The Dagara farmer at home and away: migration, environment and development in Ghana
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This appendix explains how district out-migration rates were estimated. The last population census of Ghana – held in the year 2000 – inquired about people’s place of birth, using three categories: place of enumeration; elsewhere in the region; and outside the region. In the third category, people had to specify in which region or country they were born. Census reports provide in-migration rates at district level. However, since the census questionnaire does not inquire about birth district (only birth region), no exact out-migration figures exist at district level. The census only reports out-migration rates at regional level. Without district level out-migration rates, the spatial analyses of migration causes and consequences in this research (Chapter two, three and six) would not have been possible. Therefore it was decided to estimate out-migration rates at district level. This appendix explains the procedure followed in the estimation process and sheds light on the differences between the estimation procedures in the different chapters.

The first step was to investigate which demographic variables could best explain known out-migration rates at regional level. Four variables, for which data were available at district level, were found to be closely related to out-migration rates:

- **Population growth (1970-2000):** Districts with more out-migration tend to have lower population growth rates. The calculation of population growth was based on a comparison of regional population size at the time of the 1970 and 2000 population censuses. Correlation with out-migration: $R = -0.881$, $p < 0.01$.
- **Elderly population (65+):** Districts with more out-migration tend to have a higher proportion of elderly people because young people are more prone to migrate, leaving the old people behind. In addition, many migrants return to their home areas for retirement. Correlation with out-migration: $R = 0.808$, $p < 0.01$.
- **Sex ratio of the population aged 15-64:** In districts with more out-migration, sex ratios (men per hundred women) of the population aged 15 to 64 tend to be lower because men in this age group are more mobile than women. Correlation with out-migration: $R = -0.893$, $p < 0.01$.
- **Urbanization rate.** Districts with more out-migration tend to be less urban. Despite the existence of substantial rural-rural migration flows in Ghana, migrant sending areas are more likely to be rural while migrant receiving areas are more likely to be urban. Correlation with out-migration: $R = -0.645$, $p < 0.05$. This variable was only used in Chapter two.
These variables do not represent causes, but consequences of migration. For example, the fact that areas with more out-migration have a higher proportion of elderly people is not because the elderly are more prone to migrate, but rather the opposite. Districts with more out-migration have a higher proportion of elderly people because people in this age group are less prone to migrate.

For Chapter two, three and six the procedures to estimate district out-migration rates differed slightly for three reasons. Firstly, Chapter three looked at North-South migration only. In Chapter two and six, inter-regional migration within Northern Ghana was included in the total out-migration rate, producing slightly higher figures than for North-South migration alone. Secondly, in chapter three and six only out-migration rates for twenty-four districts in Northern Ghana needed to be estimated while for the analysis in Chapter two, data for all 110 Ghanaian districts was needed. Because of changes in administrative boundaries in 1988, population growth figures could not be calculated for all Ghanaian districts. The variable population growth was substituted with the variable urbanization rate. Thirdly, in Chapter two, the crude sex ratio (instead of the sex ratio for population aged 15-64) was taken because age-specific sex ratios were not available for all districts in Ghana.

Below, the estimation procedures for Chapter two, three and six are described in more detail.

**In Chapter two**, inter-regional out-migration rates for all 110 districts in Ghana were estimated using the following equation:

\[
\text{Out-migration (\%) = 175.015 + (population aged >64 * 3.561) - (sex ratio * 1.715) - (urbanization rate * 0.153)}
\]

The model explains 93.0 percent of the variation in out-migration rates at the regional level. The resulting district estimates were subsequently corrected with the residues from the linear regression at regional level. For example, the model estimates an out-migration rate for Lawra District of 50.6 percent. From the regional regression it is known that the real out-migration rate for the Upper West Region is 5.4 percent higher than the one predicted by the model. The corrected out-migration rate for Lawra District is 50.6 percent + 5.4 percent = 56.0 percent. Out-migration is expressed here as the people born in Lawra District who are living in another region in Ghana divided by the total district population. If out-migration is expressed over the total population born in Lawra District (so including out-migrants and excluding in-migrants), the percentage is 37.8.

**In Chapter three**, North-South migration rates for the 24 districts in Northern Ghana were estimated. The estimation procedure differed from that of Chapter two and six. The procedure was more cumbersome and was later refined.
because the resulting out-migration figures had already been published in Van der Geest (2009), it was decided to maintain the same figures in this dissertation. Instead of using a linear regression with three predicting variables at once, three out-migration rates were predicted, each predicting variable producing a separate out-migration rate. After that, the average of the three was calculated. The equations were as follows:

- Out-migration (%) = 47.39 – 0.21 * population growth 1970 to 2000 (%)
- Out-migration (%) = 152.00 – 1.45 * adult sex ratio (men per hundred women)
- Out-migration (%) = -32.77 + 10.19 * population aged > 64 (%)

Subsequently, the district data were corrected for known North-South migration rates at regional level. For example, the predicted total number of North-South migrants from the Upper West Region was 180,480. However, from the census report we know that the actual number of North-South migrants from the Upper West Region was 199,462. Hence the district estimations for the Upper West Region were corrected with a factor 1.105 (199,462/180,480). The model predicts a North-South migration rate of 41.8 percent for Lawra District. After correction, the rate stands at 46.2 percent. Using the same procedure to calculate total domestic inter-regional out-migration (including inter-regional migration within Northern Ghana), the model produces an out-migration rate of 52.7 for Lawra District. If expressed over the total population born in Lawra District, the out-migration rate is 36.6 percent.

In Chapter six, out-migration rates for the 24 districts in Northern Ghana were estimated using the following equation:

\[
\text{Out-migration} \% = 80.48 - (\text{population growth} \times 0.073) + (\text{proportion elderly} \times 1.528) - (\text{adult sex ratio} \times 0.643)
\]

The model explains 92.1 percent of the variation in out-migration rates at the regional level. The resulting district out-migration rates were then corrected for known out-migration rates at regional level. This model produces an out-migration rate of 51.3 percent for Lawra District. If expressed over the total population born in Lawra District, the out-migration rate is 35.9 percent.