, the number of the child at different age groups, the maximum level of education of a household member, how the remittance spent by the household and household's location specific fixed effect are statistically significant for most of the samples with a consistent sign. Our primary variables of interest, *lniremi* and *lndremi* reported at the top of the table. For all the samples, the coefficient of *lniremi* is greater than one and coefficient of *lndremi* is positive but less than one, unveil that international remittance plays a more important role in households' human capital investment compared to internal remittance.

The effect of a 1% rise in *lniremi* on households with at least one child of primary school age and one child of the secondary school going age are 1.278% and 1.114%, respectively. By comparison, 1% raise in *lndremi* on households with at least one child of the primary school going age and one child of the secondary school going age are 0.45% and 0.606%, respectively. International remittance has a strong effect on households with primary school age child compared to households with the secondary school going age child, but internal remittance has a relatively weaker effect on households with primary school age child.

Comparing the effect of remittance between samples we find that a 1% rise in international remittance increases education expenditure for rural and urban households by 1.293% and 1.448%, respectively. On the other hand, a 1% increase in internal remittance increases education spending by rural and urban households by 0.52% and 0.544%, respectively, which demonstrates that the effect of an increase in domestic remittance on both types of households is of similar magnitude, but urban households invest more in education with a similar increase in international remittance.

For low-income and high-income households, a 1% rise in international remittance increases education expenditure by 1.322% and 1.607%, respectively. By contrast, a 1% increase in internal remittance increases education spending by 0.591% and 0.457%, respectively. International remittance has a greater effect on high-income households compared to low-income households, but domestic remittance has a weaker effect on high-income households.

4.4.3 Remittance Impact on Children's Choice of School

In this section, we present the impact of remittance on children's choice of school. We only consider children aged between 5 and 24 to examine the impact of remittance on the selection of a school. There is a total of 23,742 children within this age group. Each household may choose an option from the following five; not attending, government schools, private schools with government grant, private schools, and other institution. Table 4.15 reports the coefficient estimates of MNL models for school choice considering not attending as base category. To check the robustness of the model we also estimate it with different sub-samples. Coefficients of two important variables *lniremi* and *lndremi* for all the sub-samples presented in Table 4.16.

All The Children Aged between 5 and 20

The effect of internal and international remittance on attendance in a private school with government grant, private school, and other institutions are positive. All the coefficients are also statistically significant for *lniremi* but only other institution is statistically significant for *lndremi*. The coefficients of the choice of government school are negative for both the remittance variables but statistically insignificant, which reveals that increases in *lniremi* enhances the probability of a child attending a private school with government grant, private school and other institution by 4.25%, 7.78% and 4.16% respectively, though it does not have any impact on government school attendance. On the other hand, an increase in *lndremi* only enhances the probability of attending other institutions.

We also use the number of households, migrant, and child-specific control variables. Most of the coefficients are statistically significant for all the choice options. *lnland* and *lnexp* can be use as a proxy for wealth of a household. The increase in the wealth of a household will increase the probability of children attending any school. If a household uses its remittance on education expenditure, $RIEdu$, the chance of attending private school increase by 0.971% for those households, although it does not have any significant impact on other choices. If a household head is male, the probability of attending any types of school by a child increases, but the number of male members aged greater than 15 and number of female member aged greater than 15 reduces the probability of school attendance by children. An increase in the maximum level of education by a household member enhances the likelihood of children attending government schools, a private school with grant and other institution by 0.151%, 0.298%, and 0.295%, respectively. But it does not have any significant impact on attending the probability of attending private schools.

If a migrant member is an immediate family of the household head, it increases the likelihood of children attending all types of school. The exception is when the migrant is a daughter-in-law or son-in-law, which adversely affects the likelihood of children attending other institutions. Most of the coefficients are also significant. Sign of the coefficients of $CAge$ are positive, and $CAge^2$ are negative for all the options and statistically significant at 1%, presenting that age of a child increases their probability of attending any types of schools but at a decreasing rate. If a child works either part-time or full-time and lives in a rural location, it adversely affects the probability

of attending any type of school. The total road in kilometers in the household's resident district reflects the level of infrastructure of the location. It indicates that communication is easier and increase the probability of a child attending any types of school. For example, if a district's total road increases by 100 kilometers likelihood of attending government, a private school with government grant, private school, and other institutions increases by 0.039%, 0.0559%, 0.430%, and 0.105% respectively.

Robustness Check

Table 4.16 reports multinomial logit estimation for different sub-sample. For children under 15 years old, *lniremi* only increases the probability of choosing a private school by 0.067. But *lndremi* has a significant negative impact on the probability choosing of private schools by -0.0622; and significant positive impact on the probability choosing of other institution, 0.07. For children aged above 14 both *lniremi* and *lndremi* have a positive and significant impact on the probability of attending all types of school. Though it's impact on the probability of attending government school is positive, it is not significant.

If a child is a boy *lniremi* has a positive impact on the choice of both types of private schools and *lndremi* has a positive impact only on other institutions and the rest of the coefficients are insignificant. For female children, both *lniremi* and *lndremi* have a positive and significant impact on the choice of attending all types of schools except government school.

For children who are living in a rural location, *lniremi* increases the probability of attending all kinds of schools, but *lndremi* only has a positive and significant impact on the choice of other institutions. On the other hand, for children living in an urban location, *lniremi* adversely affects the selection of government school and positively affects the choice of private school. *lndremi* only has a significant positive impact on the choice of a private school.

If a child's household owns no or little land, *lniremi* increases the probability of choosing both types of private schools, but *lndremi* adversely affect the choice of a government school. On the other hand, if a child's household own more land *lniremi* positively influence the selection of both types of private schools and *lndremi* positively influence the choice of private school and other institutions.

Finally, we estimate the model based on migrant members relationship with the household

head. If the migrant member is a child of the household head, *lniremi* positively and significantly affect the choice of private school with government grant and *lndremi* positively and significantly influence the selection of other institutions. On the other hand, if a migrant member is not a child of the household head *lniremi* increases the probability of choosing all types of schools, but *lndremi* only enhances the likelihood of choosing a private school.

4.4.4 Remittance Impact on Agricultural Production

In this section, we present the results for the impact of remittance on agricultural production. To control for the cross-endogeneity issue between migration, remittance, and production equations, we estimate the model by three-stage least squares. In the first stage we regress both international and internal migration indicator variables with household-specific variables and two instruments, $Intmigr * HA$ and $Distance * HA$. In the second stage, we regress *lniremi* and *lndremi* with household and child-specific variables and five instruments, *lnexp* and indicators of how the household use the remittance received. In the final stage, we regress *lncpd*, natural log of the value of crop produced per decimal of land, on the number of internal and international migrants and the amount of remittance with other household-specific variables. We also estimate *lncpd* with all the variables used in different stages by OLS and do a Hausman test to compare the consistency of the estimation.

Table 4.17 presents all the stages of 3SLS and OLS estimations. Former two columns of the table are for the decision of international and internal migration and the next two columns are for remittances. The fifth column is for the production of crop estimated by 3SLS. The last column reports the estimation of crop production by OLS. To examine the impact of remittance on household's crop production we only consider households who participate in crop production. There is a total of 5,619 households in the sample that produces corp.

Here we discuss the results of OLS estimation. The last column of Table 4.17 shows that the number of internal and international migrants hurt household's crop production, but both types of remittance have a positive effect on crop production. But, only international migration and remittance variables are statistically significant. Here, an important issue is that the number of migrants, the level of remittance and value of crop production by a household may be subject to the same shock, which will cause an endogeneity problem and in that case OLS would be inefficient

and biased.

Now, we analyze the results of 3SLS estimation. After considering endogeneity issue, the direct effect of both types of migration on crop production is negative but insignificant. That indicates that migration of family member does not affect households crop production because family labor and market labor are perfect substitutes. 3SLS estimation results also show that both types of remittance have a positive and significant impact on household crop production.

A 1% increase in international and internal remittance increases a household's crop production by 0.0982% and 0.316%, respectively, which exhibits that domestic remittance has a strong effect on household's crop production compared to that for international remittance and can explained by the fact that households with international migrants already have a higher level of capital compared to households with internal migrants. Thus, the marginal effect of international remittance on households agricultural production is lower than in the case of the domestic remittance. To check the efficiency of our 3SLS estimator over OLS estimator, we do a Hausman test. The Hausman test statistic is 127.59 and statistically significant at a 1%, which confirms that OLS estimation is not an efficient estimator for analyzing the impact of remittance on crop production.

4.5 Summary

In this chapter, we have studied the impact of remittance on households consumption, human capital investment, choice of schooling and crop production for Bangladeshi households. We have estimated different consumption equations in the case of internal and international remittance using information on the households in a selection corrected estimation framework which incorporates migration decision by households. Considering only the households with at least one child below 20 we examined the impact of remittance on human capital investment by households. To control for possible endogeneity and selection problem, we estimate the model with IV, JIV, 2SLS and 3 stage and then compared the results with OLS.

To analyze the impact of remittance on children's choice of school, we employ a multinomial logit estimation for all children and young adults aged between 5 and 24 within all households. Finally, controlling for cross endogeneity between migration decision, remittance sent and crop production, we used 3SLS estimation to study the effect of remittance on household crop production. We also

estimate the model with OLS to check for the consistency of the model. Here, we only considered households who participate in crop production.

Results indicate that both internal and international remittances have a positive impact on households' food consumption, expenditures on durable goods, housing, education, health and other goods. Results also confirm that 3 stage estimation is efficient compared to the OLS. After controlling possible self-selection bias, 3 stage produces higher magnitude and positive coefficients for both internal and international remittance. Results show that international and internal remittance increases households education expenditure significantly and again 3 stage estimator is unbiased and efficient among all estimators.

Further, we find that international remittance has a strong effect on households with primary school aged children compared to households with the secondary school aged children, but internal remittance has a relatively weaker effect on households with primary school age child. The effect of an increase in domestic remittance on both rural and urban households is of similar magnitude, but urban households invest more in education with a similar increase in international remittance. International remittance has a greater effect on high-income households compared to low-income households, but domestic remittance has a weaker effect on high-income households.

International remittance enhances the probability of a child attending a private school with or without government grant and other institution, but an increase in internal remittance only enhances the probability of attending other institutions. Both, international and internal remittance increase household's crop production significantly, though the impact of internal remittance is greater.

4.6 Tables

Table 4.1: Descriptive Statistics for All Households

Sample	Variables	All HH	Remittance Receiving Status		
			Non	Internal	International
	lniremi				7.0738
	lndremi			5.5138	
	$lnfe$	12.9635	12.9295	12.9174	13.2571
	lndue	8.7682	8.7011	8.8269	9.2702
	lnhoe	8.5834	8.5170	8.6213	9.0990
	lnee	8.3815	8.3139	8.3684	8.8775
	lnhee	7.7862	7.7083	7.9999	8.3139
	lnoe	7.7794	7.5875	8.0908	8.8836
	lnland	2.7900	2.6485	3.5638	3.5110
	lnhpcinc	4.4253	4.6116	3.9196	3.2084
Includes All The Households	*Rural*	0.6444	0.6280	0.7914	0.6986
	$HHMale$	0.8494	0.9064	0.6158	0.5183
	$HHEdu1$	0.5148	0.5209	0.4906	0.4787
	$HHEdu2$	0.1593	0.1540	0.1957	0.1818
	$HHEdu3$	0.2685	0.2605	0.2964	0.3171
	$Male$			0.9496	0.9813
	$Age1$			0.3698	0.2521
	$Age2$			0.4590	0.5557
	$Age3$			0.1381	0.1705
	$Edu1$			0.0993	0.0957
	$Edu2$			0.2604	0.2565
	$Edu3$			0.5065	0.6066
	Observations	12,652	10,620	695	1,337
Households with Child Age below 20	*Primary*	1.0647	1.0702	0.9771	1.0607
	Secondary	0.6358	0.6140	0.7304	0.7621
	$Maxedu$	4.8996	4.8707	4.6998	5.2080
	Observations	10,939	9,214	523	1,202
Only The Households who Produce Crop	*lncpd*	5.6998	5.6958	5.6927	5.7323
	lnland	4.1837	4.1741	4.2090	4.2381
	$N15$	3.1126	3.0654	3.0840	3.4688
	Observations	5,638	4,627	369	642
Children Age between 5 and 24 inclusive	*EduExp*	1.27%	1.27%	1.09%	1.45%
	$Work$	0.1369	0.1369	0.1132	0.0850
	Observations	23,048	22,923	892	2,399

Table 4.2: Choice of School by Children

Choice of School	No	Internal	International
$NotEnrolled$	36.22%	31.62%	28.66%
$Government$	27.68%	23.84%	23.36%
$Private-Grants$	30.17%	35.82%	40.12%
$Private$	1.97%	1.79%	3.16%
$Other$	3.97%	6.93%	4.70%
$Total$	100%	100%	100%

Table 4.3: Consumption Behavior for Households Receiving Internal Remittance (Heckman)

$Coefficients$	$lnfe$	$lndue$	$lnhoe$	$lnee$	$lnhee$	$lnoe$
$lnexp$	0.984***	0.750***	0.959***	1.406***	0.688***	1.701***
$Rural$	0.0510***	-0.212***	-0.946***	-0.619***	-0.203	-0.575***
$Chittagong$	0.0182	-0.340**	-0.22	0.00934	0.800***	-0.616*
$Rajshahi$	-0.0349	0.284**	0.303	0.136	0.0967	0.491*
$Popden$	0.00421	0.0411*	0.0538	0.0261	-0.0646	0.219*
$Number$	0.00182	0.128***	-0.0366	-0.061	0.0965***	-0.0491
$HHAge$	5.90E-05	-0.00458	-0.0076	0.0408	-0.0153	-0.0388
$HHAge^2$	-2.31E-06	1.55E-05	0.00011	-0.000349	0.000148	0.000495*
$HHMale$	0.0123*	0.059	-0.18	-0.514***	0.101	-0.297*
$Intmigr$	-0.143**	2.582***	2.036	1.12	-0.969	4.439**
$Children$	0.000271	-0.0898**	0.12	-0.255**	0.0504	-0.0871
$Constant$	0.0223	-1.333*	-2.914**	-9.798***	-0.656	-13.00***
$Observations$	12,652	12,652	12,604	12,360	12,588	12,531
$Wald\chi^2$	64131***	650***	206***	177.6***	216***	223.8**
$LR\chi^2$	0.00268	1.665	1.907	1.722	6.749***	4.15***

*** p<0.01, ** p<0.05, * p<0.1

Table 4.4: Consumption Behavior for Households Receiving International Remittance (Heckman)

Coefficients	*lnfe*	*lndue*	*lnhoe*	*lnee*	*lnhee*	*lnoe*
lnexp	0.939***	0.690***	1.158***	0.982***	0.870***	1.429***
Rural	0.0184**	0.0548	-0.837***	-0.844***	0.0231	-0.0307
Chittagong	0.0300**	0.0642	0.0101	-0.241	0.423**	0.427*
RajshahiR	-0.0466***	0.261**	0.122	0.214	0.0468	0.0376
Popden	-0.00253*	0.0271***	0.0307*	0.0139	-0.111***	0.0009
Number	0.00343*	0.0598***	-0.0345	0.0866***	-0.00062	-0.0409*
HHAge	0.00197**	0.00864	0.0300**	0.00132	-0.00421	-0.00489
$HHAge^2$	-1.65e-05**	-7.44E-05	-0.000279**	-4.64E-05	0.00011	8.96E-05
HHMale	0.0413***	-0.173***	-0.171*	-0.272**	-0.0166	0.0554
Intmigr	-0.339***	0.0954	-0.576	2.399	-1.085	-1.007
Children	0.00194	-0.00366	-0.0478	-0.346***	0.0274	-0.0576
Constant	0.650***	-0.653	-6.197***	-4.228***	-3.318**	-10.20***
Observations	12,652	12,650	12,534	12,252	12,497	12,521
$Wald\chi^2$	29476***	556.6***	633.9***	247.2***	254.6***	284.3***
$LR\chi^2$	536.2***	2.633	0.242	4.856**	6.60E-05	0.406

*** p<0.01, ** p<0.05, * p<0.1

Table 4.5: First Stage of Impact of remittance on consumption Behavior (Heckman Remittance Selection)

Coefficients	*lniremi*	*Iremi*	*lndremi*	*Dremi*
lnexp	0.252***	0.736***	0.639***	0.104**
lnland	0.0467**	0.111***	-0.0179	0.0674***
Rural	-0.126**	0.172***	-0.511***	0.401***
Chittagong	-0.0894	-0.304***	0.240**	0.254**
Dhaka			0.138	0.106
Rajshahi	0.0534	0.258***	-0.156	-0.303***
Popden	0.0576***	0.0789***	0.241***	-0.127***
Number		-0.0360***		-0.0563***
Riconsu		0.602***		0.647***
HHAge	-0.00559***	-0.0351***	-0.0230***	0.0351***
$HHAge^2$		0.000395***		-0.000159**
HHMale		-1.303***		-0.679***
HHEdu2				0.160***
HHEdu3				0.210***
HHEdu4		-0.604***		-0.303**
Intmigr		5.220***		-1.327**
Children		0.0970***		
Constant	4.048***	-10.53***	0.216	-4.004***
Observations	12,652		12,652	
$Wald\chi^2$	47.56**		196.9***	
$LR\chi^2$	6.329***		32.24***	

*** p<0.01, ** p<0.05, * p<0.1

Table 4.6: Impact of Internal and International Remittance on Households Food Consumption Expenditure with OLS and 3 stage

$Coefficients$	OLS_d	$3stage_d$	OLS_i	$3stage_i$
$Rural$	-0.185***	0.203***	-0.185***	0.246***
$Chittagong$	0.238***	-0.00131	0.200***	0.271***
$Dhaka$	-0.00874	-0.255***	-0.0211*	-0.176***
$Khulna$	-0.151***	-0.121***	-0.149***	-0.0938***
$Rajshahi$	-0.149***	-0.0654***	-0.146***	-0.237***
$Nmg15$	0.193***	0.197***	0.206***	0.158***
$Nse15$	0.0747***	0.0311***	0.0662***	0.0128***
$Nue15$n	0.150***	0.0620***	0.152***	0.0240***
$Ncb5$	0.101***	0.0123**	0.0974***	-0.00616
$lnhpcinc$	-0.0121***	-0.0108***	-0.00507**	-0.00865***
$lnland$	0.0671***	0.0801***	0.0609***	-0.0474***
$lndremi$	-0.00352			
$\widehat{lndremi}$		0.538***		
$lniremi$			0.0328***	
$\widehat{lniremi}$				2.190***
$Constant$	12.54***	8.392***	12.50***	-3.004***
$Observations$	12,652	12,652	12,652	12,652
R^2	0.374	0.629	0.388	0.757
$Hausman\chi^2$	46272.3***		-26492.67	

*** p<0.01, ** p<0.05, * p<0.1

Note: d stands for internal remittance and i stands for international remittance.

Table 4.7: Impact of Internal and International Remittance on Households Durable Goods Expenditure with OLS and 3 stage

$Coefficients$	OLS_d	$3stage_d$	OLS_i	$3stage_i$
$Rural$	-0.228***	0.115***	-0.226***	0.136***
$Chittagong$	0.472***	0.261***	0.407***	0.501***
$Dhaka$	0.236***	0.0183	0.213***	0.0945***
$Khulna$	0.241***	0.264***	0.241***	0.286***
$Rajshahi$	0.148***	0.217***	0.147***	0.0692***
$NMg15$	0.139***	0.140***	0.159***	0.108***
$Nse15$	0.193***	0.156***	0.180***	0.142***
$Nue15$	0.354***	0.276***	0.356***	0.248***
$Ncb5$	0.0943***	0.0146*	0.0864***	0.00255
$lnhpcinc$	-0.00925***	-0.00880***	0.00198	-0.00709**
$lnland$	0.105***	0.118***	0.0959***	0.00995***
$lndremi$	0.0163***			
$\widehat{lndremi}$		0.475***		
$lniremi$			0.0559***	
$\widehat{lniremi}$				1.845***
$Constant$	7.967***	4.320***	7.913***	-5.117***
$Observations$	12,633	12,633	12,633	12,633
R^2	0.369	0.458	0.386	0.492
$Hausman\chi^2$	2640.97***		3729.6***	

*** p<0.01, ** p<0.05, * p<0.1

Note: d stands for internal remittance and i stands for international remittance.

Table 4.8: Impact of Internal and International Remittance on Households Housing Expenditure with OLS and 3 stage

$Coefficients$	OLS_d	$3stage_d$	OLS_i	$3stage_i$
$Rural$	-0.826***	-0.373***	-0.824***	-0.358***
$Chittagong$	0.575***	0.302***	0.510***	0.619***
$Dhaka$	0.247***	-0.0439	0.225***	0.0651**
$Khulna$	-0.184***	-0.158***	-0.184***	-0.131***
$Rajshahi$	0.131***	0.229***	0.132***	0.0391
$Nmg15$	-0.022	-0.0189	-0.00191	-0.0603***
$Nse15$	0.243***	0.193***	0.231***	0.177***
$Nue15$	0.546***	0.439***	0.547***	0.404***
$Ncb5$	-0.0131	-0.119***	-0.0202	-0.131***
$lnhpcinc$	0.00485	0.00577	0.0163***	0.00783
$lnland$	0.0899***	0.108***	0.0815***	-0.0312***
$lndremi$	0.0179**			
$\widehat{lndremi}$		0.627***		
$lniremi$			0.0567***	
$\widehat{lniremi}$				2.375***
$Constant$	8.372***	3.539***	8.315***	-8.484***
$Observations$	11,703	11,703	11,703	11,703
R^2	0.272	0.336	0.279	0.355
$Hausman\chi^2$	1283.86***		1630.21***	

*** p<0.01, ** p<0.05, * p<0.1

Note: d stands for internal remittance and i stands for international remittance.

Table 4.9: Impact of Internal and International Remittance on Households Education Expenditure with OLS and 3 stage

$Coefficients$	OLS_d	$3SLS_d$	OLS_i	$3SLS_i$
$Rural$	-0.550***	-0.174***	-0.551***	-0.132***
$Chittagong$	0.407***	0.178***	0.345***	0.457***
$Dhaka$	0.199***	-0.0477	0.181***	0.03
$Khulna$	0.0748*	0.110**	0.0799*	0.139***
$Rajshahi$	0.01	0.0867*	0.0158	-0.0878*
$Nmg15$	-0.0770***	-0.0495***	-0.0513***	-0.0769***
$Nse15$	0.450***	0.417***	0.436***	0.401***
$Nue15$	0.678***	0.596***	0.679***	0.560***
$Ncb5$	-0.392***	-0.449***	-0.401***	-0.465***
$lnhpcinc$	-0.0419***	-0.0403***	-0.0309***	-0.0400***
$lnland$	0.133***	0.147***	0.124***	0.0202**
$lndremi$	-0.00781			
$\widehat{lndremi}$		0.541***		
$lniremi$			0.0495***	
$\widehat{lniremi}$				2.220***
$Constant$	8.038***	3.762***	7.972***	-7.865***
$Observations$	8,134	8,134	8,134	8,134
R^2	0.356	0.385	0.361	0.4
$Hausman\chi^2$	408.51***		588.51***	

*** p<0.01, ** p<0.05, * p<0.1

Note: d stands for internal remittance and i stands for international remittance.

Table 4.10: Impact of Internal and International Remittance on Households Health Expenditure with OLS and 3 stage

$Coefficients$	OLS_d	$3stage_d$	OLS_i	$3stage_i$
$Rural$	-0.127***	0.0717**	-0.124***	0.126***
$Chittagong$	0.737***	0.613***	0.680***	0.751***
$Dhaka$	0.149***	0.028	0.127***	0.0532*
$Khulna$	0.181***	0.186***	0.175***	0.202***
$Rajshahi$	0.0192	0.0492	0.0112	-0.048
$Nmg15$	0.121***	0.119***	0.135***	0.0972***
$Nse15$	0.139***	0.118***	0.128***	0.104***
$Nue15$	0.227***	0.180***	0.229***	0.151***
$Ncb5$	0.105***	0.0572***	0.0976***	0.0400**
$lnhpcinc$	0.0132**	0.0124**	0.0219***	0.0135**
$lnland$	0.111***	0.120***	0.105***	0.0454***
$lndremi$	0.0367***			
$\widehat{lndremi}$		0.276***		
$lniremi$			0.0498***	
$\widehat{lniremi}$				1.286***
Constant	6.884***	4.781***	6.850***	-2.213***
$Observations$	11,545	11,545	11,545	11,545
R^2	0.152	0.164	0.157	0.178
$Hausman\chi^2$	174.24***		304.87***	

*** p<0.01, ** p<0.05, * p<0.1

Note: d stands for internal remittance and i stands for international remittance.

Table 4.11: Impact of Internal and International Remittance on Households Other Expenditure with OLS and 3 stage

$Coefficients$	OLS_d	$3stage_d$	OLS_i	$3stage_i$
$Rural$	-0.400***	0.0714*	-0.400***	0.141***
$Chittagong$	0.648***	0.373***	0.469***	0.731***
$Dhaka$	0.341***	0.0403	0.273***	0.131***
$Khulna$	0.131**	0.167***	0.136**	0.209***
$Rajshahi$	0.0569	0.170***	0.0647	-0.0412
$Nmg15$	-0.0344	-0.0125	0.0247	-0.0539***
$Nse15$	0.353***	0.303***	0.318***	0.280***
$Nue15$	0.580***	0.467***	0.584***	0.416***
$Ncb5$	-0.0115	-0.107***	-0.031	-0.129***
$lnhpcinc$	0.0190**	0.0203**	0.0527***	0.0231***
$lnland$	0.273***	0.300***	0.249***	0.137***
$lndremi$	0.0316**			
$\widehat{lndremi}$		0.680***		
$lniremi$			0.149***	
$\widehat{lniremi}$				2.867***
$Constant$	6.409***	1.096***	6.227***	-14.06***
$Observations$	9,653	9,653	9,653	9,653
R^2	0.23	0.264	0.261	0.286
$Hausman\chi^2$	474.48***		432.85***	

Note: d stands for internal remittance and i stands for international remittance.

Table 4.12: Remittance Impact on Human Capital Investment

$Coefficients$	OLS	IV	JIV	2SLS	3 stage
$lniremi$	0.0513***	0.0754***	0.0753***		
$lndremi$	-0.0225	0.0233	0.0242		
$\widehat{lniremi}$				0.0657***	
$\widehat{lndremi}$				0.0404	
$\widehat{lniremi}$					1.142***
$\widehat{lndremi}$					0.506***
$HHEdu1$	-2.783***	-2.769***	-2.769***	-2.763***	-2.386***
$HHEdu2$	-2.186***	-2.183***	-2.183***	-2.178***	-1.889***
$HHEdu3$	-1.239***	-1.240***	-1.240***	-1.237***	-1.037***
$Islam$	-0.13	-0.141	-0.141	-0.134	-0.177*
$RIEdu$	1.604***	1.618***	1.618***	1.632***	1.580***
$RIConsu$	0.235**	0.224**	0.224**	0.226**	0.237**
$lnland$	0.259***	0.255***	0.255***	0.257***	0.235***
$lnhpcinc$	-0.0955***	-0.0958***	-0.0958***	-0.0982***	-0.0947***
$Children$	-0.917***	-0.901***	-0.901***	-0.898***	-0.813***
$Primary$	1.628***	1.645***	1.645***	1.643***	1.653***
$Secondary$	0.702***	0.722***	0.722***	0.723***	0.715***
$Maxedu$	0.231***	0.210***	0.210***	0.211***	0.109***
$Rural$	-0.810***	-0.816***	-0.816***	-0.821***	-0.627***
$Barisal$	0.163	0.15	0.149	0.13	0.395***
$Chittagong$	-0.477***	-0.477***	-0.477***	-0.467***	-0.398***
$Khulna$	0.407***	0.406***	0.406***	0.407***	0.683***
$Rajshahi$	0.329***	0.326***	0.326***	0.330***	0.573***
$Rangpur$	-0.320***	-0.322***	-0.322***	-0.324***	-0.0831
$Sylhet$	-0.755***	-0.738***	-0.738***	-0.727***	-0.614***
$Constant$	6.036***	5.822***	5.822***	5.822***	-4.856***
$Observations$	10,933	10,933	10,933	10,933	10,933
R^2	0.345	0.345	0.421	0.345	0.355
$HausmanTest$	174.58***	181.24***	154.04***	190.94***	

*** p<0.01, ** p<0.05, * p<0.1

Table 4.13: First Stage of Impact of Remittance on Human Capital Investment (OLS and Heckman Remittance Selection)

$Coefficients$	OLS		Heckman			
	$lniremi$	$lndremi$	$lniremi$	$Iremi$	$lndremi$	$Dremi$
$HHAge$	-0.0202***	0.0176***	0.000691	-0.0307*	0.022	0.0699***
$HHAge^2$	0.000191**	-0.000161***	1.95E-06	0.000273**	-0.000209	-0.000578***
$lnexp$	0.244***	-0.149***	0.393***	0.628***	0.485***	-0.799***
$Nmig$	-0.118	0.344***	-0.149***	-0.143**	-0.0424	0.532***
$Yearsm$	0.172	1.031***	0.175**	0.0956	0.724***	0.738***
$Mspouse$	1.150***	0.14	0.309***	0.895***	1.136***	0.236
$Age1$	2.629***	1.523***	-0.476**	3.074***	0.164	2.372***
$Age2$	3.241***	1.150***	-0.397*	3.145***	0.524**	2.093***
$Age3$	2.781***	1.126***	-0.530**	2.714***	0.147	2.107***
$Edu3$	0.755***	-0.263**	0.0641	0.348***	-0.0172	-0.0369
$Popden$	0.0453***	-0.0326***	0.0669***	0.143***	0.156***	-0.277***
$Intmigr$	1.141***	-0.655***		3.925***		-2.815***
$Saudi$	3.062***	-2.359***		2.217***		-2.799***
$Malaysia$	3.334***	-2.388***		7.326***		-7.967***
$Constant$	-2.899***	1.643***	2.100**	-11.62***	-2.700*	5.802***
$Observations$	10,939	10,939	10,939		10,939	
R^2	0.719	0.406				
$Wald-\chi^2$			96.91***		237.5***	
$LR-\chi^2$			6.428**		4.763**	

*** p<0.01, ** p<0.05, * p<0.1

Table 4.14: Robustness Check for 3 stage Estimation

$Coefficients$	$Primary$	$Secondary$	$Rural$	$Urban$	$Low-inc$	$High-inc$
$\widehat{lniremi}$	1.278***	1.114***	1.293***	1.448***	1.322***	1.607***
$\widehat{lndremi}$	0.450***	0.606***	0.520***	0.544***	0.591***	0.457***
$lnhpcinc$	-0.0554**	-0.123***	-0.0864***	-0.0925***	-0.0422**	-0.179**
$lnland$	0.226***	0.309***	0.192***	0.195***	0.169***	0.190***
$HHEdu1$	-2.177***	-3.431***	-1.888***	-2.655***	-1.986***	-2.597***
$HHEdu2$	-1.366***	-2.735***	-1.319***	-2.009***	-1.473***	-1.931***
$HHEdu3$	-0.709***	-1.539***	-0.681***	-0.859***	-0.703**	-0.984***
$Islam$	-0.312**	-0.0804	-0.163	-0.314*	-0.256**	-0.166
$Children$	-0.312***	-0.780***	-0.290***	-0.591***	-0.283***	-0.597***
$Primary$		1.317***	1.926***	2.110***	1.804***	2.148***
$Secondary$	0.533***		1.136***	1.050***	1.185***	0.970***
$Maxedu$	0.0911**	0.199***	0.0563	0.219***	0.0652*	0.167***
$RIEdu$	1.657**	1.692***	2.090***	1.589**	1.769***	2.259***
$RIConsu$	0.164	0.089	0.14	0.438**	0.062	0.485***
$Rural$	-0.591***	-0.658***			-0.681***	-0.500***
$Barisal$	0.256	0.355	0.203	0.749***	0.259*	0.550***
$Chittagong$	-0.275**	-0.547***	-0.626***	-0.157	-0.618***	-0.325***
$Khulna$	0.623***	0.775***	0.640***	0.782***	0.634***	0.699***
$Rajshahi$	0.594***	0.604***	0.695***	0.560***	0.586***	0.654***
$Rangpur$	-0.245	-0.334	-0.118	0.329*	-0.0912	0.168
$Sylhet$	-0.572***	-0.638***	-0.837***	-0.465*	-0.712***	-0.701***
$Constant$	-3.269**	-3.701**	-7.838***	-8.729***	-7.498***	-8.845***
$Observations$	4,123	3,606	8,146	4,498	6,325	6,323
R^2	0.228	0.293	0.407	0.421	0.404	0.426

*** p<0.01, ** p<0.05, * p<0.1

Table 4.15: Impact of Remittance on Children Choice of School

$Coefficients$	Govt.	Priv.Grant	Private	Other
$lniremi$	-0.00142	0.0425***	0.0778***	0.0416**
$lndremi$	-0.00371	0.021	0.0654	0.0851***
$lnland$	0.0799***	0.193***	0.0922**	0.211***
$lnexp$	0.580***	0.775***	2.043***	0.16
$RIEdu$	0.297	0.389	0.971**	-0.274
$HHMale$	0.304***	0.361***	0.568**	0.421**
$NM15$	-0.144**	-0.334***	-0.00595	-0.222**
$NF15$	-0.124*	-0.213***	-0.00138	-0.325***
$Maxedu$	0.151**	0.298***	-0.102	0.295***
$Child$	0.779***	1.178***	1.793***	0.642***
$Spochi$	0.246*	0.575***	0.651	-0.830***
$GChild$	0.858***	1.203***	2.190***	0.18
$CAge$	0.841***	1.526***	0.731***	1.231***
$CAge^2$	-0.0234***	-0.0407***	-0.0218***	-0.0353***
$Work$	-0.713***	-1.408***	-1.714***	-1.863***
$Rural$	-0.229***	-0.379***	-1.025***	0.0891
$Totalroad$	0.000394**	0.000559***	0.00430***	0.00105***
$Observations$		23,742		
$PseudoR^2$		0.21		
$Waldchi2$		5519***		

*** p<0.01, ** p<0.05, * p<0.1

Note: Household origin location specific fixed effect, distance from household's resident district to capital city Dhaka, remittance invested for business, consumption, construction, household head age, age squared, household's believe of religion, population density at origin location, region weighted male employment at international destination, international migration rate, number of family members primary school going age, number of family members secondary school going age are not reported.

Table 4.16: Impact of Remittance on Children Choice of School by Children Age, Gender, Household live in Rural or Urban Location, Household's Ownership of Land and Migrant's Relationship with Household Head

Sample	*Coef.*	Govt.	Priv.Grant	Private	Other
$Age < 15$	*lniremi*	-0.0131	-0.0213	0.0670**	-0.0131
	lndremi	-0.0237	-0.0622**	-0.0585	0.0700*
Observations	13,592	PR^2	0.243	$Wald\chi^2$	6352***
$Age > 14$	*lniremi*	0.0235	0.0932***	0.0851*	0.105***
	lndremi	0.0294	0.0785**	0.233***	0.105**
Observations	10,150	PR^2	0.102	$Wald\chi^2$	1635***
Boy	*lniremi*	0.00979	0.0476**	0.0610*	0.0184
	lndremi	-0.0223	-0.0232	-0.0275	0.0729*
Observations	11,853	PR^2	0.212	$Wald\chi^2$	2777***
Girl	*lniremi*	-0.0139	0.0418**	0.0977**	0.0644**
	lndremi	0.0119	0.0559**	0.148**	0.0910*
Observations	11,889	PR^2	0.216	$Wald\chi^2$	25766***
RuralHH	*lniremi*	0.0232*	0.0613***	0.0688*	0.0646***
	lndremi	0.00851	0.018	0.0222	0.0957***
Observations	15,487	PR^2	0.219	$Wald\chi^2$	4210***
UrbanHH	*lniremi*	-0.0522*	-0.0114	0.0765*	-0.0306
	lndremi	-0.0397	0.0388	0.149*	-0.175
Observations	8,255	PR^2	0.197	$Wald\chi^2$	9708***
Less/NoLand	*lniremi*	0.0265	0.0612***	0.0831**	0.0512
	lndremi	-0.0585*	0.0347	0.0139	0.0432
Observations	11,890	PR^2	0.204	$Wald\chi^2$	15223***
MoreLand	*lniremi*	-0.0137	0.0292*	0.0634*	0.03
	lndremi	0.0271	0.0094	0.113*	0.0975**
Observations	11,852	PR^2	0.219	$Wald\chi^2$	3110***
MigChild	*lniremi*	-0.0227	0.0268*	0.031	0.00722
	lndremi	-0.0123	0.0175	0.029	0.0957***
Observations	18,406	PR^2	0.225	$Wald\chi^2$	4379***
MigNChild	*lniremi*	0.0511**	0.0795***	0.103**	0.132***
	lndremi	0.0343	0.038	0.153*	-0.00479
Observations	5,336	PR^2	0.174	$Wald\chi^2$	4632***

*** p<0.01, ** p<0.05, * p<0.1

Table 4.17: Remittance Impact on Agricultural Production

Coefficients	3SLS					OLS
	IMig	*DMig*	*lniremi*	*lndremi*	*lncpd*	*lncpd*
lniremi					0.0982**	0.0220**
lndremi					0.316*	0.0169
$NIMig$			3.107***	-0.0591	-0.177	-0.141***
$NDMig$			-3.031	2.546	-0.78	-0.0317
Household Specific:						
$Ng15$	0.0477***	-0.0766***	0.196	0.0343	0.0218**	-0.00289
$Yongd$	0.00296	0.0465***				-0.0105
$HHMale$	-0.298***	-0.139***			0.214***	0.0215
$HHAge1$	-0.0357	0.475***			-0.0815**	-0.0427
$HHEdu1$	0.0101	-0.137***				0.035
$HHEdu4$	-0.0831**	-0.0513				-0.166**
$Islam$					-0.0348	-0.0195
lnoptl					-0.143***	-0.182***
lnhpcinc	-0.0241***	0.00308	0.0718	0.0446		0.0141**
lnland	0.0518***	-0.0388***				0.0546***
$CAAge$			-0.145	-0.0705		-0.0165
$CAAge^2$			0.00894	0.00447		0.0007
$Schooling$			0.839	0.369		0.115***
FPD			-0.783	-0.317		-0.137***
$Popd * HA$	2.41e-06***	2.33e-06***				7.06e-07**
Instruments:						
$Intmigr * HA$	-0.0097	-0.0271				-0.00599
$Distance * HA$	-1.82E-05	0.000116***				-2.09E-06
lnexp			-1.832	-0.436		0.177***
$RIConst$			79.33	23.04		-0.0461
$RIBus$			-30.03	-16.53		-0.103
$RIMarri$			-91.48	-45.48		-0.525***
$RIEdu$			17.07	-11.34		0.136

*** p<0.01, ** p<0.05, * p<0.1

Note: Household's origin specific fixed effect, live in rural location, migrant level of education, remittance invested for business, construction, education, consumption and international destination dummy variables are also included in the estimation for different equations but not reported.

Chapter 5

Conclusion and Policy Implications

5.1 Conclusion

This dissertation consists of three related essays on the rural-urban migration decision, the motivation to remit and the effect of remittance on households. Chapter two explores the risk diversification aspect of the rural-urban migration. A critical finding is that the monthly income correlation between the rural agricultural sector and the urban informal sector plays an important part in the household decision to send members to urban locations. Results are consistent across all the specifications and sub-samples with a stable coefficient value statistically significant at 1%. Most of the other coefficients support the theory and are relatively stable over different sub-samples and are statistically significant at 1%.

The coefficients for the square of the average monthly income is negative, as expected, but insignificant for the entire samples with household specific variables, while significant for many of the sub-samples. Consistent with the theory, the coefficient of the standard error of income are negative for all specifications and sub-samples, and statistically significant, except for the sub-samples with the male household head and high-income households. Prior studies of place-to-place migration found counter-intuitive results concerning standard deviation of the income variable, with coefficients frequently having unanticipated signs, which are statistically insignificant. The multinomial conditional logit framework adopted here confirmed the expected sign and are statistically significant in most cases. More importantly, coefficients of the correlation variable are negative as well, which is consistent with risk-averse households, that place migrants to diversify

risk. This study is one of only a few studies corroborating the portfolio theory of migration. Results of the study also confirm the prediction of the option theory of migration. It would be of great interest for future research to empirically examine and compare these two channels of family migration theory.

Chapter three examines the motivation of migrants for sending remittance. Our results are consistent with both the altruistic and insurance models. Both altruistic and insurance motive simultaneously determine the decision to send remittances by a migrant. We have examined the insurance motive for sending remittance by migrants to households indirectly using only migrant specific attributes. It would be interesting to investigate the insurance motive using a more direct approach by using income risk at both household's origin and migrant's destination with the income correlation between origin and destination locations. Researchers have investigated the insurance motive of remittances using direct approaches. Future research done in this area could study the motivation for sending remittance using income risk and correlation of income between two places, as none of the earlier literature used them.

Chapter four analyzes the impact of remittance on households. Results indicate that internal remittance-receiving households are negatively selected in their unobserved characteristics for health and other expenditure categories. On the other hand, international remittance-receiving households are negatively selected for food consumption but positively selected for education spending category. Estimating each expense category with internal and foreign remittance by OLS and 3 stage and then performing Hausman test, we showed that 3 stage estimation is efficient in 11 out of 12 cases after controlling self-selection for remittance. Our results also indicate that both types of remittance have a positive and significant impact on all consumption categories. Moreover, the impact of international remittance on each expenditure category is large.

Controlling for the possible endogeneity issue, the IV, JIV, and 2SLS produce coefficients of internal and international remittance variables that are positive but only significant for international remittance. After taking care of the selection issue, 3 stage provides a positive and higher magnitude of the coefficients for both internal and international remittance, which are statistically significant at 1% level. Following previous results, foreign remittance has a dominant effect on human capital investment. Finally, the Hausman test statistics also confirm that our 3 stage estimation is the efficient one among all estimation models.

We showed that children of households receiving international remittance have a higher probability of attending a private school with or without a government grant and other educational institutions, but internal remittance receiving households' children have a higher likelihood of attending only other types of educational institutions. To check the sensitivity of the results, we estimate the model with different sub-samples by individual's age, gender, the location of households resident, the ownership of land and the migrant's relationship with the household head. In most of the cases, international remittance has a positive effect on the choice of private schools with or without a government grant and other types of school; and internal remittance has a positive effect on other types of school.

Results show that both internal and international remittance enhances households crop production. In this case, the effect of domestic remittance is significant, and the Hausman test confirms the efficiency of our 3SLS estimation. The results from this study fill the gap in applied remittance literature in the context of Bangladeshi households. The applied remittance study for Bangladesh may be extended further. We can examine the effect of remittance on child labor, asset accumulation, access to formal credit markets, development of the rural financial market, poverty and inter-household inequality. We hope to further study more relevant influences of remittance on Bangladeshi households in the near future.

5.2 Policy Implications

The findings of this dissertation are also important from a policy perspective. The results of the second chapter support the fact that wage differences, uncertainty of wage, correlation between rural agricultural wage and urban-informal sector wage and migration cost play an important role in the migration and destination of migration decisions. The results of the third chapter show that the altruistic and the insurance models simultaneously explain migrants' motive for sending remittance. The findings in the fourth chapter indicate that both internal and international remittance increase the consumption of food and expenditure of durable goods, housing, education, health, and other commodities. Remittance also raises human capital investment, increase the probability of getting better schooling and increases agricultural production.

Our findings clearly carry policy implications for the government, since, beyond private costs

and benefits, migration has social implications. Through rural-urban migration, human resources move from a less productive rural sector to more productive urban location and improves sectoral allocation of resources. Rural-urban migration also causes changes in income distribution, access to better education, leads to rural brain drain, increases the number of single-parent households, increases urban population density, demand for urban housing and public services. Migration also leads to increase in the crime rate, congestion and environmental degradation. To the extent that excessive migration imposes congestion and other social costs, policies must address the issues. Wage gaps are the main driver of migration from rural to urban regions. To counter the effect, the government should focus on developmental activities in rural areas not just urban areas. Government offices should be decentralized to rural areas, so that people do not need to go to urban locations for public services. The government should provide incentives to the private sector to locate in the rural market. These measures will create employment in rural locations, increase rural expected income and families will not have so many incentives to send a member to urban locations for work. Other than job-creation, the government should also focus on providing quality education, health services, banking facilities, utilities and communication services in rural locations to motivate rural households to stay in their original locations. The findings of the portfolio model in chapter 2 suggest that an important motivation for families to send migrants to urban locations is risk diversification. The process is aggravated by the fact that other forms of income smoothing is not available for many rural Bangladeshi families. Availability of insurance, against risks like crop failure, as well as access to credit markets are policy measures that can help reduce the need to send migrants in order to stabilize income.

Bangladesh has a huge potential to raise international remittance by not only sending more migrants abroad but also improving their professional skills and language proficiency to improve the standard of living of the recipient households by raising both consumption and investment, which in turn, would raise the growth rate of the overall economy. Both internal and international migrants with higher education send more remittance to the household compared to lower-educated migrants. There are limited training facilities for those who are willing to migrate abroad. Most of the international migrants from Bangladesh are semi-skilled or unskilled and thus, earn low income in foreign countries. Therefore, government should focus more on vocational training along with conventional education. Moreover, the government should undertake policy to familiarize the

potential migrants with the language used in their destination country. The service can be provided by the government itself or by the agencies sending labor to foreign countries. Helping migrants to earn a better remuneration and cope with the environment in the foreign country. A modest investment on human capital for international migrants will increase foreign remittance, which will play an important role in the economy, both at the micro and macro level. At the micro level, the household's consumption, production and investment will increase. At the macro level, the foreign exchange reserve will increase, the economic growth rate will rise and the country will achieve a greater economic stability.

The cost of migration and the uncertainty in migrant's destination discourage households from sending members away. Most of the households in Bangladesh do not have access to information regarding the process of migration and depend primarily on middlemen, which increases both the processing cost and uncertainty. A large number of them even try to migrate illegally, sometime with deadly consequences. Public policy needs to address this tragic issue urgently. The government should open an agency or assign representatives at the grass roots level to provide all relevant information, thus eliminating the need for middlemen, which will reduce both the cost and the uncertainty for a potential migrant. The exchange rate and cost of sending remittance also determines the amount of remittance sent by an international migrant. It is important that households receive the remittance conveniently in their local area. Bangladesh has achieved some success in this matter since, in most of locations, households can easily collect remittance sent to them. However, the government should still monitor the channels through which remittance are sent, in part to make sure that there are no unreasonable charges.

The government can also encourage migrants to send more remittance by subsidizing or matching the amount remitted for education of children, as well as agricultural or industrial investment, improving human capital development and productivity. We can expect to see an increase in employment, lower poverty, stable prices and higher economic growth. Migrants from Bangladesh are heavily concentrated in a few countries of Middle East. The government needs to diversify the choice of overseas locations through adoption of relevant strategies to expand migration to other countries in Middle East and penetrate OECD countries that have aging problems and low population growth. The Bangladeshi government should also target emerging economies like Russia, China, South Africa, many East European countries, Middle Asian countries and India for

migration. Although migration and remittance have become important part of the economy of Bangladesh, there is no formal migration and remittance policy. A coherent and integrated set of policies need to be urgently put in place.

Bibliography

Acharya, Chakra P, & Leon-Gonzalez, Roberto. 2014. "How do migration and remittances affect human capital investment? The effects of relaxing information and liquidity constraints". *Journal of Development Studies*, **50**(3), 444–460.

Acosta, Pablo, Calderon, Cesar, Fajnzylber, Pablo, & Lopez, Humberto. 2008. What is the impact of international remittances on poverty and inequality in Latin America? *World Development*, **36**(1), 89–114.

Adams, Richard H, & Cuecuecha, Alfredo. 2013. "The impact of remittances on investment and poverty in Ghana". *World Development*, **50**, 24–40.

Agarwal, Reena, & Horowitz, Andrew W. 2002. Are international remittances altruism or insurance? Evidence from Guyana using multiple-migrant households. *World development*, **30**(11), 2033–2044.

Altonji, Joseph G, Hayashi, Fumio, & Kotlikoff, Laurence J. 1992. "Is the extended family altruistically linked? Direct tests using micro data". *The American Economic Review*, 1177–1198.

Ambler, Kate, Aycinena, Diego, & Yang, Dean. 2015. "Channeling remittances to education: A field experiment among migrants from El Salvador". *American Economic Journal: Applied Economics*, **7**(2), 207–232.

Amuedo-Dorantes, Catalina, & Pozo, Susan. 2006. "Remittances as insurance: evidence from Mexican immigrants". *Journal of Population Economics*, **19**(2), 227–254.

Anam, Mahmudul, & Chiang, Shin-Hwan. 2007. "Rural–urban migration of family labor: A portfolio model". *The Journal of International Trade & Economic Development*, **16**(3), 325–335.

Arzaghi, Mohammad, & Rupasingha, Anil. 2013. "Migration as a Way to Diversify: Evidence from Rural to Urban Migration in the US". *Journal of Regional Science*, **53**(4), 690–711.

Banerjee, Biswajit, & Kanbur, SM. 1981. "On the specification and estimation of macro rural–urban migration functions: with an application to Indian data". *Oxford Bulletin of Economics and Statistics*, **43**(1), 7–29.

Bansak, Cynthia, & Chezum, Brian. 2009. "How do remittances affect human capital formation of school-age boys and girls?". *The American economic review*, **99**(2), 145–148.

Barro, Robert J. 1974. "Are government bonds net wealth?". *Journal of political economy*, **82**(6), 1095–1117.

Becker, Gary S. 1974. "A theory of social interactions". *National Bureau of Economic Research.*

Becker, Gary S. 2009. *"A Treatise on the Family"*. Harvard university press.

Beyene, Berhe Mekonnen. 2014. "The effects of international remittances on poverty and inequality in Ethiopia". *The Journal of Development Studies*, **50**(10), 1380–1396.

Binci, Michele, & Giannelli, Gianna Claudia. 2016. "Internal versus International Migration: Impacts of Remittances on Child Labor and Schooling in Vietnam". *International Migration Review.*

Bouoiyour, Jamal, & Miftah, Amal. 2015. "The Impact of Remittances on Children's Human Capital Accumulation: Evidence from Morocco". *Journal of International Development.*

Bui, Thi Thanh Nga, Le, Thi Thanh Ngan, & Daly, Kevin James. 2015. "Microlevel impacts of remittances on household behavior: Viet Nam case study". *Emerging Markets Review*, **25**, 176–190.

Caruthers, Hillary. 2013. "Risk management and rural to urban migration decisions in Indonesia". *Unpublished Manuscript.*

Chen, Kong-Pin, Chiang, Shin-Hwan, & Leung, Siu Fai. 2003. "Migration, family, and risk diversification". *Journal of Labor Economics*, **21**(2), 353–380.

Connell, John, Dasgupta, Biplab, Laishley, Roy, & Lipton, Michael. 1976. "Migration from rural areas: The evidence from village studies". *Oxford Economic Papers.*

Cushing, Christiadi, & Cushing, Brian. 2007. "Conditional Logit, IIA, and Alternatives for Estimating Models of Interstate Migration". *In: "annual meeting of the Southern Regional Science Association. Charleston, SC.*

Daveri, Francesco, & Faini, Riccardo. 1999. "Where do migrants go?". *Oxford Economic Papers*, **51**(4), 595–622.

Davies, Paul S, Greenwood, Michael J, & Li, Haizheng. 2001. "A conditional logit approach to US state-to-state migration". *Journal of Regional Science*, **41**(2), 337–360.

De, Prabal K, & Ratha, Dilip. 2012. "Impact of remittances on household income, asset and human capital: evidence from Sri Lanka". *Migration and Development*, **1**(1), 163–179.

Durand, Jorge, Kandel, William, Parrado, Emilio A, & Massey, Douglas S. 1996. "International migration and development in Mexican communities". *Demography*, **33**(2), 249–264.

Esfahani, Hadi S, & Salehi-Isfahani, Djavad. 1989. "Effort observability and worker productivity: towards an explanation of economic dualism". *The Economic Journal*, **99**(397), 818–836.

Ghatak, Subrata, Levine, Paul, & Price, Stephen Wheatley. 1996. "Migration theories and evidence: an assessment". *Journal of Economic Surveys*, **10**(2), 159–198.

Greene, William H. 2003. *Econometric analysis*. Pearson Education India.

Gubert, Flore. 2002. "Do migrants insure those who stay behind? Evidence from the Kayes area (Western Mali)". *Oxford Development Studies*, **30**(3), 267–287.

Harris, John R, & Todaro, Michael P. 1970. "Migration, unemployment and development: a two-sector analysis". *The American economic review*, 126–142.

Heckman, James J. 1976. "The common structure of statistical models of truncation, sample selection and limited dependent variables and a simple estimator for such models". *Pages 475–492 of: Annals of Economic and Social Measurement, Volume 5, number 4*. NBER.

Hendrickx, John, *et al.* . 2000. "Special restrictions in multinomial logistic regression". *Stata Technical Bulletin*, **56**, 18–26.

Katz, Eliakim, & Stark, Oded. 1986. "Labor migration and risk aversion in less developed countries". *Journal of labor Economics*, 134–149.

Kroeger, Antje, & Anderson, Kathryn H. 2014. "Remittances and the human capital of children: New evidence from Kyrgyzstan during revolution and financial crisis, 2005–2009". *Journal of Comparative Economics*, **42**(3), 770–785.

Low, Allan. 1986. "Agricultural development in southern Africa: farm-household economics and the food crisis".

Lucas, Robert EB, & Stark, Oded. 1985. "Motivations to remit: Evidence from Botswana". *The Journal of Political Economy*, 901–918.

McFadden, Daniel, *et al.* . 1973. "Conditional logit analysis of qualitative choice behavior".

Mueller, Charles F. 1982. *"The economics of labor migration: A behavioral analysis"*. Elsevier.

Nguyen, Cuong Viet, & Nguyen, Hoa Quynh. 2015. "Do internal and international remittances matter to health, education and labor of children and adolescents? The case of Vietnam". *Children and Youth Services Review*, **58**, 28–34.

O'Keefe, Suzanne. 2004. "Locational choice of AFDC recipients within California: a conditional logit analysis". *Journal of Public Economics*, **88**(7), 1521–1542.

Paulson, Anna L. 1994. *"Insurance motives for migration: Evidence from Thailand"*. Ph.D. thesis, University of Chicago, Dept. of Economics.

Rozelle, Scott, Taylor, J Edward, & DeBrauw, Alan. 1999. "Migration, remittances, and agricultural productivity in China". *The American Economic Review*, **89**(2), 287–291.

Sana, Mariano, & Massey, Douglas S. 2005. "Household composition, family migration, and community context: Migrant remittances in four countries". *Social Science Quarterly*, **86**(2), 509–528.

Singh, Inderjit, Squire, Lyn, & Strauss, John. 1986. *"Agricultural household models: Extensions, applications, and policy"*. The World Bank.

Stark, Oded. 1984. "Rural-to-urban migration in LDCs: a relative deprivation approach". *Economic Development and Cultural Change*, **32**(3), 475–486.

Stark, Oded. 1991. "The migration of labor". *The Journal of Industrial Economics*, **41**(2).

Stark, Oded, & Levhari, David. 1982. "On migration and risk in LDCs". *Economic development and cultural change*, **31**(1), 191–196.

Stark, Oded, & Lucas, Robert EB. 1988. "Migration, remittances, and the family". *Economic Development and Cultural Change*, 465–481.

Taylor, J Edward. 1987. "Undocumented Mexico—US migration and the returns to households in rural Mexico". *American Journal of Agricultural Economics*, **69**(3), 626–638.

Taylor, J Edward, & Adelman, Irma. 2003. "Agricultural household models: genesis, evolution, and extensions". *Review of Economics of the Household*, **1**(1-2), 33–58.

Todaro, Michael P. 1969. "A model of labor migration and urban unemployment in less developed countries". *The American economic review*, **59**(1), 138–148.

Van Dalen, Hendrik P, Groenewold, George, & Fokkema, Tineke. 2005. "The effect of remittances on emigration intentions in Egypt, Morocco, and Turkey". *Population Studies*, **59**(3), 375–392.

Vanwey, Leah K. 2004. "Altruistic and contractual remittances between male and female migrants and households in rural Thailand". *Demography*, **41**(4), 739–756.

WBG, World Bank Group. 2016. *World Development Indicators*. Available from http://data.worldbank.org/data-catalog/world-development-indicators.

Wooldridge, Jeffrey M. 2010. *"Econometric analysis of cross section and panel data"*. MIT press.

Appendix

Household Income and Expenditure Survey 2010:

Executive Summary and

Data Collection Methodology

Appendix A
Household Income and Expenditure Survey 2010:
Executive Summary

This report presents final results from the fifteenth round of the Household Income and Expenditure Survey (HIES) conducted by Bangladesh Bureau of Statistics. The key finding from HIES 2010 is that the standard of living of the population in general has improved very significantly in recent years. This is reflected in reduced incidence of poverty with stability in the distribution of income and expenditure; increased nutrition from a more diversified food consumption basket; and higher level of living in terms of non-food indicators.

Survey period, sample size and new modules in the questionnaire: The survey was carried out during February 2010 – January 2011. The 2010 HIES covers 12,240 households, drawn from 612 Primary Sampling Units (PSUs), from 16 strata - 6 rural, 6 urban, and 4 Statistical Metropolitan Areas. Compared to the 2005 HIES, this round shows an increase of 21.43% in terms of PSUs and households. In addition to the modules canvassed in 2005, four additional modules were introduced in 2010: (1) Disability (2) Migration and Remittances (3) Micro Credit and (4) Crisis & Crisis Management.

Poverty: Based on the upper poverty line, in HIES-2010 incidence of poverty is estimated at 31.5 percent at the national level, 35.2 percent in rural area and 21.3 percent in urban area. In 2005, these rates were 40.0 percent at the national level, 43.8 percent in rural area and 28.4 percent in urban area. Poverty has declined by 8.5 percentage points (approximately 1.7 percent per annum) at national level, 8.6 percentage points in rural area and 7.1 percentage points in urban area during 2005 to 2010.

Division level breakdowns of poverty estimates: The estimates of Head Count Rates by Divisions using the upper poverty lines from the 2010 HIES 2010 reveals that, Rangpur Division has the highest incidence of poverty (HCR) at 46.2%, followed by Barisal Division 39.4% and Khulna division 32.1%. On the other hand, Chittagong Division has recorded the lowest HCR of incidence of poverty at 26.2%, followed preceded by Sylhet Division 28.1% and Rajshahi Division (New) 29.8%.

Poverty by sex of head of household: Poverty incidence is found to be significantly less

for female-headed households than that for male- headed ones. Using the upper poverty line, the HCR of incidence of poverty is 32.1% for the male heads where, 26.6% for the female heads. While differences by religion are relatively slight, size of landholdings and educational attainment are negatively correlated with poverty incidence, as might be expected.

Depth and severity of poverty: The depth and severity of poverty have also declined. Using the lower poverty line, Poverty Gap (depth) has declined from 4.6 percent in 2005 to 3.1 percent in 2010 and the squared poverty gap (severity) has declined from 1.3 percent in 2005 to 0.8 percent in 2010.

Food and Nutrition: Per capita per day intake of food items has increased by 5.4 percent to 1000.0 grams in 2010 from 947.8 grams in 2005 at the national level. The rates of increase in rural and urban areas are 6.13 percent and 3.37 percent respectively in 2010 relative to 2005. The average quantity of rice intake (fine, medium and coarse combined) decreased to 416.0 grams in 2010 from 439.64 grams in 2005 at the national level. But consumption of wheat (wheat flour and maida) increased to 26.0 grams in 2010 from 12.08 grams in 2005. Per capita per day intake of potato increased to 70.13 grams in 2010 from 63.30 grams in 2005. Consumption of vegetables, fruits, chicken/duck, onion, food taken outside and miscellaneous items also increased in 2010 relative to 2005.

The overall calorie intake per capita per day increased by 3.56 percent to 2318.3 K.cal in 2010 from 2238.5 K.Cal in 2005. It increased by 4.06 percent in rural and 2.3 percent in urban areas. Per capita per day protein intake (in grams) has significantly increased in 2010, although it did not change in last two surveys (2005 and 2000). At national level, it has increased to 66.26 grams per capita per day in 2010 from 62.52 grams per capita per day in 2005. Per capita per day protein intake has increased to 66.24 grams in 2010 from 61.74 in 2005 in rural areas. In urban areas, the same increased to 69.11 grams in 2010 from 64.88 grams in 2005.

Standard of Living: The quality of life appears to have improved. The overall housing condition has improved in 2010 relative to 2005. In 2010, at national level, 25.12 percent of the households reported to have used brick/cement in the walls of main dwelling structure, compared with 19.63 percent in 2005. Use of brick/cement has increased both in rural and urban areas. Use of hay/straw/bamboo/leaves as wall materials has decreased substantially. Access to safe sources of drinking water also improved. About 10.62 percent households use supply water as against 7.63

percent in 2005. At the national level 56.62 percent households reported to have tested presence of arsenic contamination in their tube-wells. Of these only 7.32 percent household found the result to be positive.

Access to electricity and mobile phones has increased remarkably. Households with access to electricity increased to 55.26 percent in 2010 from 44.23 percent in 2005. In rural areas, it increased to 42.49 percent in 2010 from 31.19 percent in 2005 and in urban areas it increased to 90.10 percent in 2010 from 82.61 percent in 2005. A phenomenal increase is observed in case of mobile phone use. It has increased to 63.74 percent in 2010 from a meager 11.29 percent in 2005. This increase pervaded both rural and urban areas. Over 56.7 percent households in rural area have reported its use in 2010 as against 6.05 percent in 2005. In urban area its use has increased to 82.74 percent in 2010 from 26.73 percent in 2005.

Income and consumption inequality: The concentration of income has slightly decreased. The Gini co-efficient of income decreased to 0.458 from 0.467 in 2005. Incomes accruing to households belonging to Decile-1 to Decile-5 are recorded at 2.00 percent, 3.22 percent, 4.10 percent, 5.00 percent and 6.01 percent respectively at national level in 2010. These shares have not changed relative to 2005. These five deciles continue to share only 20.33 percent of total income, although they comprise 50 percent of the population.

The distribution of consumption expenditure has been stable. The Gini co-efficient of consumption expenditure is estimated at 0.321 in 2010 at national level, compared to 0.332 in 2005. There are very slight changes in the percentage shares of consumption expenditures in the deciles relative to those of 2005 round of survey. Deciles 1 to 6 have almost similar shares of consumption expenditures, deciles 7 to 9 have gained slightly and the share of decile 10 declined slightly.

Several factors are likely to have contributed to declining poverty and generally improving level of living during 2005-10: Some of the indicative ones are briefly described below, and their correlations with poverty will be explored through further analysis. These have been obtained from the new modules added to the 2010 HIES, and will be examined in greater depth in the near future.

Income growth: The average monthly household income in 2010 is estimated at Tk. 11,479 at the national level, Tk. 9,648 in rural area and Tk. 16,475 in urban area. In 2005, the same was Tk.7,203 at the national level, Tk. 6,095 in rural area and Tk. 10,463 in urban area. Average nominal income increased by 59.38 percent at the national level, 58.27 percent in rural area and

by 57.48 percent in urban area in 2010 relative to 2005. Real incomes grew by 15 percent at the national level, 13 percent in rural areas and 14 percent in urban areas. Such increases over a five year period are indeed small and this primarily reflects significant under-reporting of income. It is therefore useful to look at the expenditure side as well.

Expenditure level: In 2010, the average monthly household expenditure is estimated at Tk. 11,200 at the national level, Tk. 9,612 in rural area and Tk. 15,531 in urban area. In 2005 the same was Tk. 6,134 at the national level, Tk. 5,319 in rural area and Tk. 8,533 in urban area. In nominal terms, it increased by 82.59 percent at the national level, 80.71 percent in rural area and by 82.01 percent in urban area relative to 2005. Real expenditure increased by 38.1 percent at the national level, 35.6 percent in rural areas and 38.6 percent in urban areas.

Remittance: Remittances significantly boost income, consumption and saving at the household level. In all divisions, income, consumption and saving per household of remittance receivers far exceed that of households who do not receive remittances. For the remittance receiving households in 2010, income per month is on average 82 percent higher, consumption per month is 37.7 percent higher and saving per month is 107 percent higher relative to households who do not receive remittances. Poverty headcount rates of remittance receiving households are 61 percent lower than the poverty headcount rate of households who do not receive remittances. Only 13.1 percent of the remittances receiving households were below the poverty line in 2010, compared with 33.6 percent for non-receiving households and 31.5 percent national average poverty incidence. Earlier, HIES 2005 revealed that the poverty amongst remittance receivers was 17 percent compared with 42 percent for households not receiving remittances.

Demographic Trends: The average size of household has continued to decrease. It has declined from 4.84 in 2005 to 4.5 in 2010. The demographic dependency ratio of population in 2010 is estimated at 65.3 at the national level. In 2005, this was 77.5. In the rural areas, the demographic dependency ratio is estimated at 78.1 in 2010 compared with 82.2 in 2005. In the urban areas, the demographic dependency ratio decreased from 61.1 in 2005 to 60.3 in 2010.

Education: Access to education has increased. Literacy rate of population aged 7 years and over stands at 57.91 percent at national level, compared with 51.9 percent in 2005. In rural area, literacy rate in 2010 was 53.37 percent, compared with 46.7 percent in 2005. In urban area, literacy rate was 70.38 percent in 2010, compared with 67.6 percent in 2005. In 2010, enrollment rate of

children aged 6-10 years for both sexes at the national level was 84.75 percent, compared with 80.38 percent in 2005. The enrollment rate for girls is higher than that of the boys in both rural and urban areas.

Crisis and Crisis Management: Only 0.84% of the 2010 HIES households faced any kind of crisis during the last 12 months preceding enumeration - 0.30% in urban areas and 1.03% from rural. The most common types of crisis are drought/irregular rains, floods, and excessive crop diseases/pests. When crisis hit, 35.43% of households coped using previous savings, 16.54% by getting help from friends and relatives, and 14.68% by taking loans. No household reported reducing health and education expenditures.

Safety Nets: The proportion of people benefiting from at least one public safety net program has increased. In 2010, 24.57 percent of the households reported to have received benefit during the last 12 months from at least one type of program. In contrast, only 13.06 percent households reported to have received benefit from SSNP in 2005. In rural area 30.12 percent households received benefits from SSNP as against 15.64 percent households in 2005. There was similar increase in urban areas. Survey findings indicate that the SSNP have been widened substantially both in coverage and amount during the period 2005 to 2010.

The findings further affirm that SSNPs are reasonably well targeted. Poverty incidence of the beneficiaries of SSNPs is 43.4 percent overall, compared with 27.5 percent poverty incidence of population not included in the SSNPs. However, the poverty incidence of population not included in SSNPs in Rangpur 37.6 percent and Barisal 33.5 percent are higher than national average poverty incidence. SSNPs are therefore reaching the poor but not all the poor everywhere Disability: The net percentage of population suffering from any type of disability is about 9.07% - 8.13% for males and 10.00% for females. The proportion of disabled in rural areas is 9.63%, and in urban areas is 7.49%. The most common disability is reported to be some difficulty related to eyesight. As may be expected, disabilities tend to increase with age, in general.

Migration: About 12.28% of the 2010 HIES households reported any kind of migration either within the country or abroad. Of these, 8.60% households reported migration abroad. The proportion of migration from rural areas is higher than that from urban areas. Most migrants are in the 25-44 age-group, and are overwhelmingly male.

Micro credit: In the 2010 HIES, 32.03% of the households received loans from financial or non-

financial institutions, friends, money lenders, etc. during the last 12 months preceding the day of enumeration. The proportion is higher in rural areas (35.08%) than in urban areas 23.70%. On the other hand, 14.51% of the households reported depositing money in any micro-finance or financial institution, while 5.64% reported depositing money for saving in any informal financial institution such as local co-operatives, clubs, etc. The key sources of loans are Grameen Bank (21.11%), ASA (18.37%), and other NGOs 14.29%. The primary reasons for taking loans are Business 23.73%, followed by Agriculture 21.09%. The average amount of loan taken per reporting household is Tk. 28,062 at the national level, while it is Tk. 21,804 in rural areas and Tk. 54,122 in urban areas.

Appendix B

Data Collection Methodology

Household Income and Expenditure Survey (HIES) is one of the core activities of the BBS; it contains a wide range of socio-economic information at the household level that has strong influence in the decision making process for the government. It is widely used across the world, particularly in the low income developing countries, for assessing poverty level and the living standard of the people at large. Considering its importance, the national governments and the international agencies have been striving for the improvement of survey methodology and to establish of HIES technical standard.

This survey provides valuable data on household income, expenditure, consumption, savings, housing condition, education, employment, health and sanitation, water supply and electricity, etc. The survey data can also be used for compilation of national accounts of the household sectors, analysis of poverty situation and other information on household related characteristics. It also provides the weights for computation of Current Price Index (CPI). It becomes the main data source for preparation of the Poverty Reduction Strategy (PRS) and Five Year Plan (FYP). It is also used for monitoring the progress of poverty reduction and the Millennium Development Goals (MDGs) indicators.

Historical Background

As statistical tool, the Household Expenditure Survey is practiced over hundred years. It can be traced back to 1857, when Ernst Engel first collected data on 153 Belgian family budgets from a group of homogeneous families in respect of taste and prices of commodities they used and that encouraged him to formulated a law that, the percentage of expenditure on food is on the average follows a decreasing function of income.

In 1904 another inquiry was made by the British Board of Trade on 2000 families of wage earners in urban areas in England. In 1920s and 30s such family budget surveys were conducted in several industrial areas in India to provide weights for construction of cost of living index numbers. The first family budget survey was conducted in Japan in 1925 covering 4785 households. Thus, during the early part of the 20^{th} century, this sort of survey spreaded over many parts of the world covering various sections of population.

Household Expenditure Survey (HES) was first conducted in our part of the world, now comprising Bangladesh, during the mid fifties. The geographical coverage of that survey was only limited to four selected cities of the country. In an attempt to provide the national estimates, coverage of the survey, thereafter, was extended to rural areas.

After independence, Household Expenditure Survey was first carried out in 1973-74 and the result was published in two volumes. HES data collected for the years 1974-75 and 1975-76 were not published. Some selected tables of the surveys 1976-77, 1977-78 and 1978-79 were published in the Statistical Yearbooks of 1980, 1982 and 1983-84 respectively. Detailed reports could not be published due to delay in data processing. In HES 1981-82 provision was made to collect data on several socio-demographic characteristics to correlate consumption and expenditure pattern with different segments of population. Since 1973-74 up to 1981-82 data were collected using recall method.

A combination of both recall and diary methods were introduced during HES 1983-84. For this purpose, two types of schedules were introduced. One was called "Diary" to collect data on food and beverage consumed by the household on daily basis for one month by locally recruited person designated as "Diary Keeper". The other was called "Schedule" to collect non-food expenditure with varying reference period by the BBS field staff at the end of the month. Almost similar methodology was followed in the subsequent surveys held during 1985-89, 1988-86, 1991-92 and 1995-96.

In the latest Household Income and Expenditure Survey (HIES) conducted in 2010, many of changes have been introduced in the methodology in order to improve the quality of data. In addition, 4 additional modules were added. These are; crises and coping measures, micro-credit, migration and remittance and disability. This is the third survey in which almost instant data entry was done using laptop in each sample area. In the HIES-2010 a team based approach was taken in the data collection and data entry. As many as 34 teams engaged across the country for field operation. Each team consisted of two enumerators cum data entry operators, one supervisor and 2 female facilitators. Female facilitators were recruited from the resident of the area where enumeration was taken place. Her task was to ease the work of the enumerators. Engagement of female enumerators yield very effective results as access to the household became easier for collection of data; particularly of food consumption data from the housewife of the sample household. Each

team was provided with a laptop to make data entry at the field level. Therefore, data collection and data entry were done almost simultaneously at the field. All the survey teams were supplied with an internet modem to send data to the headquarters. Thus, data of the previous month were sent to Dhaka Head Office through Internet within the 7^{th} of the following month. This was a significant improvement over the other previous HIES surveys by making the best use of ICT technology for quick data transfer.

Since 2000 HES, emphasis was given for collect information on income in addition to expenditure and consumption. Besides, in 2010 HIES, the questionnaire included more comprehensive coverage of different income sources of households compared to earlier rounds. Therefore, 2005 HIES can truly be termed as proper Household Income and Expenditure Survey (HIES-2005). This nomenculture is also followed in 2010. In HIES-2010, a separate module on Social Safety Nets Programmes (SSNP) was used as was done in HIES 2005. In 1995-96 survey, a separate module was also used to collect data on the community in the rural PSU. Data Entry Program had the provision of detecting validity and consistency errors in the data. In case of the 2010 survey, there was scope of data correction at field level by revisiting PSUs by field supervisors, if any case of there detection of error by the data entry program.

Objectives of the Survey

The main objectives of HIES 2010 were to:

- Obtain detailed data on household income, expenditure and consumption.
- Determine poverty profile with urban and rural breakdown.
- Provide information about standard of living and nutritional status of the population.
- Provide data to determine the weights of Consumer Price Indices (CPI).
- Provide household level consumption data for compiling national accounts estimates.
- Provide detailed information on health status and educational level of the population.
- Determine poverty estimates by administrative divisions and detailed socio-economic characteristics of the population and household.

- Provide benchmark data for formulation of appropriate policy for poverty reduction, improvement in standard of living and nutritional status of the population.

- Provide relevant data for monitoring of the Poverty Reduction Strategy (PRS), Five year plan and the Millennium Development Goals (MDGs).

- Provide data on type, volume and distribution of resources under different Social Safety Nets Programmes (SSNP).

- Provide data on disability, migration, remittances, microcredit and disasters management.

Sample Design

A two stage stratified random sampling technique was followed in drawing sample of HIES 2010 under the framework of Integrated Multipurpose Sample (IMPS) design developed on the basis of the sampling frame based on the Population and Housing Census 2001. The IMPS design consisted of 1000 Primary Sampling Units (PSUs) throughout the country. There were 640 rural and 360 urban PSUs in the sample. The PSU was defined as contiguous two of more enumeration areas (EA) used in Population and Housing Census 2001. Each PSU comprised of around 200 households. In the first stage about one half, 612 is in exact out of total 1000 IMPS PSUs, were drawn. These PSUs were selected from 16 different strata. There were 6 rural, 6 urban and 4 SMA strata. In the second stage, 20 households were selected from each of the rural PSUs and also PSUs located in the municipal areas and SMAs. Thus, the HIES is a sub-set of IMPS.

According to the sample design, the survey has completed in one complete year (1^st February, 2010 to 31^st January, 2011). This has been done in order to capture the seasonal variations in a cycle of one year in income, expenditure and consumption pattern. This entire period of one year has been divided into 18 terms. In each term a total of 34 PSUs are covered to collect data from a total of 680 sample households. In HIES-2010, 12240 households were selected where 7840 from rural area and 4400 from urban area.

It may be mentioned that Rangpur Division has been created by the Government after the sample selection was finalized for HIES 2010. Originally this Division was a part of Rajshahi Division and as it existed before creation of Rangpur Division. In order to fulfill the requirement of planning and administration of this newly created Division, it has been decided to tabulate the

data separately for both Rajshahi and Rangpur Divisions as exist at present and at the same time also tabulate the data for the former Rajshahi Division as per original sample design to meet the requirement of comparability with the previous HIES.

Training and Field Operation

Enumerators, data entry operators and the supervisors were given detail training on the survey before the field operation. There were 36 (including two reserve) enumeration teams for the survey. Each enumeration team was comprised of a supervisor, 2 enumerator cum data entry operators and two female facilitators. This team of five members was assigned to 1 PSU to collect data for a continuous period of 20 days.

During this period, for collecting information on food consumption, the households were divided into two groups each consisting of 10 households. Each enumerator collected information on food consumption of the households for 14 days by paying 7 visits. Information on food consumption of previous two days were collected during each visit.

This time refresher training was organized for enumerators cum data entry operators, supervising officers and divisional coordinators after completion of the first round of data collection. The problems identified by the enumerators cum data entry operators during data collection and data entry, were discussed in the refreshers training and the possible solutions were given. This resulted in the improvement of the data quality in the subsequent rounds of the survey.

Survey Operation

For detail description of survey management, survey questionnaire, training, field test, staffing and organization of field work please see the Household Income Expenditure Survey 2010 report.

Concepts, Definitions and Limitations

Concepts and definitions used in Household Income and Expenditure Survey-2010; problems and limitations encountered in the survey also have been described in the Household Income Expenditure Survey 2010 report.

Improvements in Household Income and Expenditure survey - 2010

The following measures were taken in order to ensure quality and increase coverage of Household Income and Expenditure Survey-2010 data.

- Data capturing in the sample area using laptop with the help of an improved data entry

software.

- Data entry program was designed to detect inconsistencies and errors in data at data entry stage and made way to correct data by revisiting the relevant sample households at data collection stage.
- Refreshers training were conducted after 1^st round of data collection.
- Correction of data through instant field visit by supervisors during data entry period.
- Data were transferred to HQ through Internet.
- Sample size has been significantly increased in HIES-2010 for robustness of the findings as well as to enhance reliability.
- The aforementioned measures and adoption of technologies helped BBS to publish HIES 2010 report in much shorter time span compared to previous surveys

Supervision and Quality Control

Strong supervision and quality control measures were adopted in HIES 2010. As mentioned earlier, there were 34 teams, each team comprising of 2 enumerators-cum data entry operators and two female facilitators and one supervisor. In order to improve the quality of data collection, 34 supervisors were appointed to supervise the work of 34 teams. The Regional Statistical Officers from 23 Regional Statistical Offices and 11 Statistical Officers/Assistant Statistical Officer from the HQ were engaged as supervisors. In addition, 2 Supervisors and 4 enumerators were kept reserve for addressing emergencies Thus, the number of enumerators and supervisors were in fact 70 and 36 respectively. There were also eight Divisional coordinators to supervise and coordinate the activities of the enumerators and supervisors in their respective divisions. Thus, each team was composed of 5 members; 2 enumerators/cum data entry operators, 2 female facilitators and 1 supervisors. In HIES 2010, the tasks of supervisors were determined before commencement of the field work. The supervisors were given the authority to examine all questionnaires completed by the field staff and verify that each interview has been carried out correctly and the questionnaires properly completed. Aside from the supervision by the field supervisors, the Divisional Coordinators from the headquarters frequently visited the sample areas and observed one or more interviews carried

out by enumerators in every term and provide solution to any problem faced by the enumerators. Provisions were made for holding term-wise discussions of the supervisors with all of his team members in order to access the progress of the interviewer. The enumerators and female facilitator used this opportunity to inform the supervisors of any problem they faced during the period and the supervisors, in their turn, helped the enumerators in solving their problems. The control and supervision measures as discussed above vastly enhanced the quality of enumeration in HIES 2010.

Data Entry, Processing and Validation

The interviewers regularly entered all the information collected during the interview into the laptop at the end of the day. If they have noticed any inconsistency in the data, they went back to the relevant households and made required changes to remove the discrepancy. Once they has completed and checked the information, they must also "validate" the data entered through data entry program that has the mechanism to check the information for accuracy. Thus, the data were cleaned and validated at the field level. The entered data were sent to the headquarters through Internet by the first week of the following month. Thus, data entry, cleaning and validation were completed in the HIES headquarters located in Dhaka, simultaneously along the survey work. After receiving all the data from the field, they were merged together for tabulation and thoroughly edited for any missing data or inconsistency in the data. Finally, tables were generated from the cleaned data using data analysis software like STATA, FoxPro and SPSS.