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District-level Spatial Analysis of Migration Flows in Ghana: Determinants and Implications for Policy

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Acknowledgements

Abstract

The present study investigates the determinants of inter-district migration flows over the 1995-2000 period in Ghana. A combination of socio-economic, natural and spatial 'district-level' attributes are considered as potential variables explaining the direction of migration flows. In addition to the 'net' migration model, 'in' and 'out' migration models are also employed within the context of the gravity model. Results in the three models consistently show that people move out of districts with less employment and choose districts with high employment rate as destinations. While shorter distance to roads encourages out-migration, districts with better water access seem to attract migrants. Generally, people move out of predominantly agrarian districts to relatively more urbanized districts.

Keywords: Gross migration, Net migration, Inter-district migration flows, spatial analysis, Ghana, Africa

1. Introduction

Since ancient times, migration has been an important part of social and economic life of human beings. For some it is a strategy of improving livelihoods while for some others it is a way of escaping man-made and natural calamity (Anarfie, et al., 2003). Most of all, it is a common phenomenon in the process of transformation of an economy (Cebula and Alexander, 2006; Cebula, 2005).

As migration flows are important in determining the demographic and socio-economic composition of regions in specific administrative boundaries - districts -, an understanding of inter-district migration flows is essential for anyone attempting to analyze the general process of regional change. Explaining the dynamics of migration is important since it has far reaching implications for setting up policy and responding to socio-economic change. Nowadays, policy makers have become increasingly aware of the role of migration flows. Thus research results from this study will support government policy makers and planners to be better aware of the district attributes that underlie the process by which migration flows are directed.

West Africa is one of the few regions where relatively large-scale free movement of people takes place (Zachariah and Conde, 1981) and internal migration accounts for most of the migratory movements (Ackah and Medvedev, 2010). *"In West Africa, climatic zones are so ordered that the slack season in the Savannah zone is the busiest season along the southern coast; the period of inactivity in the Savannah zone corresponds to the time of peak agricultural demands in the cocoa regions of the forest zones"* (Kasanga and Avis, 1988). Therefore, migration is a vital element of the contemporary scene in most of West Africa.

In Ghana, migration is an important component of people's livelihood strategies. Studies indicate that Ghana 'loses' people as a result of migration. Annually, Ghana's net migration rate (in-migrants minus out-migrants) is -55 persons per 100,000 inhabitants (World Fact Book, 2007). Ghana preserves its position as a net sender country especially when compared to neighboring countries like Nigeria, Benin, Togo and Côte d'Ivoire which have a net migration rate of 26, 58, 0, and 0 per 100,000 inhabitants respectively (World Fact Book, 2007). Internally, within the period between 1995 and 2000 only, about 1.4 million people have changed their district of residence (Ghana Census, 2000). This translates to a '71 to 1000' migrant to population ratio.

Various studies on 'migration in Ghana', such as Udo (1974), Kasanga and Avis (1988), Nabila (1992), Tutu (1995), Litchfield and Waddington (2003), Anarfi, et al., (2003) and Ackah and Medvedev (2010) attempted to explain the rapid rural-urban migration and most of these studies lay emphasis on the migrants from the north to the central and coastal areas of the country. These studies are conducted at the household-level. No such attempt is made to characterize the migration flow behavior at the district-level. There are major knowledge gaps about the level, pattern, differentials and directions of district-level migration flows and their determinants within Ghana. This study, to our knowledge, is the first of its kind as the study of inter-regional migration in the region. Thus we expect the study will bridge the research gap prevailing in the area.

The other important contribution of the paper is its attempt to include the whole range of district-level characteristics, especially the unusual combination of socio-economic and environmental (GIS-aggregated spatial data base) district-level characteristics that could play a role in directing

migration flows. This study considers both the 'gross' and 'net' migration models so as to capture the migration flow dynamics and the resulting determinants in its entirety.

The remainder of this study is organized as follows. In the second section, the empirical model specification within the context of the gravity model is illustrated. Also, the "in" and "out" migration models are specified. The data, source and explanation of the range of the variables, justification for their inclusion as well as descriptive statistics of the variables are discussed in section three. The fourth section is devoted to the analysis of the main results and subsequent discussions. Section five concludes.

2. The Model

Within the context of the gravity model[1], we specify models for the "Gross Migration" (GM) flows. For the "Net Migration" (NM), the probit model is used. This is because the dependent variable is discrete with either net-receiving or net-sending districts. The "gross" migration accounts for the "in" and "out" migration separately. As the dependent variables in the models (Equations 1 and 2) are proportions that fall between zero and one, the fractional logit model is applied (Papke and Wooldridge, 1996).

The inclusion of both the NM and GM models will help differentiate the determinants of In Migration Rate (IMR) and Out Migration Rate (OMR). Greenwood (1975) argues that although theoretical foundations of NM and GM models are similar, the theoretical implications are different. It has been argued that based on theoretical grounds, gross migration models are to be preferred to net migration models (Kau and Sirmans, 1977; Tabuchi, 1985), because net models do not clearly demonstrate whether a selection of district attributes primarily affect IMR or OMR (Rogers, 1990 as cited in Cadwallader, 1992; Brown, 1997). The other rationale behind employing the 'gross' migration model is that some variables may have similar forecasted effect on both the IMR and OMR, which may then offset the estimates of net migration (Brown, 1997). The estimates using the 'net' approach would thus underrate the overt and covert inter-district migrant exchanges. To control these setbacks, in addition to the NM model, the GM flow approach is also employed. This distinction is important for informing policy making related to migration flows.

2.1 The out-migration model specification: the decision to leave

Several studies (Yap, 1977; Kau and Sirmans, 1977; Milne, 1991; Cadwallader, 1992; Taylor and Martin, 2001) show that the out-migration variable used in a multivariate regression is represented as a rate of the flow from i to j over the population in the origin i, thus the denominator should be the appropriate population at risk. Following these empirical models, OMR is defined as the number of migrants over the population at origin, OM_i/P_i (Equation 1). Out-migration from an area is determined by the first decision that migrants make, that is, the decision to leave. In making this decision, individuals compare the characteristics of their origin district i to the possibilities outside. In the specification employed here, the mean characteristics over all districts represent a blend of outside opportunities. Individuals considering out-migration view their origin characteristics relative to these outside opportunities. These characteristics are designated as $Y_{hi}/(\sum_i Y_{hi}/N)$ in Equation 1 below. In addition, there are also characteristics ($\sum_c \alpha_{hi} S_{ci}$) which influence migration flows that are not compared across areas but instead determine the propensity of people within the area to move out.

The variables in their relative forms are mainly prices, population density, urbanization rate, number of clinics per population, average rainfall and the coefficient of variation of rainfall while all other variables are in their absolute terms.

We model the determinants of out-migration by weighting each district's number of out-migrants as a rate of total population in the district. Following Brown (1997), the model is specified as follows:

$$\frac{OM_i}{P_i} = \alpha_i + \sum_i \alpha_c S_{ci} + \sum_h \alpha_h \frac{Y_{hi}}{\sum_i Y_{hi} \Big/ N} + \varepsilon \tag{1}$$

where: OM_i is the total number of out-migrants from origin district i; P_i is the total population in district i; S_{ci} and Y_{hi} are the vectors of district characteristics at absolute and relative levels respectively; α's are parameters to be estimated; N is the total number of districts; and ε is the error term.

2.2 The in-migration model specification: the destination choice

We model the determinants of in-migration also by taking a district's total number of in-migrants as a rate of total population in the destination district. Also for in-migration model, we use district characteristics both in absolute and relative forms in which for relative variables the origin characteristics are compared with the composite average characteristics of all districts in the country. Following Brown (1997), the model is specified as follows:

$$\frac{IM_j}{P_j} = \beta_o + \sum_j \alpha_c S_{cj} + \sum_h \beta_h \frac{Y_{hj}}{\sum_i Y_{hj} \Big/ N} + \varepsilon \tag{2}$$

where: IM_j is the total in-migrants to district j; P_j is the total population in the destination district j; γ_{hj} is the vector of district characteristics at their relative value; β's are parameters to be estimated; N is the total number of districts; and is ε the error term.

3. Variables, data sources and pre-processing

The spatial unit for migration analyses is 'district' ($N = 110$ districts in Ghana). The propensity to migrate is empirically a function of district's attributes, interaction and regional competitive characteristics. We hypothesize different factors (including infrastructure, environmental and socio-economic characteristics) that can explain migration flows at the district-level as explained in Table 1. OMR, IMR and NM variables serve as dependent variables in the model specification. The spatial distribution of the IMR and OMR variables is shown in figures 1a & 1b.

Table 1 Definitions of variables used and corresponding data sources

Variables	Definitions	Data sources
Dependent variables		
OMR	Ratio of people who moved out of their place of residence (district) to total district population (1995–2000)	Ghana 2000 Population and Housing Census (G2000PHC) (Ghana Statistical Service, 2002)
IMR	Ratio of people who moved into the district (in-migrants) to total district population (1995-2000)	G2000PHC
NM	Net Migration: Number of in-migrants minus number of out migrants [=1 if positive and 0 otherwise](1995-2000)	G2000PHC
Explanatory variables		
Socioeconomic variables		
EMP_RATE	Ratio of employed people to total economically active population (15 ≤ age ≤ 65)	G2000PHC
PRICES	Price index (in Cedis) for food and non-food goods	Ghana Living Standard Survey IV data (GLSS-IV)
URB	Ratio of urban residents to total population	G2000PHC
POPDEN	Population density per square kilometer	G2000PHC
MAJOR_TOWN[2]	1 if a district has major town and 0, otherwise	G2000PHC
BED	Number of hospital beds per 1000 population	G2000PHC
HOSPITALS	Number of hospitals/operating clinics per 1000 population	G2000PHC
DOCTORS	Number of doctors per 1000 population	G2000PHC
HOUSE_OWN[3]	Proportion of people who live in own house	G2000PHC
WAT_ACCESS	Share of people with access to pipe and tanker water supply	G2000PHC
Environmental factors		
DIST_TOWN	Mean distance to nearest town, in km	GLOWA-Volta Project Geo-database
DIST_WATER	Mean distance to nearest water bodies (km)	GLOWA-Volta Project Geo-database
DIST_ROAD	Mean distance to main road (km)	GLOWA-Volta Project Geo-database
SHARE_FOREST	Share of forest land in the district (in 1992/1993)	AVHRR Land use/cover - GLCF (Hansen et al. 1998)
SHARE_SAVAN	Share of savannah (wood) land in the district (in 1992/1993)	AVHRR Land use/cover - GLCF (Hansen et al. 1998)
SHARE_GRASS	Share of grass land in the district (in 1992/1993)	AVHRR Land use/cover - GLCF (Hansen et al. 1998)
SHARE_CROP	Share of crop land in the district (in 1992/1993)	AVHRR Land use/cover - GLCF (Hansen et al. 1998)
RAIN_AVA	Mean annual rainfall in the district (1981-1994 in mm/year)	CRU TS 2.1 (Mitchell and Jones, 2005)
RAIN_VAR	Standard deviation of annual rainfall (1981-1994 in mm/year)	CRU TS 2.1 (Mitchell and Jones, 2005)

3.1 Socio-economic variables and data sources

OMR, IMR and NM variables serve as dependent variables in the model specification. NM rates of Ghanaian districts are demonstrated in Fig. 2. Employment rate (EMP_RATE), being an important driver seen by migration theorists, is one of the target variables hypothesized to have impacts on migration flows. It is expected that declining employment rate in the source district leads to an increase in out-migration, while by the same token; increasing employment rate in the receiving district encourages inflow of migrants. The ratio of urban residents (URB) -as a proxy for urbanization- is included in the variables list and it is hypothesized that people are likely to migrate into more urbanized areas. Regarding the price variable (PRICES), it is expected that the higher the rate of prices in the receiving place j, the less economically attractive it is to potential in-migrants. To see the effect of health facilities in migration flows, we include the number of doctors per population (DOCTORS), Hospital beds (BED) and number of operating hospitals and clinics (HOSPITALS). It is expected that these will positively affect in-migration.
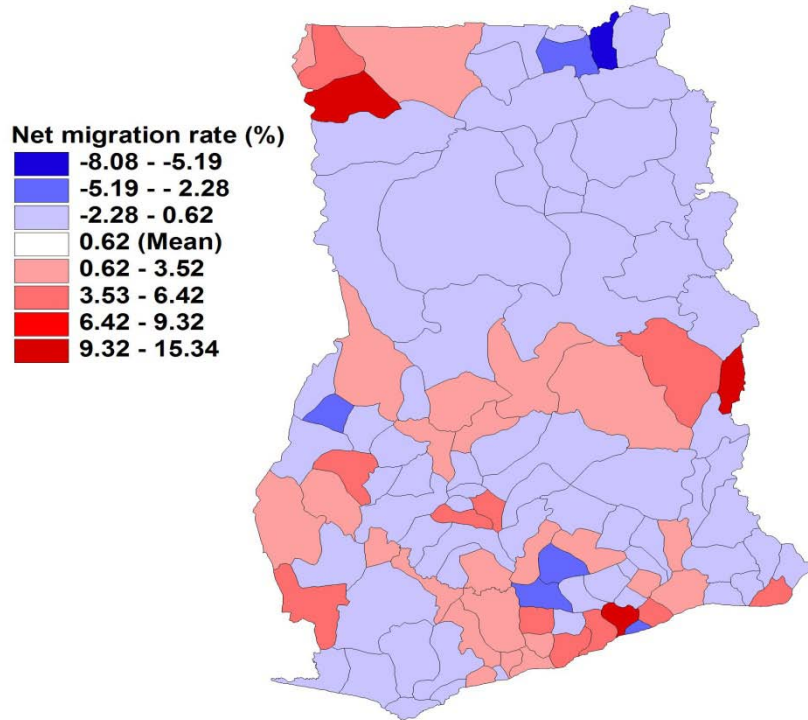
Figure 1 Spatial distribution of in- and out-migration rates (qualitative classes) for the period 1995-2000.
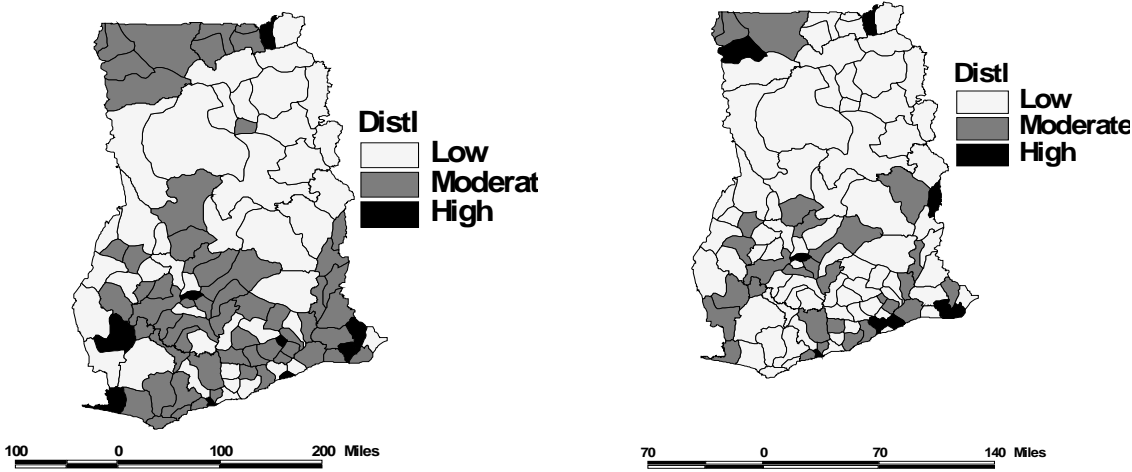
a) In-migration rate (IMR) (1995-2000)   b) Out-migration rate (OMR) (1995 - 2000)

Figure 2 Spatial distribution of net migration rates (NM) for the period 1995-2000.

Note: Unit of NM: % of total district's population. The class wide is equal to the standard deviation (SD) of the NM mean. Negative values (blue color band) and positive values (red color band) indicate net population loss and gain, respectively.

The major source for the socio-economic data is the Ghana 2000 census taken from the Ghana Statistical Service (GSS). The complete matrix of migration flows together with data on the house holding/tenure arrangement, health facilities, urbanization rate and employment rate are extracted from the census data. Price indices were extracted from the GLSS (Ghana Living Standard Survey) IV data.

3.2   Environmental variables, data sources and spatial analyses

Proximity to towns (DIST_TOWN) (Fig. 3a) is included as a proxy variable for the degree of urbanization within a district. The less value of the variable would translate to lower cost of physical access to towns. It is likely that people move to towns where they have better access to higher-wage jobs and service benefits that are lacking in rural areas leading for a hypothesis that the variable has a positive effect on the in-migration. The proximity to water bodies (DIST_WATER) (Fig. 3b) is a proxy measurement of physical access to inland water resources. A lower value of DIST_WATER for a district indicates a high potential of access to freshwater sources in the area. It is likely that people would want to live near important rivers as these water sources are crucial for domestic consumption and production activities. Thus, we hypothesize that DIST_WATER would have a negative impact on net migration.

Proximity to roads (DIST_ROAD) (Fig. 3c) is a proxy indicator for access to market that would be important in shaping migration flows. Land use data is also employed to characterize districts with shares of land used for cropping, forest, savannah and grassland all included in the modeling of the migration flows (Fig. 3d). The hypothesis is that districts with higher shares of natural

land-cover types (forestland, savanna or grassland) may be those in remote areas with less population, where people would want to move out of.

Figure 3   Spatial distribution of (a) distance to towns, (b) distance to water bodies,(c) distance to roads and (d) land use.
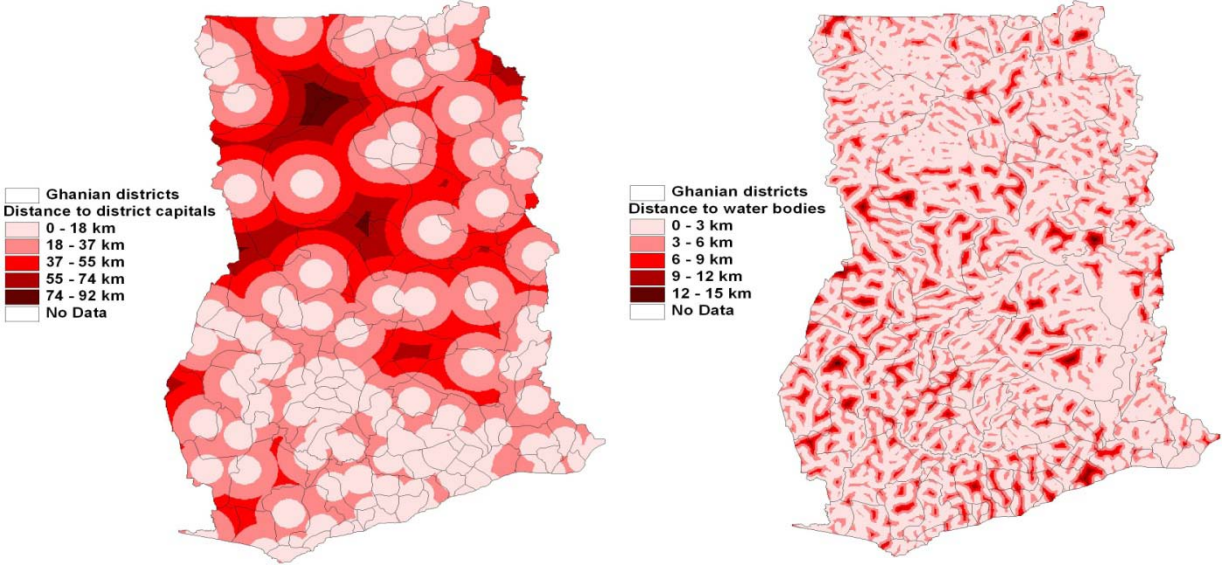
a)Distance to district capitals (DIST_TOWN)

(b) Distance to water bodies (DIST_WATER)
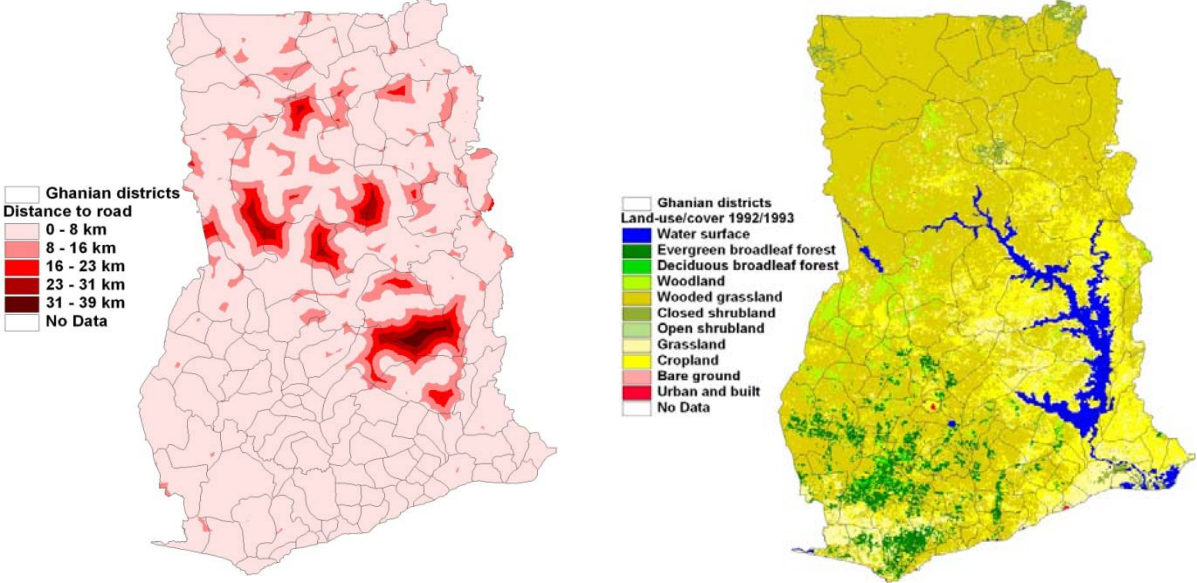
c) Distance to main road (DIST_ROAD)

(d) Land use/cover 1992/1993

The standard deviation of inter-annual rainfalls (RAIN_VAR) (Fig. 4) reflects the variability of incoming water resources for agricultural production. Higher RAIN_VAR, i.e. less rainfall reliability, would indicate an undesired environmental change for agricultural production, thus the effect of this variable on net migration may be negative. Given the fact that the majority of Ghana is under water stress, higher rainfall availability (RAIN_AVA) would reflect a more favorable situation for human livelihoods. Thus, this variable would play a positive role for in-migration flows.

Figure 4   Spatial distribution of rainfall availability and variability.
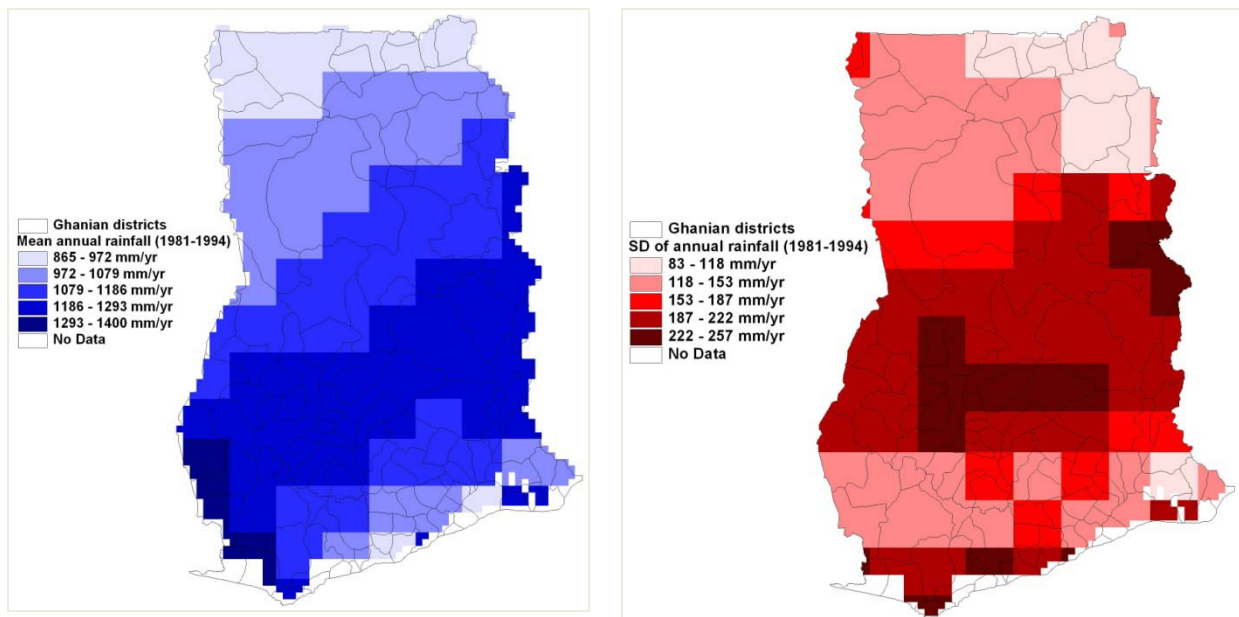
a) Mean annual rainfall (1981-1994)
(RAIN_AVA)

b) Standard deviation of annual rainfall (1981-1994)
(RAIN_VAR)

To produce district-level data of the environmental variables, our spatial analyses include the following two steps. First, we produce numerical grids (grid cell size = 1km^2) of the environmental variables by extracting and re-sampling GIS raster data from relevant sources. Distances to main roads, towns and water bodies were computed based on thematic maps provided by the GLOWA-Volta project (http://www.glowa-volta.de). Rainfall data were extracted from a climate gridded dataset of the Climate Research Unit (CRU) at the University of East Anglia (CRU TS 2.1) (Mitchell and Jones, 2005). Land use/cover (for 1992/1993) data were taken from the Global Land Cover Facility (GLCF) at the University of Maryland (Hansen et al., 1998). Second, based on the numerical grids we calculate the spatial mean values of the environmental variables for every district. These computed environmental data were joined with district's socio-economic data to form an interdisciplinary panel data that were used for the empirical migration analyses.

4. Results and Discussion

4.1 Spatial heterogeneity of migration outcomes and potential influencing factors

High coefficient of variation (CoV) values compared to the mean values of the variables mean a high spatial variability of the attributes across the country and the subsequent implication for influencing migration outcomes (Table 2). The implication is that with high CoV district-level attributes, it is commendable to model migration outcomes in a spatially explicit style. CoV of a variable is important information to give explanation why some independent variables are significant in explaining migration flows while others are not. The health indicator (DOCTORS), SHARE_SAVAN, SHARE_FOREST, and MAJOR_TOWN seem to have among the highest CoV. Thus it is expected that these variables are significant in directing migration flows.

Table 2   Descriptive statistics of investigated variables

Variable	Mean	Standard Dev.(SD)	Coef. of Variation (CoV)
Dependent variables			
OMR	0.055	0.022	0.408
IMR	0.061	0.032	0.522
NM	0.006	0.029	4.685
Explanatory variables			
EMP_RATE	0.820	0.080	0.098
PRICES	8243.21	6737.37	0.817
URB	0.301	0.22	0.719
POPDEN	263.96	91.19	0.346
MAJOR_TOWN	0.15	0.36	2.42
DIST_TOWN	2.676	0.849	0.318
BED	0.842	0.719	0.854
HOSPITALS	0.071	0.038	0.530
DOCTORS	0.026	0.032	1.209
HOUSE_OWN	0.649	0.154	0.238
WAT_ACCESS	0.270	0.245	0.906
DIST_WATER	2.677	0.850	0.317
DIST_ROAD	2.383	2.204	0.925
RAIN_AVA	1129.59	113.48	0.100
RAIN_VAR	173.69	39.37	0.227
SHARE_FOREST	5.515	8.821	1.599
SHARE_SAVAN	6.765	8.518	1.259
SHARE_GRASS	65.799	19.250	0.293
SHARE_CROP	18.164	16.670	0.918

4.2 The net migration and its determinants

Before proceeding with the outmigration and in-migration models, characterizing the "net sending" and "net receiving" districts with a net migration probit model would serve as background

information for the gross migration models later in the paper. It helps us illustrate who the net-receiving districts are and what distinguishes them from the net-sending counterparts.

Table 3 Probit results for determinants of the net migration flow

Variable	Coefficients	Marginal coefficients
EMP_RATE	8.25 (3.22)***	3.20
PRICES	0.0001 (0.45)	5.33e-06
DIST_TOWN	0.05 (1.10)	0.018
RAIN_AVA	-0.002 (-1.01)	-0.0009
RAIN_VAR	0.011 (1.71)*	0.004
DIST_WATER	0.48 (1.77)*	0.184
HOSPITALS	3.19 (0.47)	1.237
DOCTORS	16.01 (1.07)	6.204
FORESLAND_PERCAPITA	- 3.30 (-2.27)**	-1.279
SAVANLAND_PERCAPITA	2.47 (1.54)	0.958
GRASSLAND_PERCAPITA	-0.40 (-1.76)*	-0.156
CROPLAND_PERCAPITA	-1.29 (-1.86)**	-0.499
DIST_ROAD * HOSPITALS	1.39 (0.46)	0.537
DIST_ROAD * DOCTORS	-11.38 (-1.97)**	-4.411
Constant	-7.57 (-3.36)***	-
N	84	
Wald chi2 (14)	35.50	
Prob>chi2	0.0012	
Pseudo R^2	0.27	

Note: The numbers in parentheses are Z-ratios. ***, ** and * indicate significance levels at 1%, 5% and 10% respectively. Dependent Variable is the dummy NM (1 = Net receiving district with positive net migration and 0, otherwise)

Variable EMP_RATE turned a statistically significant and positive result. This indicates that it is more likely for net receiving districts to have higher employment rate attracting new migrants (Table 3). Numerically, an increase in employment rate by 1% increases the probability of a district to become a net receiver by 3.2%. Coefficient estimates of distance from water bodies (DIST_WATER) turned positive and significant indicating higher inflow of migrants to places near water bodies/rivers. The marginal coefficient estimate of 0.18 indicates that net receiving districts are on average 0.18 kms closer to water bodies than their net-sending counterparts.

As shown by the negative and significant coefficients, districts with higher cropland, forestland and grassland per capita are less likely to be places of attraction for migrants. Since districts with higher cropland, forestland and grassland per capita are predominantly agrarian; we can argue that people are moving to relatively more urbanized or non-agrarian districts. The positive and significant coefficient of RAIN_VAR shows that places with higher rainfall variability (and thus less rainfall reliability) are more likely to become net receiving districts. In view of the fact that net-receiving districts are less agrarian, this result is not surprising.

The interaction variable (DIST_ROAD*DOCTORS) has a significant impact with a negative sign meaning that places with shorter average distance to roads and fewer doctors are more likely to be attractive for migrants. The result is not surprising owing to the insignificance of all health indicator variables.

4.3   Out-migration determinants

In order to explicitly determine the factors explaining out migration, we run a fractional logit model on the out-migration model specified in equation 2 (Table 4). An interesting finding is the statistical significance and negative coefficient estimate of the employment rate (EMP_RATE). This finding suggests that the incidence of out-migration is highly sensitive to changes in the employment rate. Similar findings are that of Sommers and Suits (1973), and Pissarides and Wadsworth (1989) which found a positive correlation of unemployment rate and out-migration rate from an area. This correlation challenges the hypothesis in the seminal Harris and Todaro model (Todaro, 1994), which suggests that a high unemployment rate in many areas of Africa had limited impact on the deterrence of migration (Bigsten, 1996). Many other earlier studies (Gallaway et al., 1967 and Miller, 1972) also found the employment rate to be insignificant.

As expected the parameter estimate for urbanization rate (URB) shows that it negatively influences the out-migration rate. This means it is more likely to exercise out-migration for districts with low urbanization rate than their un-urbanized counter parts. Assuming that low urbanization rate is comparable to a more agrarian life, people may be going in search of better city life in urbanized districts. This confirms the results on the probit model of net migration in which districts with relatively lower cropland; forestland and grassland per capita are 'net' receiving districts.

House ownership (HOUSE_OWN) turned a statistically significant and negative result. This shows that households who live in their own house are less mobile and thus districts populated with such households are less likely to send out migrants as evidenced by the negative sign of the variable. The coefficient of distance from roads (DIST_ROAD) is negative and significant implying that outmigration rate is higher for districts with shorter average distance from main roads. This makes sense as shorter distance from roads translates into lower transportation and thus migration costs. The interaction variable (DIST_ROAD*CROPLAND_PERCAPITA) also turned a negative and statistically significant result. This is interesting as it shows that the crop per capita variable gains its importance for districts which have a shorter average distance from roads. When such districts are also characterized with less CROPLAND_PERCAPITA, thus less food, the likelihood of moving out is high.

Table 4   Generalized Linear Method (GLM) estimates of the determinants of out-migration flows: Fractional Logit model results

Variable	Coefficients	Marginal coefficients
EMP_RATE	-1.81 (-3.25)***	-0.093
URB	-0.69 (-1.96)**	-0.035
WAT_ACCESS	0.12 (0.57)	0.006
HOUSE_OWN	-1.38 (-3.22)***	-0.070
MAJOR_TOWN	0.32 (1.54)	0.018
DIST_ROAD	-0.29 (-1.63)*	-0.015
DIST_ROAD*CROPLAND_PERCAPITA	-0.03(-3.14)***	-0.001
DIST_ROAD*RAIN_AVA	0.0003(1.79)**	0.00001
Constant	-3.59 (-0.58)	
N	110	

Note: The numbers in brackets are Z-ratios. Symbols ***, **, and * show statistical significance at 1%, 5% and 10% respectively. Dependent Variable is the OMR.

4.4   In-migration determinants

Again, the parameter estimate for employment rate (EMP_RATE) shows a statistically significant and positive coefficient[4]. This illustrates those districts with relatively higher employment rate experience higher rates of in-migration. This result goes in line with labor migration theories of Todaro (1994) equating migration with job probability. It also contradicts the argument advanced in the literature (Bukenya, et al., 2003) that migrants are more concerned with the individual probabilities of acquiring and retaining employment than with the average employment rate among all workers in a given market or state.

Table 5   GLM estimates of the determinants of in-migration flows: Fractional Logit model results

Variable	Coefficient	Marginal coefficient
EMP_RATE	1.88 (1.87)**	0.107
URB	-0.38 (-1.08)	-0.022
WAT_ACCESS	0.44 (2.11)**	0.025
PRICES	2.8e-06 (0.67)	1.59e-07
RAIN_AVA	5.68 e-07 (0.00)	3.22e-08
RAIN_VAR	0.002 (1.14)	0.00008
SHARE_FORESTLAND	-0.015(-2.33)**	-0.0008
SHARE_SAVANLAND	-0.016 (-2.48)***	-0.0009
SHARE_GRASSLAND	-0.0009 (-0.16)	-0.00005
SHARE_CROPLAND	0.004 (0.54)	0.0002
CROPLAND_PERCAP	-1.104 (-3.13)***	-0.0626
DIST_ROAD*HOSPITALS	0.79 (0.96)	0.045
DIST_ROAD*DOCTORS	-0.83 (-0.80)	-0.0468
DIST_ROAD*BED	0.017 (0.37)	0.00099
MAJOR_TOWN	-0.096 (-0.51)	-0.0053
constant	-4.26 (-3.71)***	-
N	96	

Note: The numbers in brackets are Z-ratios *** and ** significant at 1% and 5% respectively. Dependent variable is the IMR.

As predicted, coefficient estimate on access to water (WAT_ACCESS) is found to be positive and statistically significant. Consistent with the out-migration and net migration model results, many environmental factors (SHARE_FOREST, SHARE_SAVANNAH and CROP_PERCAPITA) turned a negative coefficient implying the attraction of people to more urbanized districts.

5. Conclusions and Policy Implications

The study attempts to capture a wide set of factors that cross over disciplines which affect migration flows by incorporating economic variables such as prices and employment rate to ecological variables such as rainfall availability and variation across place and time together with land use variables.

The probit model for net migration showed that the net receiving districts are characterized with high employment rate (a result supported in effect by both out-migration and in-migration models), high rainfall variability and generally less agrarian. Regarding the out-migration model, people move out of less urbanized areas. Cropland area affects outmigration negatively only for those living in places nearer to roads while rainfall availability affects out-migration positively for those who are living in places far from roads indicating the importance of agriculture for those in the remote areas. Though water access was not significant variable for the out-migration model, it was positive and significant for the in-migration model with the implication that people choose to move into places with better water access laying credence to the importance of water bodies and water access for in-migrants.

Generally, employment rate was consistently significant in the three models implying the uncontested role that employment plays in directing migration flows. People do move in search of jobs. While shorter distance to roads encourages out-migration, districts with better water access seem to attract migrants. By and large, people move out of predominantly agrarian districts and choose relatively more urbanized districts as destinations.

The implication is that creating jobs and setting improved urban infrastructure in net-sending districts would contribute to lessening the pressure of migration flows to few destinations in the country. Thus, urbanizing the net-sending districts would stem the flow or re-direct the direction of migration flows which would eventually contribute to even distribution of the population in the country.

What makes this study distinct from other similar studies is the validation of the econometric model results with the GIS map upshots. More so, the diversity in the nature of the variables included as drivers of migration is another added value of the study. To our knowledge, it is the first of its kind to attract such pool of natural and socioeconomic drivers of migration and the interactions of such variables. We employ 'net', 'in' and 'out' migration models to capture the migration flow in its entirety so as to differentiate the dynamics of migration. These made it possible to have a comprehensive analysis of variables influencing not only people's decision of moving out but also their choice of destination.

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[1] The gravity model provides a flexible approach to modeling spatial interaction analysis in diverse field of studies, such as migration, commodity flows and traffic flows. Derived from Newton's law of gravity, the gravity model in migration assumes that migration varies directly with the degree of the force of attraction and inversely proportional to distance. In its most general form, the traditional gravity model is specified as follows:

$$M_{ij} = G \frac{P_i P_j}{d_{ij}}$$

where: M_{ij} is migration between places i and j; P_i and P_j are population of places i and j, respectively; d_{ij} is distance between places i and j; and G is a constant. Extended gravity model of migration contains variables representing economic, climatic, and natural characteristics of places of origin and destination. Expanding Equation 1 to include place characteristics yields empirical specification of the migrant flow equation of the form:

$$M_{ij} = \lambda_o + \beta_k \sum_{k=1}^{2} r_{i,j} + \gamma_k \sum_{k=1}^{2} U_{i,j} + \phi_k \sum_{k=1}^{2} E_{i,j} + \varepsilon$$

In the above equation, we have a set of variables that can explain the migration flows from i to j. This includes a group of variables identifying the domestic economic activities such as price indexes ($r_{i,j}$), employment rates

$(U_{i,j})$, and natural and environmental factors $(E_{i,j})$.

2 The definition of 'major town' follows the Ghana Statistical Service (GSS) in which 20 largest cities in the country are identified as major towns. (Dummy variable, 1= if at least one of these cities lies in the district and 0, otherwise)

3 House holding/tenure arrangement for households is mainly owning, renting, rent-free, and perching. For our purpose, the share of the households who own the house they live in as a proportion of the total household population is used.

4 The consistent significance of EMP_RATE in all the three models despite its lowest CoV value (Table 2) demonstrates its uncontested role in directing migration flows. However, partly the significance of the employment rate variable may have to do with (the exclusion of) per capita income. Owing to data limitation, we were not able to include per capita income and this may have changed the result. Cebula (2005) indicated in his work of US interstate migration that it is per capita income and not employment that plays a significant role in directing migration flows.