FAERE

French Association
of Environmental and Resource Economists

Working papers

Climate element of migration decision in Ghana : Micro Evidence

Franklin Amuakwa-Mensah

WP 2015.18

Suggested citation:

Franklin Amuakwa-Mensah *(2015).* Climate element of migration decision in Ghana : Micro Evidence. *FAERE Working Paper, 2015.18.*

ISSN number:

http://faere.fr/working-papers/

Climate element of internal 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 decisions 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. The climate condition in various ecological zones of Ghana is used as a proxy to investigate the effect of climate elements on migration decision. Results show that socio-economic factors such as anticipated welfare gains, household size, education, the sector of employment and others, together with climatic element do significantly affect an individual's migration decision. Findings further suggest a positive effect of climate element on migration decisions. The coastal savannah and forest ecological zones have a greater probability of accommodating more in-migrants relative to the northern savannah ecological zone. In addition, marginal effects reveal that the probability to migrate to coastal savannah zone relative to northern zones is higher than the probability to migrate to forest zones relative to northern zone. Moreover, anticipated welfare gains reinforce the effect of climate elements and also entrenches the divergence between the probability of migrating to coastal and forest zones relative to the northern zones. 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

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 is seen as an adaptive strategy as it helps reduce the risk associated with the adverse effect of environmental and climate change. Accordingly, 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, this study employs an econometric technique within migration model framework to explore how environment or climate element explains migration decisions. Accordingly, this study investigates whether climate element is one of the many drivers of internal migration in Ghana. The study makes use of the climate conditions characterising the various ecological zones in Ghana to generate a proxy for climate element. This makes it possible to examine how climate element together with other socio-economic variables explains migration decision over the years. Though the study acknowledges 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 the study employs 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. 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).

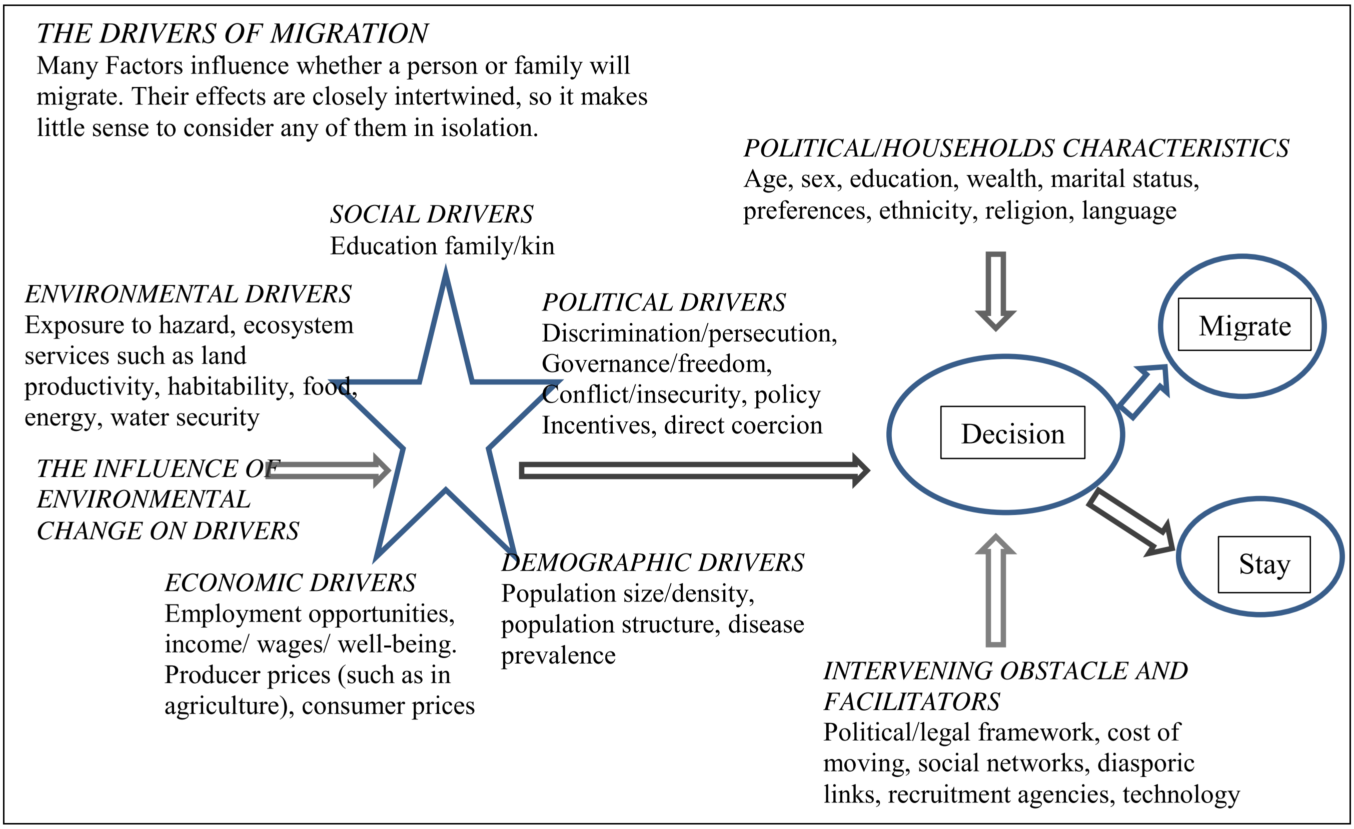
Unlike earlier studies in Ghana (Van de Geest, 2011; Warner and Afifi, 2013), this study carries out a nationwide analysis of how climate element explains migration decision and also investigates how the determinants of migration for 2005/06 defer from that of 2012/13 using Heckman's two steps procedure. We observed slight variations in the determinants of internal migration decisions in Ghana for the periods 2005/06 and 2012/13. Educational attainment has mixed effect on migration decisions for both periods and this effect for each educational category switches sign between the periods. However, the pooled sample suggests a negative effect of higher educational attainment on migration decisions. Also, anticipated welfare gains have a significant effect on migration decisions for the 2005/06 and pooled samples but not for the 2012/2013 sample. Nonetheless, a significant effect is observed in all samples when an interaction between anticipated welfare gain and climate elements is considered. Findings further suggest a positive effect of climate element on migration decisions. The coastal savannah and forest ecological zones have greater probability of accommodating more in-migrants relative to the northern savannah ecological zones. Also, marginal effects reveal that the probability to migrate to coastal savannah zone relative to northern zones is higher than the probability to migrate to forest zones relative to northern zone. Moreover, anticipated welfare gains reinforce the effect of climate elements and also entrenches the divergence between the probability of migrating to coastal and forest zones relative to the northern zones. The socio-economic variables which affect migration decisions in addition to anticipated welfare gains and educational attainment for the periods under review include experience, age, household size, marital status, ethnicity, sector of occupation, sex and level of urbanization.

The remainder of this study is organized as follows: section two reviews the determinants of migration decisions by considering both climate and socio-economic variables, section three discusses the climate and migration situation in Ghana. The fourth section provides an in-depth explanation of the methods and justification of variables use in the econometric analysis. Section five discusses the 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; Amuakwa-Mensah *et al.,* forthcoming; 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.

Figure 1: Conceptual Framework for Climate-Induced Migration



Source: Adopted from black et al. 2011

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). In other words, 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.

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 this study, the ecological zones have been reclassified into three: forest, coastal and northern savannah. 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.

Table 2 shows the internal migration distribution in Ghana based on ecological zones. 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 years 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 that 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 (aged 16 years and above) 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".

4.0 Methodology and data

This study makes 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:

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

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 assumes 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;

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

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,

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

From equation 3, these personal characteristics include age, sex, education level, marital status and so on, and the community characteristics which include cost of living and environmental factors, unemployment rate, regional factors 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 is used as the study follows 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 variances not constant for all observations. Thus;

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

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

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

$f\left(\bullet\right)$ and $F\left(\bullet\right)$ 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. Given $\psi_i = \beta_0 + \beta_1 X_i + \beta_2 Z_i$ and by adding the error term we have equation (8) which is called the reduction form equation;

$$M_i = \beta_0 + \beta_1 X_i + \beta_2 Z_i - \varepsilon_i * \quad (8)$$

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 accounts 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, real total household expenditure per equivalence scale is used as a proxy for the individual's welfare. Equivalence scales takes into account the household size and composition of the household (that is, the number of children and adults in the household). Therefore by considering real total expenditure per equivalence scale, the individual's welfare can be ascertained. 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
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, where welfare is defined as real total expenditure divided by equivalence scale

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. Using a categorical variable for the climate element than actual climate values is appropriate in this case because there is no much variation within each ecological zone for climate values for a particular year on average. Also, using categorical variable for climate element makes it possible to know the migration behaviour at each ecological zone. In the structural equation, an interaction between the climate elements and anticipated welfare gain is also considered in a separate model to examine whether these variables enforce each other in affecting migration decisions. In all the analysis, the 2005/06, 2012/13 and pooled (both survey waves) samples are considered.

4.1 Data

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. This dataset is a nationwide household survey conducted by Ghana Statistical service and sponsored by international organizations. Both rounds of the Ghana Living Standards Survey focus on the household and members of the household as key socio-economic units and provide important insights into living conditions in Ghana. In addition to the demographic information collected in the surveys, the data also covers various aspects of living conditions, such as, consumption, education, health, housing, employment, migration, tourism and remittance flows. Moreover, the datasets make it possible to decompose the analyses on the basis of several categories, such as, administrative regions, ecological zones, rural-urban location, and gender of household head.

Pertaining to this study, the individual is the unit of analysis. For individuals above the age of fifteen years, the total respondents are about 17,748 and 36,203 for 2005/06 and 2012/2013 rounds of the survey respectively (see Table 2 above). Descriptive statistics of the variables used in this study is shown in Table A1 in appendix. For each wave of the survey and the pooled sample (that is, both waves), the Table A1 shows the summary statistics for migrant and non-migrant separately, and also for the two groups jointly. Whereas the observation for 2005/06 in the econometrics analysis is 6,976, that of 2012/203 is 18,452 individuals.

5.0 Discussion of Empirical Results

The empirical results from the Heckman's two stage procedure are presented in this section. The welfare model estimates independently investigates the determinants of welfare for the migrant and non-migrant. However, the structural migration model examines how climate element, anticipated welfare gain and socio-economic factors affect an individual's migration decisions. From the probit models, marginal effects at the mean values of the explanatory variables are computed 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. In the pool models the study accounted for fixed effect attributed to the survey period.

The reduced form 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 A2 (see appendix), the factors affecting migration decisions for the 2005/06, 2012/13 and the pooled samples are almost the same, with few variations with regard to education attainment, gender and sector of employment. The probability to migrate in the periods 2005/06, 2012/13 and that of the pooled sample are all significantly affected by experience, educational attainment, marital status, sector of employment, age, ethnicity and urbanization level. There is however differences in how educational attainment, sector of employment and ethnicity affect migration decisions in the two periods and the pooled sample. For instance, whereas educational attainment has positive effect on migration decisions in 2005/06, the period 2012/13 and the pooled sample portray mixed effect of educational attainment on migration decisions. The reduced-form result also show that gender of the individual is paramount in explaining migration decision in period 2005/06 and the pooled sample but not in the period 2012/2013. A detailed explanation of the determinants of migration decisions in the reduced-form equation is skipped since the estimations only helps in generating the "inverse mills" ratio to correct for selectivity bias in the welfare estimation. As a result the reduced-form estimation is not the main migration decision estimation of interest.

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, 2012/2013 and the pooled sample are presented in Table 5. The inclusion of all exogenous variables from the reduced form (that is, Table A2) in 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, 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, and the pooled sample, with slight differences depending on whether individuals are migrants or non-migrants. The age of the individual is observed to have significant effect on the welfare of both samples (migrant and non-migrants) in period 2012/13 and non-migrants in both the pooled sample and 2012/2013 period sample. Contrary, age has no significant effect on welfare for migrants in period 2012/2013 and the pooled sample. Findings in Table 4 show that educational attainment and the level of urbanization have positive effect on welfare of both migrants and non-migrants for the periods 2005/06 and 2012/13, and the pooled sample. On the contrary, age, sex of the individual, marital status and the agricultural sector of employment have negative effect on welfare level. The manufacturing and services sectors of employment are observed to have mixed effect on welfare.

Table 4: Welfare Estimation for Migrant & Non-migrant

	2005/06 (GLSS 5)		2012/13 (GLSS 6)		Pooled (GLSS 5 & 6)	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Migrants	Non-Migrants	Migrants	Non-Migrants	Migrants	Non-Migrants
Household size	-0.094***	-0.0663***	-0.0810***	-0.0659***	-0.085***	-0.0661***
	(0.0034)	(0.0034)	(0.0024)	(0.0020)	(0.0028)	(0.0021)
Basic Education	0.1428***	0.1240***	0.0638***	0.0822***	0.0941***	0.0904***
	(0.0205)	(0.0250)	(0.0193)	(0.0171)	(0.0139)	(0.0139)
Secondary Educa.	0.2973***	0.3441***	0.2415***	0.2188***	0.2508***	0.2372***
	(0.0329)	(0.0413)	(0.0198)	(0.0192)	(0.0165)	(0.0170)
Higher Education	0.6285***	0.5430***	0.7092***	0.6179***	0.6855***	0.5997***
	(0.0377)	(0.0589)	(0.0291)	(0.0351)	(0.0247)	(0.0318)
15<age<35	-0.1493***	-0.2480***	0.0422	-0.0882**	-0.0185	-0.1203***
	(0.0483)	(0.0761)	(0.0309)	(0.0384)	(0.0267)	(0.0350)
36<age<60	-0.1224***	-0.2723***	0.0188	-0.0927**	-0.0208	-0.1326***
	(0.0451)	(0.0733)	(0.0290)	(0.0369)	(0.0254)	(0.0337)
Other relation.	-0.057***	-0.0223	-0.0439**	-0.0401**	-0.0496***	-0.0412**
	(0.0214)	(0.0296)	(0.0175)	(0.0200)	(0.0135)	(0.0163)
Never married	-0.0123	-0.1027**	-0.0335	-0.1344***	-0.0351	-0.1272***
	(0.0361)	(0.0441)	(0.0336)	(0.0344)	(0.0253)	(0.0279)
Agricultural	-0.301***	-0.4603***	-0.2193***	-0.1449***	-0.2248***	-0.1628***
	(0.1037)	(0.1537)	(0.0302)	(0.0284)	(0.0292)	(0.0272)
Manufacturing	-0.0727	-0.3262**	0.0061	0.0568*	0.0074	0.0262
	(0.1014)	(0.1508)	(0.0316)	(0.0322)	(0.0292)	(0.0287)
Service	-0.0670	-0.2739*	0.0238	0.0848***	0.0253	0.0722***
	(0.0993)	(0.1487)	(0.0268)	(0.0268)	(0.0264)	(0.0251)
Male	-0.063***	-0.1107***	-0.0286**	-0.0254**	-0.0357***	-0.0425***
	(0.0187)	(0.0231)	(0.0132)	(0.0127)	(0.0107)	(0.0112)
Urban	0.3269***	0.3390***	0.2141***	0.2737***	0.2462***	0.2812***
	(0.0282)	(0.0366)	(0.0170)	(0.0164)	(0.0147)	(0.0153)
Selectivity bias	0.3859	-0.2603	0.2191	-0.6000***	0.3552**	-0.5514***
	(0.2432)	(0.2992)	(0.2342)	(0.2205)	(0.1759)	(0.1817)
Constant	4.8275***	5.5977***	7.4716***	7.9928***	4.7757***	5.3492***
	(0.1937)	(0.3501)	(0.1605)	(0.2182)	(0.1253)	(0.1839)
Observations	4,073	2,903	8,931	9,521	13,004	12,424
R-squared	0.4422	0.4777	0.3907	0.4420	0.8382	0.8097
Adjusted R-squa.	0.439	0.474	0.389	0.441	0.838	0.809
F-test	139.6	114.5	248.3	327	3081	2256
Regional fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes
Wave fixed effect					Yes	Yes

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The negative effect of household size on welfare is attributed to the fact that welfare of the individual is reduced if he/she lives in a household with more members, especially if most are dependent, as per capita consumption for the individual will be low. Given the fact that most developing countries are characterized by high low wage rates and excess labour supply (which Ghana is no exception), a household composing of more members is likely to have low per capita consumption on average, hence a lower welfare. From the results, the negative effect of household size on welfare is more pronounce for migrants than non-migrants. This means that an increase in household size will have a greater negative effect on a migrant's welfare than a non-migrant. Also, the findings show that the effect of household size on welfare is greater in the periods 2005/06 than the period 2012/13 for both migrants and non-migrants. Moreover, we 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. 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. As expected, the results show that returns to education (that is, welfare in this case) increases as one attain a higher education.

The negative effect of age on welfare for those in the working class relative to retired individuals is in contrast to expectations. Generally, welfare of retired individuals is expected to be lower compare to those in the working class since those on retirement do not earn income after retirement. The negative effect of age group relative to those in retirement, on welfare from this study may be attributed to factors such remittance received by the retired person and returns from investment. The results further show that non-migrants who are either "never married" or in other relationships have relatively lower welfare compared to those who are married (see Table 4) in the 2012/2013 and pooled samples. This assertion is also true for migrant individuals who have never married in all samples and non-migrant individuals who are in other relationships for the 2005/2006 sample. The explanation of higher welfare for the married may be due to the fact that the income of married individuals 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 the reference category) for all the samples, regardless of whether the individual is a migrant or no-migrant (see Table 4). There is however mixed effect of manufacturing and services sectors on welfare for non-migrants. Whereas non-migrants employed in the manufacturing or services sectors have lower welfare relative to those in the mining sector for the 2005/2006 sample, the reverse is that case for the 2012/2013 sample. Nonetheless, in the pooled sample, non-migrants employed in the services sector have relatively higher welfare than those in the mining sector. Surprisingly, welfare level of males is significantly lower than females for all samples irrespective of whether the individual is a migrant or not. Since the welfare level used in this study is based on self-reported expenditure adjusted by equivalence scale and price index, 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. It is also observe that the welfare difference for individuals living in urban and rural centres is higher for non-migrants than migrants.

The results in Table 4 show selectivity bias significantly affect welfare for the pooled sample and non-migrant sample for the period 2012/13. The combined effect of the selectivity bias variable (inverse Mill's ratios) on unconditional welfare is as expected. Thus, the combined truncation effect is positive, meaning that the process of self-selection serves to enhance the 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 3 and 4 (that is migrant and non-migrant for 2012/13), and that of columns 5 and 6 (that is, migrant and non-migrant for the pooled sample) of Table 4, the combined truncation effect of the selectivity bias variables (inverse Mill's ratio) are positive (that is, 0.8191 (=0.2141-(-0.6)) and 0.907(=0.3552-(-0.5514))).

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. 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. Since the structural estimation is the main migration decision equation the study investigates how climate elements together with socio-economic factors do explain migration decision of individuals. From the odd numbering columns in Table 5, we find household size, experience, educational attainment, marital status, climate elements, sectors of occupation and level of urbanization to be the factors which significantly affect migration decision in all the sample (that is, 2005/06, 2012/13 and the pool samples). However, while sex and anticipated welfare significantly affects migration decisions for 2005/06 and the pooled samples, this is not the case for 2012/13 sample (see columns 1, 3 and 5). When an interactive term between anticipated welfare again and climate elements is introduced into the model, we observe migration decisions of individuals are significantly affected by household size, experience, educational attainment, marital status, climate elements, sectors of occupation, sex, level of urbanization and anticipated welfare gain (see columns 2, 4 and 6). Nevertheless, level of urbanization does not significantly affect migration decisions for the 2005/2006 sample when an interaction between anticipated welfare gain and climate element is included (see column 2).

The results show mixed effect of household size on migration decisions across the sample. Whereas household size has positive effect on migration decisions for the 2005/2006 and pooled samples, a negative effect is observed for the 2012/2013 sample. The negative effect of household size on migration decision can be attributed to strong social ties associated with large family which will prevent an individual from migrating. Contrary to this assertion, large household size can also compel an individual to move from his/her home. The positive effect of household size on migration decision in the pooled sample indicates that an increase in household size encourages migration in Ghana (see columns 5 and 6 of Table 5). Also, a positive effect of experience on migration decisions is observed from the results. The more experienced one is the likelihood such an individual will have access to information. This stock of information and exposure of the experienced encourages migration. From the results in Table 5, the effect of experience on migration decision is almost negligible in the case of Ghana since the marginal effect is almost zero.

While educational attainment has positive effect on migration decisions for basic and secondary education in the period 2005/06, the period 2012/13 experienced migration decision to be negatively affected by educational attainment (see table 5). The reverse is the case for higher educational attainment in both periods. From the pooled sample (see columns 5 and 6), higher educational attainment is observed to have a negative effect on an individual's migration decision in Ghana. Studies by Gbortsu (1995), Beals et al., (1967) and Amuakwa-Mensah et al. (forthcoming) are in support of the negative effect of educational attainment on migration decisions in the Ghanaian concept.

Table 5: Marginal effect of Probit Structural Migration decision estimation

	2005/06 (GLSS 5)		2012/2013 (GLSS 6)		Pooled (GLSS 5 & 6)	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Household size	0.01267***	0.00545***	-0.01422***	-0.00894***	0.01308***	0.01023***
	(0.00033)	(0.00023)	(0.00068)	(0.00061)	(0.00052)	(0.00036)
Experience	0.00001***	0.00001***	0.00002***	0.00001***	0.00002***	0.00001***
	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
Basic Education	0.00474**	0.00340*	-0.03075***	-0.01070**	-0.00297	-0.00168
	(0.00234)	(0.00202)	(0.00499)	(0.00469)	(0.00333)	(0.00240)
Secondary Educ.	0.03657***	0.02896***	-0.01377**	-0.01011*	0.00054	0.00053
	(0.00365)	(0.00307)	(0.00557)	(0.00519)	(0.00410)	(0.00299)
Higher Educ.	-0.02416***	-0.01646***	0.08208***	0.05115***	-0.01683***	-0.03972***
	(0.00373)	(0.00286)	(0.00808)	(0.00782)	(0.00601)	(0.00451)
Other relationship	0.00853***	0.00882***	-0.04225***	-0.04442***	-0.00698**	-0.00118
	(0.00205)	(0.00232)	(0.00496)	(0.00449)	(0.00319)	(0.00259)
Never married	-0.08267***	-0.04374***	-0.18486***	-0.20448***	-0.21775***	-0.16562***
	(0.00425)	(0.00193)	(0.00431)	(0.00382)	(0.00315)	(0.00233)
Coastal zone	0.01651***	0.40730***	0.19061***	0.56325***	0.15766***	0.54075***
	(0.00360)	(0.00395)	(0.00680)	(0.00445)	(0.00492)	(0.00275)
Forest zones	0.01327***	0.33718***	0.14330***	0.52410***	0.13512***	0.52637***
	(0.00318)	(0.00745)	(0.00603)	(0.00799)	(0.00460)	(0.00409)
Agricultural	-0.13470***	-0.09112***	-0.04876***	-0.02023***	0.07207***	0.09381***
	(0.01480)	(0.01168)	(0.00765)	(0.00723)	(0.00592)	(0.00500)
Manufacturing	-0.21862***	-0.11718***	0.03027***	0.03897***	0.04321***	0.02584***
	(0.01843)	(0.01217)	(0.00887)	(0.00825)	(0.00647)	(0.00546)
Services	-0.15100***	-0.09359***	0.01142	0.02893***	0.07958***	0.06612***
	(0.01533)	(0.01159)	(0.00752)	(0.00697)	(0.00554)	(0.00490)
Male	-0.03422***	-0.02976***	-0.00431	-0.00753**	-0.02308***	-0.02798***
	(0.00196)	(0.00165)	(0.00368)	(0.00338)	(0.00259)	(0.00194)
Urban	-0.00450*	-0.00025	-0.02926***	-0.01612***	0.02720***	0.02327***
	(0.00249)	(0.00216)	(0.00446)	(0.00411)	(0.00316)	(0.00243)
Anticip. Welfare	0.55800***	0.21739***	-0.00848	-1.14899***	1.32197***	-0.02933***
	(0.00500)	(0.00334)	(0.01092)	(0.01637)	(0.00915)	(0.00847)
Coastal*Ant.welfare		0.70824***		2.41358***		2.44274***
		(0.02460)		(0.02364)		(0.02256)
Forestl*Ant.welfare		0.57929***		1.85733***		2.22370***
		(0.03555)		(0.02181)		(0.01412)
Observations	6,976	6,976	18,452	18,452	25,428	25,428
Pseudo R-squared	0.815	0.870	0.0885	0.208	0.294	0.540
LR chi2(23)	1658	996	2115	3859	3418	7325
Log likelihood	-874.8	-614.1	-11649	-10123	-12439	-8102
Wave fixed effect					Yes	Yes

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

NB: other control variables which have been accounted for but not reported are age categories and ethnic groups.

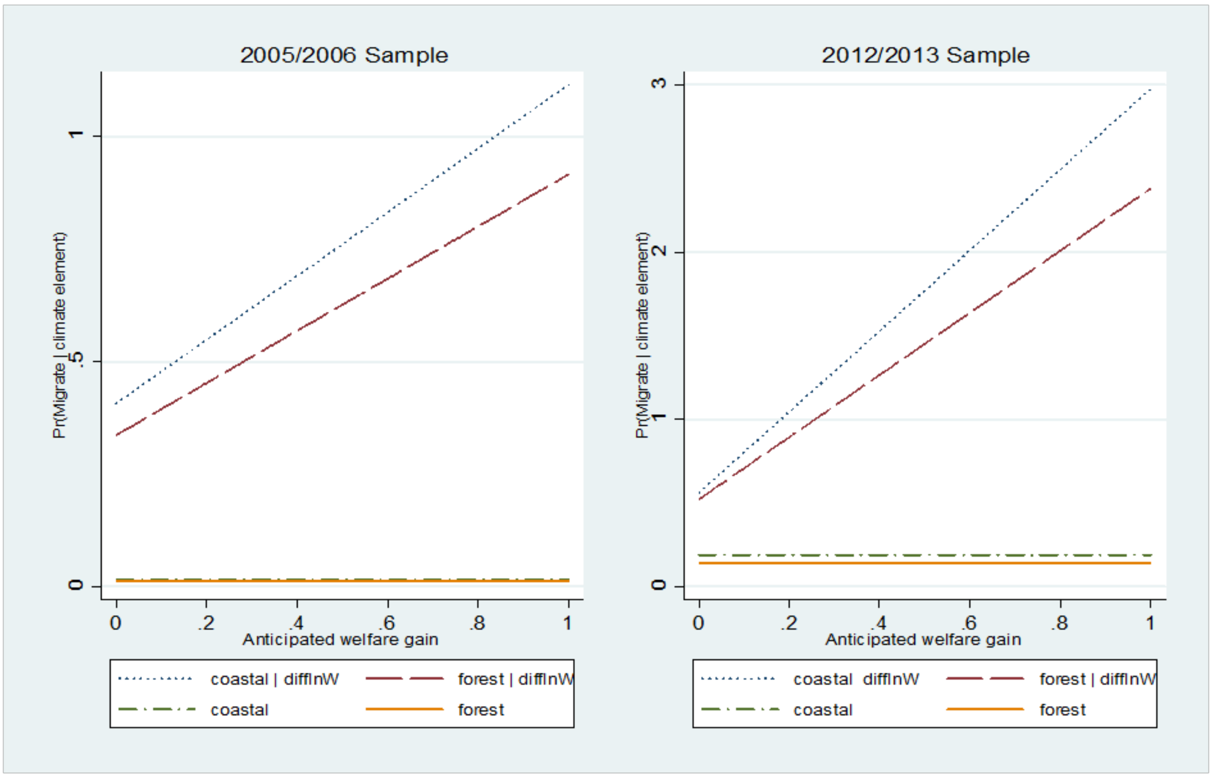
This negative effect can be linked to Bartel's (1979) argument that the incidence of unemployment is more pronounced among the less educated, and this effect may mitigate the positive effect education has on migration. From the estimation for the pooled sample, individuals with higher educational attainment are 0.017 less likely of being an in-migrant than those with no educational attainment (see column 5 of Table 5). This probability increases to 0.04 when and interaction between anticipated welfare gain and climate elements is considered (see column 6 of Table 5).

In relation to marital status, the results show that whereas individuals who have never married are less likely to be in-migrant relative to those married for the period 2005/06, those in other relationship are more likely to be in-migrant relative to those married for the same period. In the pooled and 2012/2013 samples, individuals who are never married and those who are in other relationships are less likely to be in-migrant compared to those who are married. Individuals employed in the agricultural, manufacturing and services sectors are observed to be less likely to migrate relative to those in other sectors for the period 2005/06. Conversely, for the period 2012/13 individuals in the manufacturing and services sectors are more likely to migrate relative to those in the "other sectors". However, those in the agricultural sector are less likely to migrate compared to those in the "other sectors" in the period 2012/2013. In the pooled sample, the results show that individuals employed in the agricultural, manufacturing and services sectors are more likely to migrate relative to those in the "other sectors". Males are observed to less likely to be in-migrant relative to their female counterparts in all cases. In the 2005/2006 and 2012/2013 samples, we observe individuals in the urban centres are less likely to migrate relative to their rural counterparts. Surprisingly, the reverse is observed in the pooled sample. It may be that those migrating in the urban centres are moving to other urban areas and this is much pronounced when the sample for the two periods are pooled together.

Climate factors are observe to have positive effect on migration decisions in all samples. In Table 5, the coastal savannah and forest ecological zones are seen 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, 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. In columns 2, 4 and 6, the results show that the effect of climatic elements on migration decisions is enhanced by anticipated welfare gains. This reinforcing effect of anticipated welfare gain through climatic elements is illustrated in figures 2 and 3. These figures plot the marginal effect of climate elements on migration decisions in Table 5. In figure 2, we compare the marginal effect of climate elements on migration decisions for the 2005/06 and 2012/13 samples.

Figure 2: Marginal effect of climate elements conditional on anticipated welfare gain

Panel A. Panel B.



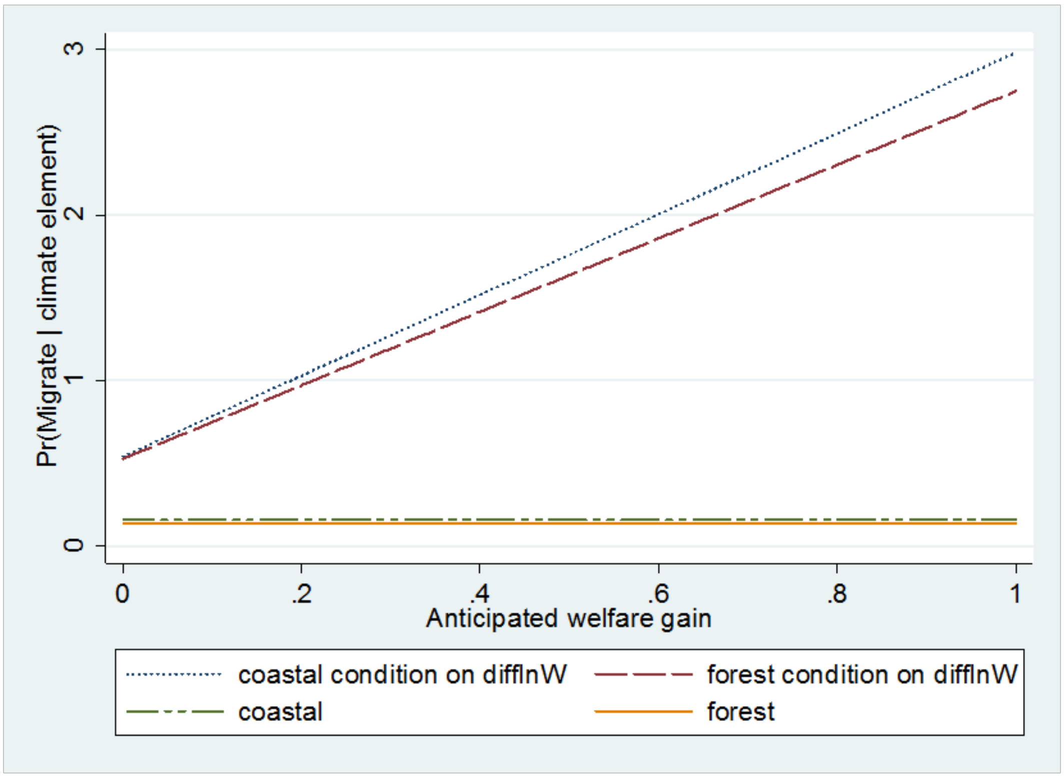
From panel A of figure 2, the marginal effects of the coastal and forest ecological zones on migration decisions almost coincide when interaction between anticipated welfare gain and climate elements is not considered (also see column 1 of Table 5). However, there is much difference between the marginal effects of the coastal and forest zone when anticipated welfare gain acts as a complementary factor to the climate elements in affecting migration decisions (also see column 2 of Table 5)[1]. This difference gradually becomes wider when anticipated welfare gain increases. In the case of the 2012/13 sample, there is a significant difference between the marginal effect of migrating to a coastal zone and that of a forest zone when no interaction between anticipated welfare gain and climate element is considered (see panel B of figure 2). Similar to the 2005/06 sample, the study finds that the marginal effect of climate elements on migration decisions increases via anticipated welfare gain for the 2012/2013 (see panel B in figure 2) and the pooled samples (see figure 3). From panel B of figure 2, the divergence between the marginal effect of migrating to the coastal zone and that of forest zone increases as anticipated welfare gain increases (also see column 4 of Table 5)[2]. This is due to the fact that the

[1] For the 2005/06 sample, the marginal effect of migrating to coastal or forest zones comprises of the direct effect and indirect effect, which is conditional on anticipated welfare gain. For the coastal zone, the marginal effect of migrating into that zone is given as 0.4073+0.7082*(anticipated welfare gain). Also, the marginal effect of migrating into the forest zone is given as 0.3372+0.5793*(anticipated welfare gain).

[2] In the case of the 2012/2013 sample, the marginal effect of migrating to the coastal zone is given as 0.5632+2.414*(anticipated welfare gain) and that of the forest zone is given as 0.5241+1.8573*(anticipated welfare gain)

slope[3] of the marginal effect of migrating to the coastal zone is greater than that of the forest zone. Similar trend is observed in the pooled sample as shown in figure 3.

Figure 3: Marginal effect of climate element conditional on anticipated welfare (pooled sample)



The location of the capital city of Ghana in the coastal zone may account for the divergence in the marginal effect of migrating to the coastal and forest zones as anticipated welfare gain increases. The perception of better prospect in the capital city may reinforce the probability of migrating into the coastal zone hence the high marginal effect as anticipated welfare gain increases.

We find significant positive effect of anticipated welfare gain on migration decisions for the 2005/2006 and pooled samples in cases of no interaction (see columns 1 and 5). Surprisingly, the marginal effect of anticipated welfare gain on migration decisions for the pooled sample is more than twice that of 2005/2006 sample, although the marginal effect of anticipated welfare gain on migration decisions for the 2012/2013 sample is negative and insignificant. When interaction between anticipated welfare gain and climate element is considered in our analysis, the results show a positive direct effect of anticipated welfare gain on migration decision for the 2005/2006 sample but a negative effect for the 2012/13 and pooled samples (see columns 2, 4 and 6). Although, the indirect[4] effect of anticipated welfare gain on migration decisions is positive for all samples (see columns 2, 4 and 6). Nonetheless, the total effect[5] of anticipated welfare gains on

[3] With respect to anticipated welfare gain

[4] This is the coefficient of the interaction term in columns 2, 4 and 6 of Table 5.

[5] For the 2005/06 sample, total effect of anticipated welfare gain for a coastal zone in-migrant is 0.926 (that is, 0.2174+0.08), that of forest zone in-migrant is 0.7967 (that is, 0.2174+0.5793). In the case of 2012/2013 sample, total effect of anticipated welfare gain for a coastal zone in-migrant is 1.2646 (that is, -1.149+2.4136), that of forest zone in-migrant is 0.7083 (that is, -1.149+1.8573). Also, the total effect of anticipated welfare gain for a coastal zone

migration decisions for all the samples are positive, and in most cases higher for the 2012/13 and the pooled samples. The estimates in Table 5 reveal that the leading factor determining an individual's migration decision is anticipated welfare gain since the marginal effects are high in most cases. This result is consistent with the underlying migration theory by Todaro (1969) and is also consistent with earlier studies in Ghana.

6. Conclusion and policy recommendation

This paper investigates the effect of climate factors on internal migration decisions by comparing the 2005/06 and 2012/13 rounds of Ghana Living Standards Survey (GLSS5 and GLSS6). The study also examined the determinants of internal migration decisions using a pooled sample (that is, GLSS5 and GLSS6 combined). It employs the Heckman two-stage method to account for selectivity bias. In order to achieve the aim of the study, the study relates the climate conditions in various ecological zones in Ghana to investigate the effect of climate elements on migration decision and how this effect has changed over the years. 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 were observed to significantly affect an individual's internal migration decision. Findings suggest that climate elements have significant positive effect on internal migration decision in Ghana. The coastal savannah and forest ecological zones were found to accommodate more in-migrants relative to the northern savannah ecological zones. In all cases, the results show that a higher marginal effect coefficient for the coastal savannah zone compared to that of the forest zone, implying 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.

Also, findings suggest that the marginal effect of climate elements on migration decisions increases via anticipated welfare gain. Couple with this, there is a divergence between the marginal effect of migrating to the coastal zone and that of forest zone increases as anticipated welfare gain increases. This conclusion is arrived when an interaction between climatic element and anticipated welfare gains is considered in the analysis. As the effect of the environment or climate element 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 the 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 jobs to be created in the sector should not require skilled workers since most people in the rural area have low education. With quality education and job creation, the welfare of individuals will be enhanced.

---

in-migrant is 2.4134 (that is, -0.0293+2.4427), that of forest zone in-migrant is 2.1944 (that is, -0.0293+2.2237) in the pooled sample.

Acknowledgement

I am very grateful for comments from participants at the FAERE 2015 conference in Toulouse, the Editor of the FAERE working paper series and the reviewer.

References

Ackah, C. and D. Medvedev (2010), *Internal Migration in Ghana: Determinants and welfare impacts*. Paper presented at the PEGNet Conference 2010: Policies to Foster and Sustain Equitable Development in Times of Crisis Development Bank of Southern Africa, Midrand South Africa, 2-3 September.

Afifi, T., and Jäger, J. (eds.). (2010). *Environment, forced migration and social vulnerability*. Heidelberg: Springer.

Armah, F. A., Odei, J. O., Yawson, D. O. and Afrifa, E. K. A. (2011), *Food security and climate change in drought-sensitive savanna zones of Ghana*, Mitig Adapt Strategy Glob Change, 16:291–306

Amuakwa-Mensah, F. (2014), *Migration-Education Linkages: The Case of Ghana*, Lambert Academic Publishing, Germany

Amuakwa-Mensah, F., Boakye-Yiadom, L. and Baah-Boateng, W. (forthcoming), "*Effect of education on migration decisions in Ghana: a rural-urban perspective"*, Journal of Economic Studies, Vol. 43, Issue 2.

Asante, F. A. and Amuakwa-Mensah, F. (2015), *Climate change and variability in Ghana: Stocktaking,* Climate. 3(1):78-99.

Asian Development Bank (ADB), (2012), *Addressing Climate Change and Migration in Asia and the Pacific*, Mandaluyong City, Philippine, Asian Development Bank

Bartel, A. (1979), *The Migration Decision: What Role Does Job Mobility Play?*, American Economic Review, Vol. 69, No. 5, pp. 775-786

Beal R. E., Mildred B. Levy and Leon N. Moses (1967), *Rationality and Migration in Ghana*, The review of economics and statistics, vol.49, No.4 pp.480-486

Becker, G.S. (1962), *Investment in human capital: a theoretical analysis*, Journal of Political Economy, 70 (Supplement), 9-49.

Black, R., Bennett, S. R. G., Thomas, S. M., and Beddington, j. R. (2011), *Migration as adaptation*, Nature 478:447–9.

Boakye-Yiadom, L. (2008), *Rural-Urban Linkages and welfare: The case of Ghana's Migration and Remittance Flows*. Doctorate thesis, Department of Economics and International Development, University of Bath

Caldwell, J. C. (1968), *Determinants of Rural-Urban Migration in Ghana*, Population Studies, Vol.22, No.3 pp.361-377.

Coniglio, N. D. and Pesce, G., (2015), *Climate variability and international migration: an empirical analysis*, Environment and Development Economics, Vol.20 (2) p. 1-35.

Environmental Protection Agency (EPA), (2011). *Ghana's Second National Communication (GSNC) to the UNFCCC; United Nations Development Programme*: New York, NY, USA

Gbortsu, E.P.S. (1995). *Socio-Demographic Profile of Internal Migrants*, In Boakye-Yiadom, L. (2008), *Rural-Urban Linkages and welfare: The case of Ghana's Migration and Remittance Flows*. Doctorate thesis, Department of Economics and International Development, University of Bath

Ghana Statistical Service (GSS), (2011). *Annual Report*; Ghana Statistical Service: Accra, Ghana

Heckman, J.J. (1979), *Sample Selection Bias as a specification error*, Econometrica, Vol.47, No.1 pp.153-161.

IOM (2009), *Migration, climate change, and the environment: Assessing the evidence*, International Organization for Migration, Geneva, Switzerland

Warner, K. and Afifi, T., (2014). *Where the rain falls: Evidence from 8 countries on how vulnerable households use migration to manage the risk of rainfall variability and food insecurity*, Climate and Development, 6:1, 1-17

Lee, L. (1978), Unionism and Wage rates: *A simultaneous equations model with qualitative and limited dependent variables*. International Economic review, Vol. 19, No.2

Lewis W. (1954). *Economic development with unlimited supplies of labour*, Manchester School of Economics and Social Studies, 22, 139-91

Lucas R. (1997) *Internal migration in developing countries*, in Lall et al. (2006), Rural-Urban Migration in Developing Countries: A Survey of Theoretical Predictions and Empirical Findings, World Bank Policy Research Working Paper 3915.

Mincer, J. (1958), *Investment in human capital and personal income distribution*, Journal of Political Economy, 70.

Myers, N. (1993). *Environmental refugees in a globally warmed world*. Bioscience, 43, 752–761.

Nakosteen, R. A. and Zimmer, M. (1980), *Migration and Income: The Question of Self-selection*, Southern Economic Journal Vol. 46, No.3 pp.840-851.

Nivalainen S. (2003), *Who move to Rural areas? Micro evidence from Finland.* ERSA 2003, Jyväskylä, Finland.

Piguet, E., Pe´coud, A. and de Guchteneire, P. (2011), *Migration and climate change: an overview*, Refugee Survey Quarterly, pp. 1–23

Piguet, E. (2010), *Linking climate change, environmental degradation, and migration: a methodological overview*, WIREs Climate Change (1) 517–524

Reed, H.E, Andrzejewski C. S. and White M. J. (2005), *An Event History Analysis of Internal Migration in Ghana: Determinants of Interregional Mobility among Residents of Coastal Central Region*, International Union for the Scientific Study of Population (IUSSP) XXVth International Population Conference Tours, France.

Schultz, T. W. (1961), *Investment in human capital*, American Economic Review, 51, 1-17.

Sjaastad, L.A. (1962): *The Costs and Returns of Human Migration. In Richardson H. W. (ed.) Regional Economics*. The University Press, Glasgow.

Stern, N. and Treasury, G. (2007), *The economics of climate change: the Stern review*. Cambridge University Press

Todaro M. (1969) A model of labor migration and urban unemployment in less developed countries, *American Economic Review*, 59, 138-48.

Van der Geest, K., (2011), *Migration, Environment and Development in Ghana*, International Conference, Rethinking Migration: Climate, Resource Conflicts and Migration in Europe.

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. In order to estimate the anticipated welfare gains, counterfactual scenario is used to predict the welfare level for both migrants and non-migrants.

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: Descriptive statistics

	2005/06 (GLSS 5)						2012/2013 (GLSS 6)						POOL (GLSS 5 & GLSS 6)					
	ALL		Migrant		Non-migrant		ALL		Migrant		Non-migrant		ALL		Migrant		Non-migrant	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
VARIABLES	mean	Sd	mean	Sd	Mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Migrant	0.584	(0.493)					0.484	(0.500)					0.511	(0.500)				
LnWelfare	5.128	(0.757)	5.236	(0.722)	4.976	(0.780)	7.730	(0.793)	7.891	(0.759)	7.578	(0.795)	7.016	(1.401)	7.060	(1.441)	6.970	(1.356)
Household size	4.927	(3.053)	4.606	(2.659)	5.377	(3.484)	5.262	(3.091)	4.727	(2.761)	5.764	(3.293)	5.170	(3.084)	4.689	(2.730)	5.674	(3.342)
Experience	1,421	(1,003)	1,578	(1,024)	1,201	(929.8)	1,333	(1,101)	1,552	(1,125)	1,127	(1,038)	1,357	(1,076)	1,560	(1,094)	1,144	(1,014)
Anticipated welf.	-0.253	(0.346)	-0.0175	(0.206)	-0.582	(0.205)	-0.231	(0.227)	-0.155	(0.206)	-0.303	(0.223)	-0.249	(0.239)	-0.110	(0.185)	-0.394	(0.200)
Coast*Anticipat.	-0.0831	(0.220)	-0.0137	(0.113)	-0.180	(0.288)	-0.067	(0.168)	-0.040	(0.122)	-0.092	(0.199)	-0.07	(0.171)	-0.031	(0.0990)	-0.110	(0.215)
Forest*Anticipat.	-0.124	(0.290)	0.00338	(0.144)	-0.302	(0.345)	-0.130	(0.194)	-0.081	(0.157)	-0.177	(0.214)	-0.135	(0.219)	-0.055	(0.137)	-0.218	(0.255)
No education	0.380	(0.485)	0.347	(0.476)	0.427	(0.495)	0.198	(0.399)	0.184	(0.388)	0.211	(0.408)	0.248	(0.432)	0.235	(0.424)	0.262	(0.439)
Basic Education	0.431	(0.495)	0.440	(0.497)	0.419	(0.493)	0.431	(0.495)	0.384	(0.486)	0.475	(0.499)	0.431	(0.495)	0.402	(0.490)	0.462	(0.499)
Secon. Educati.	0.104	(0.306)	0.107	(0.309)	0.101	(0.301)	0.295	(0.456)	0.331	(0.470)	0.262	(0.440)	0.243	(0.429)	0.261	(0.439)	0.224	(0.417)
High Education	0.0840	(0.277)	0.106	(0.308)	0.0534	(0.225)	0.0755	(0.264)	0.101	(0.301)	0.0520	(0.222)	0.0779	(0.268)	0.102	(0.303)	0.0523	(0.223)
15<age<35	0.540	(0.498)	0.472	(0.499)	0.636	(0.481)	0.601	(0.490)	0.509	(0.500)	0.687	(0.464)	0.584	(0.493)	0.498	(0.500)	0.675	(0.468)
36<age<60	0.428	(0.495)	0.489	(0.500)	0.342	(0.474)	0.355	(0.479)	0.434	(0.496)	0.281	(0.449)	0.375	(0.484)	0.451	(0.498)	0.295	(0.456)
60+	0.0324	(0.177)	0.0393	(0.194)	0.0227	(0.149)	0.0437	(0.204)	0.0563	(0.231)	0.0318	(0.176)	0.0406	(0.197)	0.0510	(0.220)	0.0297	(0.170)
Married	0.522	(0.500)	0.575	(0.494)	0.446	(0.497)	0.470	(0.499)	0.568	(0.495)	0.378	(0.485)	0.484	(0.500)	0.571	(0.495)	0.394	(0.489)
Other relationsh.	0.226	(0.418)	0.248	(0.432)	0.195	(0.396)	0.176	(0.381)	0.206	(0.405)	0.148	(0.355)	0.190	(0.392)	0.219	(0.414)	0.159	(0.366)
Never married	0.252	(0.434)	0.177	(0.382)	0.359	(0.480)	0.354	(0.478)	0.225	(0.418)	0.474	(0.499)	0.326	(0.469)	0.210	(0.407)	0.447	(0.497)
Coastal zone	0.332	(0.471)	0.356	(0.479)	0.299	(0.458)	0.247	(0.432)	0.306	(0.461)	0.192	(0.394)	0.271	(0.444)	0.322	(0.467)	0.217	(0.412)
Forest zones	0.482	(0.500)	0.505	(0.500)	0.449	(0.497)	0.467	(0.499)	0.505	(0.500)	0.431	(0.495)	0.471	(0.499)	0.505	(0.500)	0.435	(0.496)
Northern zones	0.186	(0.389)	0.139	(0.346)	0.252	(0.434)	0.286	(0.452)	0.189	(0.392)	0.376	(0.484)	0.258	(0.438)	0.173	(0.379)	0.347	(0.476)
Agricultural	0.422	(0.494)	0.381	(0.486)	0.480	(0.500)	0.430	(0.495)	0.357	(0.479)	0.498	(0.500)	0.428	(0.495)	0.365	(0.481)	0.494	(0.500)
Manufacturing	0.135	(0.342)	0.140	(0.347)	0.127	(0.334)	0.0964	(0.295)	0.107	(0.309)	0.0868	(0.281)	0.107	(0.309)	0.117	(0.322)	0.0963	(0.295)
Services	0.436	(0.496)	0.471	(0.499)	0.388	(0.487)	0.409	(0.492)	0.471	(0.499)	0.350	(0.477)	0.416	(0.493)	0.471	(0.499)	0.359	(0.480)
Other sectors	0.00659	(0.0809)	0.00761	(0.0869)	0.00517	(0.0717)	0.0645	(0.246)	0.0647	(0.246)	0.0643	(0.245)	0.0486	(0.215)	0.0468	(0.211)	0.0505	(0.219)
Other_Akan	0.230	(0.421)	0.240	(0.427)	0.215	(0.411)	0.228	(0.420)	0.249	(0.433)	0.208	(0.406)	0.229	(0.420)	0.246	(0.431)	0.210	(0.407)
Asante	0.205	(0.404)	0.209	(0.407)	0.199	(0.399)	0.125	(0.331)	0.138	(0.345)	0.114	(0.318)	0.147	(0.354)	0.160	(0.367)	0.134	(0.340)
Fante	0.121	(0.326)	0.151	(0.358)	0.0785	(0.269)	0.110	(0.312)	0.130	(0.336)	0.0904	(0.287)	0.113	(0.316)	0.136	(0.343)	0.0877	(0.283)

Ga_Adangbe	0.0925	(0.290)	0.0832	(0.276)	0.105	(0.307)	0.0746	(0.263)	0.0731	(0.260)	0.0759	(0.265)	0.0795	(0.270)	0.0763	(0.265)	0.0828	(0.276)
Ewe	0.160	(0.366)	0.169	(0.375)	0.146	(0.353)	0.149	(0.356)	0.177	(0.382)	0.123	(0.329)	0.152	(0.359)	0.175	(0.380)	0.128	(0.335)
Northern_Tribes	0.177	(0.382)	0.136	(0.342)	0.236	(0.425)	0.295	(0.456)	0.217	(0.412)	0.368	(0.482)	0.262	(0.440)	0.191	(0.393)	0.337	(0.473)
All_other_Tribes	0.0152	(0.122)	0.0118	(0.108)	0.0200	(0.140)	0.0183	(0.134)	0.0159	(0.125)	0.0206	(0.142)	0.0175	(0.131)	0.0146	(0.120)	0.0204	(0.142)
Male	0.542	(0.498)	0.547	(0.498)	0.534	(0.499)	0.531	(0.499)	0.515	(0.500)	0.546	(0.498)	0.534	(0.499)	0.525	(0.499)	0.543	(0.498)
Female	0.458	(0.498)	0.453	(0.498)	0.466	(0.499)	0.469	(0.499)	0.485	(0.500)	0.454	(0.498)	0.466	(0.499)	0.475	(0.499)	0.457	(0.498)
Urban	0.479	(0.500)	0.482	(0.500)	0.475	(0.499)	0.460	(0.498)	0.508	(0.500)	0.415	(0.493)	0.465	(0.499)	0.500	(0.500)	0.429	(0.495)
Rural	0.521	(0.500)	0.518	(0.500)	0.525	(0.499)	0.540	(0.498)	0.492	(0.500)	0.585	(0.493)	0.535	(0.499)	0.500	(0.500)	0.571	(0.495)
Western	0.104	(0.305)	0.116	(0.320)	0.0868	(0.282)	0.120	(0.325)	0.153	(0.360)	0.0891	(0.285)	0.116	(0.320)	0.141	(0.348)	0.0885	(0.284)
Central	0.0777	(0.268)	0.0962	(0.295)	0.0517	(0.221)	0.0878	(0.283)	0.0877	(0.283)	0.0879	(0.283)	0.0850	(0.279)	0.0904	(0.287)	0.0794	(0.270)
Greater Accra	0.182	(0.386)	0.204	(0.403)	0.152	(0.359)	0.136	(0.343)	0.183	(0.386)	0.0928	(0.290)	0.149	(0.356)	0.189	(0.392)	0.107	(0.309)
Volta	0.0834	(0.277)	0.0759	(0.265)	0.0940	(0.292)	0.0885	(0.284)	0.0898	(0.286)	0.0873	(0.282)	0.0871	(0.282)	0.0854	(0.280)	0.0889	(0.285)
Eastern	0.123	(0.329)	0.141	(0.348)	0.0985	(0.298)	0.122	(0.327)	0.129	(0.335)	0.115	(0.320)	0.122	(0.328)	0.133	(0.339)	0.111	(0.315)
Ashanti	0.216	(0.412)	0.215	(0.411)	0.218	(0.413)	0.128	(0.334)	0.129	(0.336)	0.126	(0.332)	0.152	(0.359)	0.156	(0.363)	0.148	(0.355)
Brong Ahafo	0.0935	(0.291)	0.0837	(0.277)	0.107	(0.309)	0.109	(0.312)	0.117	(0.322)	0.102	(0.303)	0.105	(0.307)	0.107	(0.309)	0.103	(0.304)
Northern	0.0424	(0.202)	0.0319	(0.176)	0.0572	(0.232)	0.0616	(0.240)	0.0328	(0.178)	0.0886	(0.284)	0.0564	(0.231)	0.0325	(0.177)	0.0813	(0.273)
Upper East	0.0341	(0.182)	0.0133	(0.114)	0.0634	(0.244)	0.0688	(0.253)	0.0347	(0.183)	0.101	(0.301)	0.0593	(0.236)	0.0280	(0.165)	0.0920	(0.289)
Upper West	0.0433	(0.204)	0.0236	(0.152)	0.0710	(0.257)	0.0777	(0.268)	0.0438	(0.205)	0.110	(0.312)	0.0683	(0.252)	0.0375	(0.190)	0.101	(0.301)
Observations	6,976		4,073		2,903		18,452		8,931		9,521		25,428		13,004		12,424	

Values in parenthesis represent standard deviation

Table A2: Marginal effect of reduced form probit migration estimation

VARIABLES	(1) 2005/06 (GLSS 5)	(2) 2012/13 (GLSS 6)	(3) Pool
Experience	0.0001***	0.0000***	0.0000***
	(0.0000)	(0.0000)	(0.0000)
Basic education	0.0124**	-0.0301***	-0.0154***
	(0.0052)	(0.0049)	(0.0036)
Secondary education	0.0490***	-0.0086	0.0029
	(0.0079)	(0.0055)	(0.0044)
Higher education	0.1145***	0.0973***	0.1051***
	(0.0085)	(0.0080)	(0.0061)
15<age<35	0.1334***	0.0404**	0.0630***
	(0.0203)	(0.0167)	(0.0131)
36<age<60	0.1136***	0.0251*	0.0479***
	(0.0171)	(0.0130)	(0.0104)
Other relationship	-0.0063	-0.0364***	-0.0279***
	(0.0056)	(0.0048)	(0.0038)
Never married	-0.1476***	-0.1946***	-0.1824***
	(0.0064)	(0.0042)	(0.0035)
Agricultural	-0.2062***	-0.0691***	-0.0841***
	(0.0274)	(0.0075)	(0.0067)
Manufacturing	-0.1095***	0.0262***	0.0111
	(0.0288)	(0.0089)	(0.0076)
Services	-0.0979***	0.0087	0.0046
	(0.0283)	(0.0075)	(0.0067)
Male	0.0245***	-0.0021	0.0063**
	(0.0046)	(0.0036)	(0.0029)
Urban	-0.1302***	-0.0386***	-0.0629***
	(0.0059)	(0.0044)	(0.0035)
Observations	6,976	18,452	25,428
Pseudo R-squared	0.0914	0.104	0.101
LR chi2(23)	782	2454	3253
Log likelihood	-4304	-11447	-15847
Wave fixed effect			Yes

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

NB: other controls which are accounted for but not reported are regional effect and ethnicity.