Climate element of migration decision in Ghana: Micro Evidence

Franklin Amuakwa-Mensah

Department of Economics,
Swedish University of Agricultural Sciences (SLU),
Box 7013, S-750 07 Uppsala, Sweden

Email: franklin.amuakwa.mensah@slu.se
fam020@hotmail.com

Abstract

The debate about how environmental or climate factors affect migration decision has generated a lot of interest in recent times, however empirical studies about the subject are limited and fragmented. This paper investigates the effect of climate factors on migration decisions by comparing the 2005/06 and 2012/13 rounds of Ghana Living Standards Survey (GLSS5 and GLSS6), using Heckman two-stage method to account for selectivity bias. This is done by relating the climate conditions in the various ecological zones in Ghana to investigate the effect of climate elements on migration decision. We find socio-economic factors together with climatic element to significantly affect an individual's migration decision, with variation over the years. Whereas climate element does not significantly explain migration decision in 2005/06, we observed climate element do have significant effect on migration decision in 2012/13. Thus, we find the coastal savannah and forest ecological zones to accommodate more in-migrants relative to the northern savannah ecological zones. Also, we observe that individuals do not prefer extreme climate conditions. With the current climate change of high temperature and low rainfall, migration may be considered as one of the several adaptation strategies in response to changes in the environment.

Keywords: Climate; environment; migration; Heckman two-stage; Ghana

JEL: O15, R23, Q54, Q57

1. Introduction

In recent times environmental variables have gained prominence in explaining migration decision, however studies which show the linkage between environmental factors and migration are limited and fragmented. Some authors have empirically demonstrated how environmental factors, which include climate variables, do explain human mobility (Afifi and Jäger, 2010; Piguet et al., 2011; Van de Geest, 2011; Coniglio and Pesce, 2015; Warner and Afifi, 2014). This interest in showing the links between environmental factors and migration, made the International Organization for Migration (IOM) coiled a working definition for the term environmental migrants. According to IOM (2009), environmental migrants are "*persons or group of persons who, predominantly for reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their homes or choose to do so, either temporarily or permanently, and who move either within their country or abroad*". The alarming effect of the environment on migration was brought to light by Myers (1993), who estimated that there would be about 150 million environmental refugees by the end of 21st century. Further the Stern's report on the economic consequence of global warming stipulates that greater resource scarcity, desertification, risks of drought and floods, and rising sea-levels could drive many millions of people to migrate (Stern and Treasury, 2007).

Migration in one way seen as an adaptive strategy as it helps reduce the risk associated with the adverse effect of environmental and climate change. Thus, migration reduces the reliance on the environment for livelihood as income is diversified through remittances, reduce risk to life, livelihood and ecosystem, and enhance the capacity of households and communities in the presence of negative effect of environmental and climate change (IOM, 2009). Aside the benefits experienced by the migrant and the origin of the migrant through remittance, skill and knowledge transfers upon his/her return, the resources or facilities at the migrant's destination is sometimes overstretch beyond its carrying capacity. The multi-causal nature of migration which comprises of the combination of "push" and "pull" factors (that can be economic, social and political) makes it difficult to establish a direct link between environment or climate factors and migration decision. This implies that research that seeks to investigate links between environment or climate change and migration, should assess the extent to which the environment or climate change is the primary driver or simply one of many drivers of migration (IOM, 2009).

This study is based on the recommendation in the report titled "Migration, Environment and Climate change: Assessing the evidence" by IOM (2009, p.29), which suggests that further research about the effect of the environment or climate on migration decision should focus on internal migration. As a response, we employ an econometric technique within migration model framework to explore how environment or climate element explains migration decision. Thus, we investigate whether climate element is one of the many drivers of internal migration. We use the climate conditions characterising the various ecological zones in Ghana to generate a proxy for climate element. This enables us to examine how climate element together with other socio-economic variables explains migration decision over the years. Though we acknowledge the limitation in using the climate characteristics of the ecological zones in analysing the effect of climate on migration, the nationwide household survey for 2005/06 and 2012/13 which we employ do not have explicit climate information. This data constraint in carrying out research about environment or climate and migration links is highlighted in the report by IOM (2009) as, "*a persistent lack of data is one of the primary challenges to measuring the migration and environment nexus, while data collection on migration and the environment represents a challenge in itself"*. However the justification of the use of ecological inference based on area characteristics is well explained by Piguet (2010) and there is empirical evidence of how researchers have used ecological inference to investigate the impact of the environment or climate on migration decision. Thus, the main hypothesis surrounding the use of ecological inference is that; if the environment plays a role in migration decisions, the prevailing environmental characteristics of a specific geographic area should be correlated with the migratory characteristics of that same area during the same period of time or after a certain time lag (Piguet, 2010).

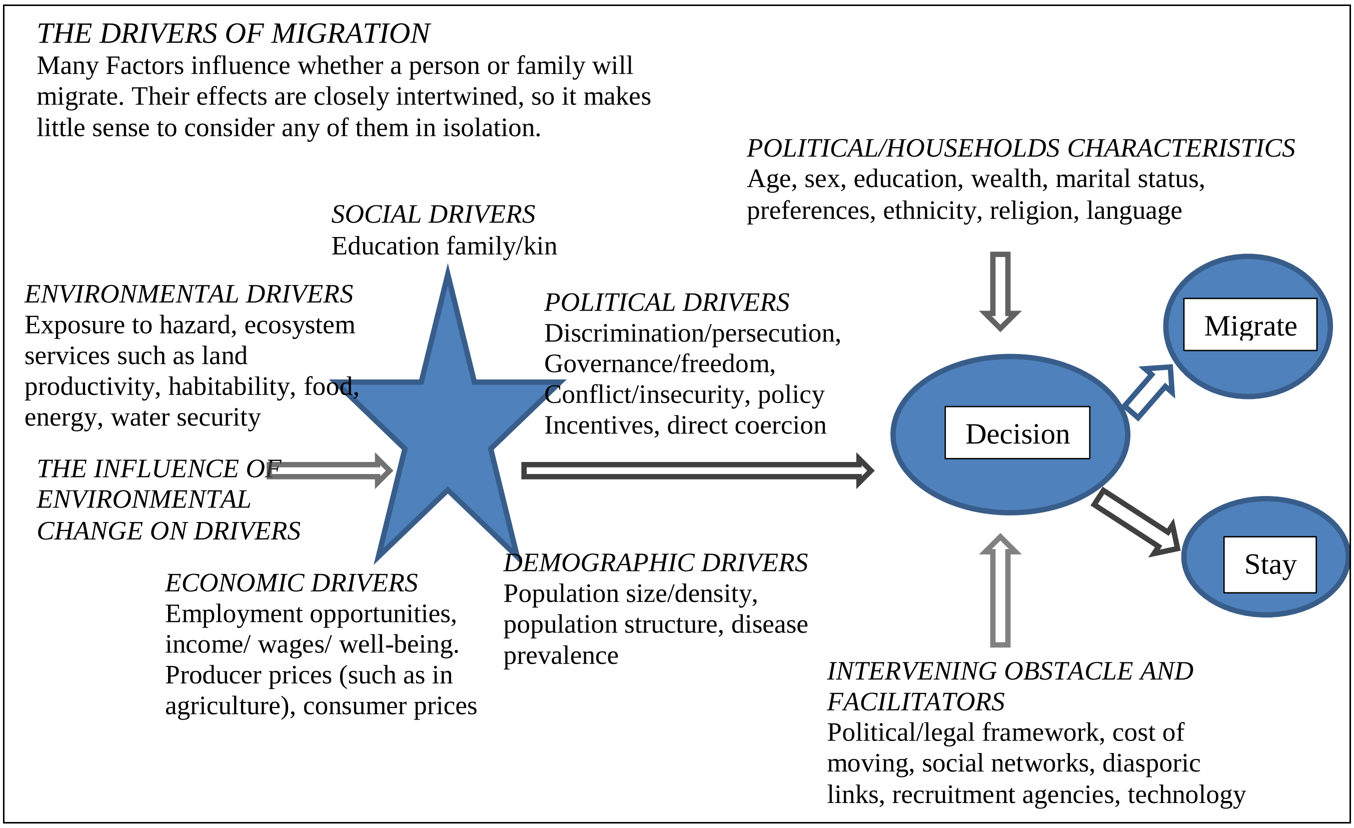
Unlike earlier studies in Ghana (Van de Geest, 2011; Warner and Afifi, 2013), this study carries out a nationwide analysis of how climate element explains migration decision and also investigates how the determinants of migration for 2005/06 defer from that of 2012/13 using Heckman's two steps procedure. We observed variations in the determinants of migration in Ghana for the periods 2005/06 and 2012/13. While climate element is very significant in explaining migration decision in 2012/13, migration decision in the period 2005/06 is not significantly affected by climate element. Also, socio-economic variables which affect migration decision for the periods under review include educational attainment, experience, age, marital status, anticipated welfare gain, ethnicity, sector of occupation, sex and level of urbanization. There is however differences in term of significance and direction of the effect of these socio-economic variables on migration decision for the periods 2005/06 and 2012/13.

The remainder of this study is organized as follows: section two analyses the determinants of migration decisions by considering both climate and socio-economic variables, section three discusses the climate and migration situation in Ghana. The forth section provides an in-depth explanation of the methods and justification of variables use in the econometric analysis. Section five discusses our empirical results and the final section six concludes and provides policy recommendations.

2.0 Environmental and Socio-economic determinants of migration decisions

The concept of migration is traced back to the works of distinguished scholars (Lewis, 1954; Mincer, 1958; Todaro, 1960; Sjaastad, 1962; Schultz, 1961; Becker, 1962; etc.) who relate the probability of an individual migrating to several factors among which are; anticipated wage difference between his/her current location and the destination location, other opportunities which exist in the destination location, improved infrastructure, and improved social amenities and services in the destination location. Many migration studies have made use of micro-level data to investigate the determinants of migration. The increasing use of micro-level data for migration studies can be attributed to the increase in the number of household surveys, especially, in developing countries. Lucas (1997) using Sjaastad's (1962) human capital framework established a micro migration equation which has the decision of individual *i* to migrate to be a function of the wage differential between the current location and the destination location, the cost involved for individual *i* to migrate, the attribute of individual *i* and a disturbance term. Several empirical studies (Beals *et al*., 1967; Caldwell, 1968; Nakosteen and Zimmer, 1980; Nivalainen, 2003; Ackah and Medvedev, 2010; Boakye-Yiadom, 2008; Amuakwa-Mensah, 2014; etc.) on migration have been able to relate migration decision to social, economic and political variables based on Sjaastad's framework. In recent times, migration studies have tried to investigate the links between environmental factors and migration. However, the multi-causal nature of migration decision and data constraint has made it very difficult in exploring the links between environmental variables and migration decisions. As shown in Figure 1, Black et al. (2011) classified the drivers of migration decision into five: social, political, economic, demographic and environmental. These drivers together with the influence of environmental changes on the driver, political and household characteristics, and the intervening obstacles and facilities, determine whether an individual or group of individuals will migrate. This means that it is important to consider how climate element will interact with other migration drivers when examining the effect of climate on migration decision, and not only the considering climate variable in isolation (ADB, 2012). Thus, environmental factors or changes influence not only migration itself but will also interact with other drivers of migration to effect migration decision. Further, decision to migrate is also effected by personal and household characteristics as well as obstacles and facilitators.

Figure 1: Conceptual Framework for Climate-Induced Migration



Source: Adopted from black et al. 2011

3.0 Climate and migration situation in Ghana

Ghana is located in West Africa and it is bordered in the east by Togo, west by Cote d'Ivoire north by Burkina Faso and south by the Gulf of Guinea. It lies between longitude 3.50W and 1.30E, and latitudes 4.50N and 11.50N. With a total land area of 239,460km^2, 8,520km^2 of it is covered by water. The country had a population size of about 24 million as at 2010 with an annual growth rate of about 2.5% GSS (2011). Ghana has a high temperature with the average annual temperature ranging between 24^{0}C to 30^{0}C. In spite of this average annual temperature, there are instances where the temperature can be 18^{0}C and 40^{0}C in the southern and northern parts of Ghana, respectively (Asante and Amuakwa-Mensah, 2015). Rainfall in the country generally decreases from south to north. The wettest area in Ghana is the extreme southwest where annual rainfall is about 2000mm. However, the annual rainfall in extreme north of Ghana is less than 1100mm (Asante and Amuakwa-Mensah, 2015). The country has two main rainfall regimes which are the double maxima regime and the single maximum regime. In relation to the double maxima regime, the two maximum periods are from April to July and from September to November in Southern Ghana (see Table 1 for summary of climate conditions). On the contrary, the single maximum regime is from May to October in Northern Ghana, this is followed by a long dry season from November to May. In short, Ghana's climate can be said to be influenced by hot, dry and dusty-laden air mass that moves from the north east across the Sahara and by the tropical maritime air mass that moves from the south-west across the southern Atlantic ocean. In addition, the rainfall pattern ranges from the bimodal rainfall equatorial type in the south to the tropical unimodal monsoon type in the north.

Table 1: Climate condition of Ecological zone

Ecological zone	Area (Km^2)	Daily mean Temp. (^{0}C)	Total annual rainfall (mm)	Daily solar radiation MJ/m^2	Major rainy season	Minor rainy season
Rain Forest	9,500	26.2	1,985	16.33	March-July	Sept.-Nov.
Deciduous forest	66,000	26.1	1,402	15.68	March-July	Sept.-Nov.
Forest-savannah Transitional	8,400	26	1,252	16.23	March-July	Sept.-Oct.
Coastal savannah	4,500	27.1	800	18.6	March-July	Sept.-Oct.
Guinea savannah	147,900	28.1	1100	19.24	May-Sept.	
Sudan savannah	2,200	28.6	957.6	21.84	May-Sept.	

Source: Armah *et al*. (2011)

Generally, the country is classified into six ecological zones: these are high rain forest, semi-deciduous rain forest, forest-savannah transition, coastal savannah, Guinea savannah and Sudan savannah (see Table 1). A greater proportion of the country is covered by Guinea Savannah zone (that is, about 62%), followed by semi-deciduous rain forest (27.7%) and Sudan savannah with the least proportion of about 1%. Over the years, the temperatures in all the ecological zones of Ghana are rising while rainfall levels have been generally reducing and patterns increasingly becoming erratic EPA (2011). The Northern savannah zones (Guinea and Sudan) have the highest level of daily solar radiation, followed by the coastal savannah, rain forest, forest-savannah transitional and deciduous forest (see Table 1). In relation to our study we have reclassified the ecological zones into three zones: forest, coastal and northern savannah zones. The forest zone comprises of rain forest, forest-savannah transitional and deciduous forest zones. The northern savannah zone comprises of Guinea and Sudan zones, and the coastal savannah zone stands alone. This reclassification is based on the classification in the Ghana Living Standard Survey dataset which is the main dataset for this study.

We have presented the internal migration distribution in Ghana based on ecological zones in Table 2. It is observed that the forest zones generally have high migrants, followed by the coastal and northern savannah zones. Whereas, the migrants in the forest zones have increased over the year, that of the northern savannah zones have reduced with the coastal savannah zone being the same (see Table 2). The sex distribution of migrants is such the females dominate over the years with a rate of 55.5% on average. This high migration patterns for females can be mostly attributed to marriage among other socio-economic factors. This is supported by the fact that majority of migrants are married (see Table 2) and in the social settings of Ghana, females mostly join their spouse in their place of residence. For the period 2005/06, the destination of migrants was mostly in the rural areas, however, in 2012/13 most migrants find themselves in urban areas as their destination. For a detailed discussion on migration distribution in Ghana based on socio-economic and regional classification see Amuakwa-Mensah (2014).

Table 2: Ecological distribution of migrants

	2005/06 (GLSS 5)				2012/13 (GLSS 6)			
Ecological zone:	*Coastal*	*Forest*	*Northern S.*	*Total*	*Coastal*	*Forest*	*Northern S.*	*Total*
Non-migrant	0.14	0.18	0.16	17,748[a]	0.12	0.23	0.15	36,203[a]
Migrant	0.34	0.45	0.22	8,845[b]	0.34	0.48	0.18	16,617[b]
Sex								
Male	0.16	0.21	0.08	0.45	0.16	0.22	0.07	0.44
Female	0.18	0.24	0.13	0.55	0.19	0.26	0.11	0.56
Destination								
Urban	0.23	0.16	0.04	0.43	0.30	0.21	0.06	0.57
Rural	0.11	0.29	0.18	0.57	0.04	0.27	0.12	0.43
Marital Status								
Married	0.16	0.23	0.15	0.53	0.16	0.25	0.12	0.53
Other relationship	0.09	0.11	0.03	0.23	0.07	0.12	0.03	0.22
Never Married	0.09	0.11	0.04	0.24	0.11	0.11	0.03	0.25

NB: figures in cells are expressed as proportions except “a” and “b” which are expressed in actual values. Values with superscript “a” and “b” represent total number of individuals interviewed and total number of migrants respectively. With the exception of the first row cells which are proportion of the values with superscript “a”, the remaining cells are proportion of the values with superscript “b”.

Source: Author’s computation from GLSS 5 and 6 datasets

4.0 Methodology and data

We made use of Sjaastad's (1962) human capital framework as a basis for examining the effect of socio-economic and climate element in explaining migration decision. For any potential migrant, the net present value or net gain from migration which the individual seeks to maximize is given by:

$$PV_{mp} = \int_{0}^{n} \left[W(t)_{im} - W_{ip}(t) \right] e^{-rt} dt - C_{imp} \qquad (1)$$

Where PV_{mp} represents the net present value of moving from location p to m;

C_{imp} represents the initial costs of moving from location p to m;

$W(t)_{im}$ represents the welfare of the individual at the place of destination;

$W(t)_{ip}$ represents the welfare of the individual at the place of origin;

t represents the period over which the individual is a migrant; and

r presents the implicit discount rate.

From equation (1), an individual will have an incentive to migrate from location p to m only if migration will increase the present value of his/her lifetime net income (that is, $PV_{mp} > 0$).

The study adopts the model of Nakosteen and Zimmer (1980) and we assume that:

At any given time, individual i will choose to migrate if the anticipated welfare gain exceeds the corresponding migration costs.

This means that at any given time, an individual will migrate if his/her percentage gain in welfare exceeds the migration costs. Thus, an individual will choose to migrate if;

$$\left[\frac{W_{mi} - W_{ni}}{W_{ni}} \right] > C_i \qquad (2)$$

Where W_{mi} denotes individual i's welfare as a migrant; and W_{ni} denotes individual i's welfare as a non-migrant. And C_i, represents direct and indirect costs incurred by individual i in moving from region m to region n.

The cost of migration is a proportion of income, which is assumed to be a proxy for welfare. It is argued that the costs of migration (C_i) can be represented as a function of one or more personal characteristics (X_i) of the migrant, one or more community characteristics (Z), and a random disturbance term. Thus,

$$C_i = g\left(X_i, Z\right) + \varepsilon_i \qquad (3)$$

From equation 3, these personal characteristics include age, sex, education level, marital status and so on, and the community characteristics include cost of living and environmental factors, unemployment rate, region and so on. From equation (2), it follows that the decision to migrate or not to migrate may be expressed as a function of (anticipated) welfare gains, personal characteristics, household characteristics and community characteristics (which includes climate factors). The control variables which are captured in X_i and Z are determined as "push-pull" factors or by other factors suggested by the New Economics of Labour Migration (NELM) literature (Lewis, 1954; Todaro, 1969). The linear functional form to be used to express this relationship is adopted from Nakosteen and Zimmer (1980). Thus, the migration decision equation which would be based on the Heckman two stage procedure is given as (see Boakye-Yiadom, 2008; Amuakwa-Mensah, 2014):

Individual *i* will migrate if:

$$M_i = \alpha_0 + \alpha_1 X_i + \alpha_2 Z_i + \lambda \left(\frac{w_{mi} - w_{ni}}{w_{ni}} \right) - \varepsilon_i > 0 \qquad (4)$$

Where, α_1 is a vector of coefficients of the variables in X_i

α_2 is a vector of coefficients of the variables in Z_i

λ is a coefficient of the welfare gain variable

α_0 is constant term

ε_i is an error term; and

It has been argued that ($\ln W_{mi}$ - $\ln W_{ni}$) and (W_{mi} - W_{ni})/W_{ni} are approximately equal (that is, $\ln W_{mi} - \ln W_{ni} \equiv \frac{W_{mi} - W_{ni}}{W_{ni}}$), see Lee (1978) for explanation). The empirical model for this study can be specified with the welfare equations formulated in logarithmic form as:

$$M_i = \alpha_0 + \alpha_1 X_i + \alpha_2 Z_i + \lambda \left(\ln W_{mi} - \ln W_{ni} \right) - \varepsilon_i \qquad (5)$$

Where M_i is unobserved, but we rather observe $M_i = 1$ if $M_i > 0$, and $M_i = 0$ if $M_i \leq 0$

The perceived difference in welfare for the migrant and the non-migrant is a paramount determinant of one's migration status. This explains the need for the inclusion of the variable ($\ln W_{mi}$ - $\ln W_{ni}$) in equation (5). It is argued by Boakye-Yiadom (2008) and Amuakwa-Mensah (2014) that an individual's welfare level depends on personal characteristics (such as educational attainment, age, sex, marital status, etc.) and community attributes (such as, the availability of socio-economic amenities). In this case, an individual's welfare equation can be expressed as a function of variables representing both individual and community characteristics. Thus,

$$\ln W_{mi} = \theta_{0m} + \theta_{1m} X_i + \theta_{2m} Z_i + \varepsilon_{mi} \qquad (6a)$$

$$\ln W_{ni} = \theta_{0n} + \theta_{1n} X_i + \theta_{2n} Z_i + \varepsilon_{ni} \qquad (6b)$$

where

θ_{1m}: Migrant vector of coefficients of the variables in X_i

θ_{2m}: Migrant vector of coefficients of the variables in Z_i

θ_{1n}: Non-migrant vector of coefficients of the variables in X_i

θ_{2n}: Non-migrant vector of coefficients of the variables in Z_i

ε_{mi} and ε_{ni} are all Normally distributed error terms with zero mean and constant variance.

From equation (5), it can be observed that the dependant variable is binary in nature and this suggest that the parameters of the decision equation (that is, equation 5) may be estimated by maximum likelihood probit or logit techniques. But in relation to this study the maximum likelihood probit technique will be used as we follow the Heckman's two stage procedure. The welfare equations expressed in equations (6a) and (6b) would be estimated by ordinary least squares (OLS) and the resulting fitted values of log-welfare could be inserted into equation (5) to obtain consistent estimates of the decision equation (that is, structural equation). As suggested by Nakosteen and Zimmer (1980) and Lee (1978), the Ordinary Least Squares (OLS) technique is inappropriate for estimating the welfare equations due to its failure to account for selectivity bias. When the welfare equation is not modified, then the conditional means of the welfare disturbance terms are non-zero and not constant for all observations. Thus;

$$E\left(\varepsilon_{mi} \middle| M_i = 1\right) = \sigma_{m\varepsilon^*}\left[\frac{-f\left(\psi_i\right)}{F\left(\psi_i\right)}\right] \tag{7a}$$

$$E\left(\varepsilon_{ni} \middle| M_i = 0\right) = \sigma_{n\varepsilon^*}\left[\frac{f\left(\psi_i\right)}{1-F\left(\psi_i\right)}\right] \tag{7b}$$

Where $\sigma_{m\varepsilon^*}$ and $\sigma_{n\varepsilon^*}$ are elements of the covariance matrix

$f(\bullet)$ and $F(\bullet)$ are the standard normal density and cumulative distribution functions respectively. We obtain ψ_i by substituting equations 6a and 6b into equation (5) and simplifying. Thus, $\psi_i = \beta_0 + \beta_1 X_i + \beta_2 Z_i$ and by adding the error term we have equation (8) which is called the reduction form equation;

$$M_i = \beta_0 + \beta_1 X_i + \beta_2 Z_i - \varepsilon_i^* \tag{8}$$

Where X_i and Z_i have their usual meaning

If we assume that the disturbance term is normally distributed with unit variance, equation (8) can be estimated by maximum likelihood probit method. This probit estimation yields fitted values (ψ_i) which will be used as estimates of the arguments in equations (7a) and (7b). Equations (7a) and (7b) summarize the selectivity bias which results from OLS estimation of the welfare equations. As a consequence, this study will account for selectivity bias by using Heckman's (1979) two-step model (see appendix 1 for step-by-step procedure). In this case, the welfare equations are modified by incorporating appropriate "selectivity variables", and adding error terms with zero means.

The dependant variable for the structural equation (that is, equation 5) is the migration status of individual i (M_i). This variable is a dummy and it takes the value of 0 if the individual is a non-migrant and 1 if the individual is a migrant. A migrant in this study is an in-migrant, that is, a person (aged 15 years or more) born outside current place of residence. The welfare equations to be estimated have the logarithm of welfare as the dependant variable. In this study, consumption expenditure of the household head is used as a proxy for welfare of a household member since it is assumed that individuals in the same household have similar welfare. The set of regressors for the structural equation includes a vector of the individual and household attributes (X_i), a vector of community characteristics (Z_i) and (anticipated) welfare gain ($\ln W_{mi} - \ln W_{ni}$). The individual and household attributes include highest educational attainment, age group, experience (captured by age squared), marital status, gender, household size, ethnicity and industry employed (see Table 3).

Table 3: Summary of variable description

Variables	**Description**
Migrate	Dependant variable for migration equation. Dummy variable where 1=Migrate and 0 otherwise
Household size	Number of household members. It is a continuous variable
Experience	experience of the individual, defined as age squared
Educational attainment	Categorical variable: No education, Basic, Secondary and Higher education. No education is the reference category
Age category	Categorical variable: 15<age<35, 36<age<60 and 60+. With 60+ as the reference category
Marital Status	Categorical variable: Married, Other relationship and never married. Married is the reference category
Region	Categorical variable: Western, Central, Greater Accra, Volta, Eastern, Asanti, Brong-Ahafo, Northern, Upper East and Upper West. With Upper West as the reference category.
Sector of employment	Categorical variable: Agricultural, Manufacturing, Service and others (which includes mining). With "other" as a reference category
Ethnicity	Categorical variable: Asante, Fante, Ewe, Ga Adangbe, other Akan, Northern Tribes and all other tribe. Northern tribes is the reference category
Ecological zone	Categorical variable: forest, coastal and Northern savannah. With Northern savannah as reference category
Sex	Dummy variable where 1=Males and 0 is female
Locality	Dummy variable where 1=Urban and 0 is rural
Anticipated welfare gain	Continuous variable which captures the difference in welfare for migrant and non-migrant
LnW	Natural log of welfare

The climatic condition of the ecological zone which is used as a proxy for climate element constitutes the community characteristics. The ecological zones are regrouped into northern savannah zones, forest zones and coastal savannah zone. We use the northern savannah zone as a reference category in our estimation. As discussed earlier in section 3, the forest zones is characterised by bimodal rainfall ranging from 1200mm to 2000mm on average annually, with a daily solar radiation rate between 15.5 MJ/m^2 and 16.34 MJ/m^2. The coastal zone is also characterised by bimodal rainfall but has an average annual rainfall of about 800mm with daily solar radiation rate of 18.6 MJ/m^2. However, the northern zones have a unimodal rainfall regime (an annual rainfall between 900mm to 1100mm on average) with a daily solar radiation rate between 19.24MJ/m^2 and 21.84MJ/m^2. The main source of data for this study is the 2005/06 and 2012/13 rounds of Ghana Living Standards Survey (GLSS) called GLSS 5 and GLSS6 respectively. These dataset is a nationwide household survey which was carried out from 2005 to 2006 in the case of GLSS 5 and from 2012 to 2013 in the case of GLSS 6.

5.0 Discussion of Empirical Results

Our empirical results from the Heckman's two stage procedure are presented in this section. From the reduced form migration estimation, we generated the inverse mill's ratio which is used in the welfare model to correct for selective bias. The welfare model estimates independently investigates the determinants of welfare for the migrant and non-migrant. We analyse migration decision of an individual from the structured migration model by examining how climate element, anticipated welfare gain and socio-economic factors affect an individual's migration decisions. From the probit models we also estimated the marginal effect at the mean values of the explanatory variables to measure the expected change in the dependent variable as a function of a marginal change in one of the explanatory variables while all other explanatory variables are held constant.

The probit model

From the Heckman's two stage procedure discussed earlier, the first step is to estimate a reduced form decision equation, which includes as explanatory variables all the exogenous variables in equation 8. Estimation results show that most of the signs of the parameter estimates generally conform to a priori expectations. From the estimation in Table A1 (see appendix), there are great differences regard the factors influencing the probability of migrating for the periods 2005/06 and 2012/2013. The probability to migrate in the periods 2005/06 and 2012/13 are both significantly affected by experience, educational attainment, region, marital status, sector of employment, gender and ethnicity. However, age and urbanization level do affect migration decision in the period 2012/13 but not in 2005/06. Experience, education, age, gender and some regions were observed to have a positive effect on migration decision in the period 2005/06. Conversely, Upper East, never married, employment in the agricultural sector and belonging to Ga Adangbe tribe show a negative effect on migration decision for the period 2005/06. During the period 2012/13, though experience, region, gender and sector of employment have signs similar to that in 2005/06, we however observe education to have a negative effect on migration decision in the period 2005/06. It should be noted that this estimation is to help us generate the “inverse mills ratio to correct for selectivity bias” and as such not the main migration decision equation.

The welfare equations

The next step is to model the determinants of welfare for the migrant and non-migrant. The estimates of the welfare model for the migrant and non-migrant equations for the periods 2005/2006 and 2012/2013 are presented in Table 4. While columns 1 and 2 relate to our welfare estimation for the period 2005/06 for migrant and non-migrant respectively, columns 3 and 4 respectively presents the migrant and non-migrant welfare estimation for the period 2012/2013. The inclusion of all exogenous variables in the reduced form (that is, Table A1) into welfare equations will result in multi-collinearity problems in the second stage of the estimation procedure (Nakosteen and Zimmer, 1980). As a result, household size is included as a regressor in the welfare equations, but excluded from the reduced form migration decision equation. And the ethnicity variable is found in the migration reduced form equation but not in the welfare equation. From the results in Table 4, it can be observe that household size, educational attainment, region, marital status, sector of occupation, urbanization level and the gender of the individual have significant effect on welfare in Ghana for the periods 2005/06 and 2012/13 with slight differences depending on whether individuals are migrants or non-migrants. The age of the individual is observed to have significant effect on only the welfare of migrant for the period 2012/13. Our findings in Table 4 show that household size, educational attainment, region and the level of urbanization have positive effect on welfare of both migrants and non-migrants for the periods 2005/06 and 2012/13. Conversely, the sector of employment and the sex of the individual have negative effect on welfare level.

Generally, we find the household size in the periods 2005/06 and 2012/13 for migrants to have a greater effect on welfare than the case of non-migrants. This indicates that migrants have higher consumption levels relative to non-migrants if their household size is large. We also observed from the results that individuals with higher educational attainment have higher welfare level relative to those with no education irrespective of whether the individual is migrant or non-migrant. Thus, the positive effect of educational attainment on welfare can be attributed to the fact that as one attains higher education, it increases the chances of the individual getting a job and more income, hence enhancing the person’s welfare. Interesting, we find that the returns to educational attainment (that is, welfare levels in this case) for all periods under review increases as one attains higher education irrespective of whether the individual is a migrant or non-migrants. Thus, the expenditure patterns of individuals in Ghana increases with the level of educational attainment. The age level is only significant in explaining welfare level for migrants in the period 2012/13 but not in the other samples. From column 3 of Table 4, it is evident that welfare levels of individuals from the age of 15 to 35 and those from 36 to 60 have relatively higher welfare than those in retirement, with those from the age of 36 to 60 having the most. This can be attributed to the fact that those from the age of 36 to 60 are more experienced and earn more income to finance their expenses compared to those from the age of 15 to 35 and those on retirement.

Table 4: Welfare Estimation for Migrant & Non-migrant

	2005/06 (GLSS 5)		2012/13 (GLSS6)	
	(1)	(2)	(3)	(4)
VARIABLES	Migrants	Non-Migrants	Migrants	Non-Migrants
Household size	0.125***	0.0978***	0.120***	0.104***
	(0.00565)	(0.00918)	(0.00463)	(0.00499)
Basic Education	0.146***	0.132***	0.0545**	0.0682***
	(0.0256)	(0.0287)	(0.0246)	(0.0224)
Secondary Educa.	0.283***	0.370***	0.242***	0.205***
	(0.0380)	(0.0478)	(0.0272)	(0.0263)
Higher Education	0.580***	0.569***	0.603***	0.515***
	(0.0520)	(0.0762)	(0.0440)	(0.0489)
15<age<35	-0.0769	-0.109	0.0710*	0.0605
	(0.0495)	(0.0830)	(0.0414)	(0.0559)
36<age<60	-0.0425	-0.0671	0.0857**	0.0844
	(0.0483)	(0.0818)	(0.0396)	(0.0527)
Western region	0.943***	0.716***	0.503***	0.655***
	(0.163)	(0.163)	(0.0964)	(0.0911)
Central region	0.866***	0.798***	0.334***	0.507***
	(0.164)	(0.176)	(0.0867)	(0.0760)
Greater Accra	1.092***	0.857***	0.613***	0.815***
	(0.162)	(0.163)	(0.0931)	(0.0973)
Volta region	0.635***	0.524***	0.315***	0.449***
	(0.154)	(0.152)	(0.0892)	(0.0780)
Eastern region	0.864***	0.819***	0.367***	0.463***
	(0.157)	(0.169)	(0.0885)	(0.0772)
Asanti region	0.893***	0.690***	0.466***	0.651***
	(0.155)	(0.153)	(0.0831)	(0.0684)
Brong-Ahafo	0.755***	0.578***	0.367***	0.502***
	(0.155)	(0.155)	(0.0911)	(0.0805)
Northern region	0.573***	0.501***	0.0520	0.223***
	(0.184)	(0.161)	(0.0932)	(0.0657)
Upper East region	0.262	0.0265	0.123	0.228***
	(0.189)	(0.171)	(0.101)	(0.0822)
Other relation.	-0.158***	-0.128***	-0.129***	-0.150***
	(0.0246)	(0.0333)	(0.0262)	(0.0310)
Never married	-0.124***	-0.123**	-0.114***	-0.0560
	(0.0473)	(0.0502)	(0.0437)	(0.0502)
Agricultural	-0.245*	-0.460***	-0.201***	-0.131***
	(0.127)	(0.170)	(0.0430)	(0.0508)
Manufacturing	-0.0614	-0.311*	-0.0137	-0.0222
	(0.119)	(0.162)	(0.0384)	(0.0480)
Service	-0.0412	-0.289*	0.0115	0.0209
	(0.118)	(0.162)	(0.0317)	(0.0442)
Male	-0.071***	-0.123***	-0.0358**	-0.0388**
	(0.0183)	(0.0225)	(0.0148)	(0.0161)
Urban	0.237***	0.201***	0.256***	0.282***
	(0.0436)	(0.0519)	(0.0387)	(0.0422)
Selectivity bias	0.0942	-0.139	0.0306	-0.0401

	(0.122)	(0.127)	(0.0980)	(0.122)
Constant	15.31***	16.02***	7.843***	7.774***
	(0.209)	(0.272)	(0.124)	(0.137)
Observations	4,073	2,903	8,931	9,521
R-squared	0.450	0.380	0.385	0.374

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In terms of the regional effect on welfare, the results in Table 4 show nine regions have relatively higher welfare than Upper West region in all the periods for both migrants and non-migrant. For 2005/06, the welfare difference between the other nine regions and Upper West region of migrants is relatively higher for migrant than non-migrants. The reverse is observed in the case of 2012/13 where the welfare difference between the other nine regions and Upper West region is relatively higher for non-migrants than migrants. Individuals living in the capital city of Ghana (that is, Greater Accra region) have relatively the highest level of welfare for all periods, irrespective of whether the individual is a migrant or non-migrant (see Table 4). This is due to the higher cost of living in that region. Over the years, our results show individuals who are either never married or in other relationships have relatively lower welfare compared to those who are married (see Table 4). This assertion is irrespective of whether the person is a migrant or non-migrant. The explanation of higher welfare for the married may be due to the fact that the married individual's income may be complemented by that of his/her spouse hence boosting the welfare of the individual.

There exist a significant difference between the welfare of individuals working in the agricultural sector and the mining sector (that is, the major sector in our reference category), irrespective of whether the individual is a migrant or not (see Table 4). Surprisingly, we find the welfare level of males to be significantly lower than females for both periods irrespective of whether the individual is a migrant or not. Since the welfare level used in this study is based on self-reported expenditure, it is more likely that females will be able to report more and accurate expenditure compared to their male counterpart hence explaining the lower welfare for males. As expected, the welfare level of individuals living in urban centres is significantly higher than those living in the rural area. We observed the difference in welfare for urban and rural centres to be high in 2012/13 than in 2005/06, indicating that there have been more welfare disparities in recent times between the urban and rural areas. The results in Table 4 show selectivity bias does not significantly affect welfare for the periods 2005/06 and 2012/13. It is however interesting to discuss the combined effect of the selectivity bias variable (inverse Mill's ratios) on unconditional welfare. In essence, the combined truncation effect should be positive so that the process of self-selection serves to enhance unconditional expected welfare. Following Nakosteen and Zimmer (1980), the combined truncation effect of inverse Mill's ratios is given as the difference between the coefficient of the selectivity bias variables (inverse Mill's ratio) for the non-migrant and that of the migrant. From columns 1 and 2 (that is migrant and non-migrant for 2005/06), and that of columns 3 and 4 (that is, migrant and non-migrant for the period 2012/13) of Table 4, the combined truncation effect of the selectivity bias variables (inverse Mill's ratio) is positive (that is, 0.2332 (=0.0942-(-0.139)) and 0.0707(=0.0306-(-0.0401))).

Structural equation

Based on the Heckman estimation procedure, the final step entails a probit estimation of the structural form of the migration decision equation (see Table 5). Here, we compute the anticipated welfare gain variable after predicting values of the log of welfare for both migrants and non-migrants for the periods 2005/06 and 2012/13. The anticipated welfare gain is inserted into the structural decision equation of each model and the results of the parameter estimates are presented in Table 5. The marginal effect estimates is shown in the columns with even numbering in Table 5. Since the structural estimation is the main migration decision equation we investigate how climate elements together with socio-economic factors do explain migration decision of individuals. As you will recall from our earlier decision we relate the climatic conditions existing in the various ecological zones in examining how these climatic conditions significantly explain migration decision.

We observed household size, educational attainment, marital status, ethnicity, sector of occupation, sex, level of urbanization and anticipated welfare gain to be the factors which significantly affect migration decision in both periods (that is, 2005/06 and 2012/13). However, while experience significantly affects migration decision of individuals in only 2005/06, climate elements significantly affect migration decision of individuals only in 2012/13. While household size, never married, sector of occupation, sex and urbanization level have negative effect on migration decision in the period 2005/06, factors such as secondary educational attainment, ethnicity, experience and anticipated welfare gain have positive effect on migration decision for the same period. For the period 2012/13, whereas household size, secondary and higher educational attainments, other relationship and sex negatively affect migration decisions, coastal savannah zone, forest ecological zones, agricultural sector, ethnicity, urbanization level and anticipated welfare again have positive effect on migration decision.

The negative impact of household size on migration decision can be explained by the fact that the extended family relation dominate in most Ghanaian household and a larger household size is associated with strong social ties. This therefore reduces the incentive for an individual to migrate. From the marginal effect estimation in Table 5, we find that household size in the period 2012/13 have greater effect on migrant's decision than in the period 2005/06 in absolute terms. The positive effect of experience on migration decision can be attribute to exposure and access to information. From the marginal effect in column 2 of Table, we find the effect of experience on migration decision is almost negligible for the period 2005/06. While educational attainment has positive effect on migration decisions in the period 2005/06, the period 2012/13 experienced migration decision to be negatively affected by educational attainment (see table 5). The positive effect of educational attainment on migration decision observed in 2005/06 is in line with other studies in Ghana such as those by Caldwell (1968) and Reed et al. (2005), suggesting that there is a higher probability for one to migrate as the individual attains higher education. On the other hand, the findings by Gbortsu

(1995) and Beals et al., (1967) are also in support of the negative effect of educational attainment on migration decisions observed in 2012/13.

Table 5: Probit Structural Migration decision estimation with Marginal Effect

	2005/06 (GLSS 5)		2012/13 (GLSS 6)	
	(1)	(2)	(3)	(4)
VARIABLES	Probit	Margin effect	Probit	Margin effect
Household size	-0.253***	-0.0081***	-0.135***	-0.0256***
	(0.0176)	(0.0005)	(0.00466)	(0.00083)
Experience	0.000238***	0.0000076***	0.000026	0.0000049
	(0.00006)	(0.000002)	(0.000029)	(0.0000055)
Basic Education	0.0536	0.0017	-0.0175	-0.00332
	(0.0897)	(0.00288)	(0.0346)	(0.0066)
Secondary Educ.	0.858***	0.0275***	-0.195***	-0.037***
	(0.131)	(0.0039)	(0.0396)	(0.0075)
Higher Educ.	0.265	0.0085	-0.158***	-0.0299***
	(0.164)	(0.0054)	(0.0605)	(0.0115)
15<age<35	0.366	0.0117	-0.0207	-0.0039
	(0.266)	(0.0087)	(0.126)	(0.0239)
36<age<60	0.218	0.00698	0.126	0.0239
	(0.193)	(0.0062)	(0.0969)	(0.0184)
Other relationship	0.0584	0.00187	-0.164***	-0.03104***
	(0.0866)	(0.0028)	(0.0377)	(0.0071)
Never married	-0.320**	-0.0103**	-0.0528	-0.01002
	(0.148)	(0.0049)	(0.0365)	(0.0069)
Coastal zone	0.0367	0.0012	0.736***	0.1397***
	(0.211)	(0.0068)	(0.0544)	(0.0102)
Forest zones	0.210	0.0067	0.566***	0.1074***
	(0.227)	(0.0072)	(0.0443)	(0.008)
Agricultural	-1.484***	-0.0476***	0.276***	0.0523***
	(0.235)	(0.008)	(0.0569)	(0.0108)
Manufacturing	-1.775***	-0.0569***	-0.0433	-0.0082
	(0.290)	(0.0093)	(0.0672)	(0.0127)
Service	-1.604***	-0.0515***	0.0900	0.01708
	(0.263)	(0.0086)	(0.0574)	(0.0109)
Other Akan	1.537***	0.0493***	0.816***	0.1549***
	(0.231)	(0.0077)	(0.0494)	(0.0092)
Asante	1.484***	0.0476***	1.164***	0.2208***
	(0.313)	(0.0098)	(0.0620)	(0.0115)
Fante	2.036***	0.0653***	0.780***	0.14798***
	(0.254)	(0.0085)	(0.0613)	(0.0115)
Ga Adangbe	2.394***	0.0768***	1.174***	0.2227***
	(0.270)	(0.0081)	(0.0696)	(0.01299)
Ewe	1.305***	0.0419***	0.671***	0.1274***
	(0.251)	(0.0081)	(0.0537)	(0.0101)
All other Tribes	0.705*	0.0226*	0.449***	0.0852***
	(0.414)	(0.0132)	(0.106)	(0.02002)
Male	-0.602***	-0.0193***	-0.0985***	-0.0187***

	(0.0911)	(0.00302)	(0.0270)	(0.0051)
Urban	-0.418***	-0.0134***	0.151***	0.02866***
	(0.122)	(0.00397)	(0.0320)	(0.0061)
Anticipat. welfare gain	7.390***	0.2371***	5.875***	1.1148***
	(0.337)	(0.0115)	(0.0720)	(0.0044)
Constant	4.599***		0.439***	
	(0.461)		(0.160)	
Observations	6,976	6,976	18,452	18,452
LR chi^2 / F-stat	35.88***		13736.07***	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

This negative effect can be link to Bartel's (1979) argument that the incidence of unemployment is more pronounced among the less educated, and this effect may mitigate the positive effect education has on migration. From our estimation for 2005/06, individuals with secondary educational attainment have about 0.028 likelihood of being in-migrant than those with no educational attainment (see column 2 of Table 5). The story is much different in the case of 2012/13, as secondary and higher educational attainments do significantly have negative effect migration decision. The negative effect implies that the more educated is less likely to migrate than those with no education. As said earlier, the presence of unemployment which is mostly dominated by the less educated might mitigated the positive of education on migration decision since the unemployed is more likely to migrate in search of job. In absolute terms, we find the marginal effect of secondary educational attainment to be higher than higher educational attainment.

In relation to marital status, our results show that whereas individuals who have never marry are less likely to be in-migrant relative to those married for the period 2005/06, those in other relationship are less likely to be in-migrant relative to those married for the period 2012/13. Individuals employed in the agriculture, manufacturing and services sectors are observed to be less likely to migrate relative to those in other sectors for the period 2005/06. However, for the period 2012/13 individuals in the agriculture sector are more likely to migrate relative to those in "other sectors". Males are observed to less likely to be in-migrant relative to their female counterparts for both periods. We found a mixed effect of urbanization level on migration decisions. Whereas the urban areas were less likely to accommodate in-migrate relative to the rural areas for the period 2005/06, the reverse is observed for 2012/13.

Generally, we find climate factors to have positive effect on migration decision over the year. However, it is only the period 2012/13 which we observe a significant effect of climate factors on migration. From our results in Table 5, we find the coastal savannah and forest ecological zones to accommodate more in-migrants relative to the northern savannah ecological zones. As you will recall, the forest zones is characterised by bimodal rainfall ranging from 1200mm to 2000mm on average annually, with a daily solar radiation rate between 15.5 MJ/m^2 and 16.34 MJ/m^2. The coastal zone is also characterised by bimodal rainfall but has an average annual rainfall of about 800mm with daily solar radiation rate of 18.6 MJ/m^2.

However, the northern zones have a unimodal rainfall regime (between 900mm to 1100mm on average annually) with a daily solar radiation rate between $19.24MJ/m^2$ and $21.84MJ/m^2$. From the marginal effect estimates from Table 5 (see column 4), the likelihood for migrants to find themselves in the coastal savannah zone relative to the northern savannah zones is greater than the likelihood for migrants to find themselves in the forest zones relative to the northern savannah zones. This finding is consistent to that of Van de Geest (2011), who observed that individuals in the Sudan savannah zone do migrate to the forest-savannah transitional zone.

One of the important findings is the positive and statistically significance of anticipated welfare gain on migration decision for both periods under review. The estimates reveal that the leading factor determining an individual's migration decision is the anticipated welfare gain (see marginal effect). Thus, an anticipated welfare gain significantly increases the probability of an individual migrating. This result is consistent with the underlying migration theory by Todaro (1969) and is also consistent with earlier studies in Ghana. From the marginal effect in Table 5, we find that the effect of anticipated welfare gain on migration decision for the period 2012/13 is higher than that of 2005/06 period.

6. Conclusion and policy recommendation

This paper investigates the effect of climate factors on migration decisions by comparing the 2005/06 and 2012/13 rounds of Ghana Living Standards Survey (GLSS5 and GLSS6). We employ the Heckman two-stage method to account for selectivity bias. In order to achieve our aim, we relate the climate conditions in the various ecological zones in Ghana to investigate the effect of climate elements on migration decision and how this effect has changed over years. It was found that socio-economic variables such as anticipated welfare gain, sector of employment, sex, experience, urbanization level, educational level, marital status and other variables, together with climatic element significantly affect an individual's migration decision with variation over the years. Whereas climate element does not significantly explain migration in 2005/06, we observed climate element to have significant effect on migration decision in 2012/13. Thus, we find the coastal savannah and forest ecological zones to accommodate more in-migrants relative to the northern savannah ecological zones. The high marginal effect coefficient for the coastal savannah zone compared to that of the forest zones may imply that individuals do not prefer extreme climate conditions. With the current climate change of high temperature and low rainfall, migration may be considered as one of the several adaptation strategies in response to changes in the environment. These adaptive strategies may either be as a way to reduce pressure on eco-systems or in terms of planned resettlement when the need arise.

As the effect of the environment or climate changes on migration decision can be either direct or indirect and also do interact with other socio-economic and political factors in affecting migration decision, adaptation strategies may take on various forms. These among others may include institutional level strategy, technological developments, community development, education and training initiatives. Based on the mixed effect of education on migration decision as evident from our study, policies to enhance the educational system in Ghana should be complemented with job creations in the entire country. Moreover, special attention should be given to the rural sector in such a way that the jobs to be created in the sector do not require skilled workers. With quality education and job creation, the welfare of individuals will be enhanced.

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Appendix 1

In estimating all the parameters of equation (5), the following procedure (Heckman two-step method) was used:

i. Probit estimation of the reduced-form migration decision equation
The regressors in equation (8) consist of the exogenous variables in all the three equations (that is, equations 5, 6a and 6b). Fitted values ($\hat{\psi}_i$) obtained from this (first) stage are used to construct the inverse Mill's ratio.

ii. Insertion of the inverse Mill's ratio into the appropriate welfare equations and estimating the welfare equations by OLS
Thus, the corrected welfare equation can be written as;

$$\ln W_{mi} = \theta_{0m} + \theta_{1m} X_i + \theta_{2m} Z_i + \sigma_{m\varepsilon^*} \left[\frac{-f(\psi_i)}{F(\psi_i)} \right] + \eta_{mi} \quad \text{(A1)}$$

$$\ln W_{ni} = \theta_{0n} + \theta_{1n} X_i + \theta_{2n} Z_i + \sigma_{n\varepsilon^*} \left[\frac{f(\psi_i)}{1 - F(\psi_i)} \right] + \eta_{ni} \quad \text{(A2)}$$

Where $E(\eta_{mi} | M_i = 1) = 0$ and $E(\eta_{ni} | M_i = 0) = 0$

The parameter estimates obtained by using the above two-step procedure according to Lee (1978) are known to be consistent. The variables for the non-migrant are generated by using counterfactual scenario.

iii. Probit estimation of the structural migration decision equation
After determining the consistent parameter estimates of the welfare equations, we obtain the fitted values of the logarithm of welfare. This is used to compute estimates of the anticipated gain in welfare ($\ln W_{mi}$ - $\ln W_{ni}$). Simultaneously with other exogenous variables, the estimates of the anticipated gain in welfare ($\ln W_{mi}$ - $\ln W_{ni}$) are substituted into the structural decision equation to obtain the probit estimates of the structural migration decision equation (that is equation 5).

Appendix 2

Table A1: Reduced Form Probit Migration Estimation and Marginal Effect

	2005/06 (GLSS 5)		2012/13 (GLSS 6)	
	(1)	(2)	(3)	(4)
VARIABLES	Probit	Margin effect	Probit	Margin effect
Experience	0.000191***	0.00007***	0.000065**	0.000023**
	(0.000044)	(0.000015)	(0.00003)	(0.000011)
Basic Education	0.0269	0.00945	-0.104***	-0.0374***
	(0.0448)	(0.01577)	(0.0352)	(0.0126)
Secondary Educ.	0.131**	0.0462**	-0.0741*	-0.0266*
	(0.0660)	(0.0232)	(0.0443)	(0.0159)
Higher Educ.	0.331***	0.1166***	0.102	0.0367
	(0.0875)	(0.0308)	(0.0716)	(0.0257)
15<age<35	0.388**	0.1366**	0.0727	0.0261
	(0.192)	(0.0674)	(0.123)	(0.0443)
36<age<60	0.308**	0.1082**	0.0573	0.0206
	(0.150)	(0.0526)	(0.0892)	(0.032)
Western region	0.872***	0.3069***	0.951***	0.3415***
	(0.171)	(0.0596)	(0.136)	(0.0484)
Central region	0.970***	0.3414***	0.583***	0.2092***
	(0.180)	(0.0623)	(0.172)	(0.0619)
Greater Accra	1.013***	0.3564***	1.146***	0.4117***
	(0.165)	(0.0572)	(0.142)	(0.0498)
Volta region	0.512**	0.1801**	0.573***	0.2057***
	(0.216)	(0.0758)	(0.144)	(0.0517)
Eastern region	1.060***	0.3729***	0.821***	0.295***
	(0.158)	(0.0547)	(0.138)	(0.0494)
Asanti region	0.710***	0.2499***	0.696***	0.2501***
	(0.162)	(0.0564)	(0.133)	(0.0475)
Brong-Ahafo	0.556***	0.1958***	0.784***	0.2818***
	(0.172)	(0.0605)	(0.135)	(0.0483)
Northern region	0.189	0.0664	-0.0444	-0.01595
	(0.165)	(0.058)	(0.136)	(0.0488)
Upper East reg.	-0.313**	-0.109998**	-0.129	-0.0464
	(0.157)	(0.0552)	(0.126)	(0.0452)
Other relationsh.	0.0240	0.00845	-0.0913**	-0.0328**
	(0.0531)	(0.0187)	(0.0453)	(0.0162)
Never married	-0.396***	-0.1394***	-0.585***	-0.21002***
	(0.0571)	(0.0198)	(0.0464)	(0.0158)
Agricultural	-0.653***	-0.2298***	-0.258***	-0.0927***
	(0.234)	(0.0824)	(0.0740)	(0.0264)
Manufacturing	-0.352	-0.1238	0.0257	0.0092
	(0.248)	(0.0872)	(0.0755)	(0.0271)
Service	-0.323	-0.1135	0.00281	0.001
	(0.225)	(0.0792)	(0.0705)	(0.0253)
Male	0.0806**	0.0284**	0.0527**	0.0189**
	(0.0339)	(0.012)	(0.0255)	(0.0091)
Other Akan	-0.0919	-0.0323	0.214*	0.0768*

	(0.201)	(0.0708)	(0.128)	(0.0458)
Asante	0.00210	0.0007	0.121	0.0433
	(0.206)	(0.0723)	(0.131)	(0.0471)
Fante	0.134	0.0473	0.326**	0.117**
	(0.207)	(0.0728)	(0.133)	(0.0478)
Ga Adangbe	-0.420**	-0.1477**	-0.264*	-0.0947*
	(0.208)	(0.0729)	(0.146)	(0.0524)
Ewe	0.00248	0.00087	0.354***	0.1271***
	(0.200)	(0.0704)	(0.128)	(0.0458)
Northern Tribes	0.155	0.0545	0.400***	0.1438***
	(0.204)	(0.0717)	(0.128)	(0.046)
Urban	-0.341***	-0.1199***	-0.0853	-0.0306
	(0.0775)	(0.0269)	(0.0609)	(0.0219)
Constant	-0.482		-0.696***	
	(0.399)		(0.227)	
Observations	6,976	6,976	18,452	18,452
F-stat	17.53***		28.99***	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1