PAA 2015 Abstract Submission: Labor Adaptation to Climate Variability in Sub-Saharan Africa

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I. Introduction

Pioneering work on environmental migration focuses on the role of permanent migration as a key form of adaptation (Halliday, 2006; Feng et al., 2010; Dillon, Mueller, Sheu, 2011; Gray and Mueller, 2012a,b; Marchiori, Maystadt, and Schumacher, 2012; Gray and Bilsborrow, 2013; Mueller, Gray, and Kosec, 2014). While these studies draw attention to relationships between permanent migration and natural disasters, permanent migration rates are rather low. By focusing on one form of mobility, studies present a narrow view of household-decision making in the context of risk. Most rural households face financial constraints when considering to move to an urban or international destination where the probability and return to employment may be higher (de Brauw, Mueller, and Lee, 2013). Low educational attainment renders limitations in the transferability of rural workers' skills at destinations (Zhang, 2006). Our main hypothesis is seasonal migration and other forms of employment offer more accessible forms of adaptation to climate change for the rural poor in Africa.

The New Economics of Labor Migration (NELM) motivates the use of migration to circumvent income risk in areas with capital market imperfections (Stark, 1985; Taylor and Martin 2001). The household selects and finances the migration of a member to migrate elsewhere to reduce income variability collectively. By extending the family spatially, household income fluctuations associated with local climate variability is reduced. Even in the context of marital migration, the departure of a female household member both relaxes household income constraints and increases its access to transfers through extended family (Rosenzweig and Stark, 1989).

Use of migration as an adaptation strategy may be less accessible to the poor for multiple reasons. First, liquidity constraints inhibit migration if financing the move is costly (Halliday, 2006). We find the asset poor are less likely to move in response to climate shocks in Ethiopia (Gray and Mueller, 2012a) yet not in Bangladesh and Pakistan (Gray and Mueller, 2012b; Mueller, Gray, and Kosec, 2014). Second, language barriers and a lack of transferable skills can dampen the returns to migration (Chiswick and Miller, 2003). Access to social networks can help migrant workers overcome these challenges at destination through the provision of referrals (Munshi, 2003). Third, the poor may be more risk averse to relieving household members. A shortage of productive members bears greater consequences on their agricultural production since they cannot afford hired labor as a substitute (Zezza et al., 2011).

Where employment migration has been limited (Munshi and Rosenzweig, 2009), a separate literature demonstrates the reliance of low-income households on off-farm labor markets to diversify away from agriculture and smooth shock-induced losses (Kochar, 1999; Rose, 2001). Recent work on rural non-farm labor markets suggests this literature might oversimplify occupational choices by focusing on a discrete measure of off-farm employment (Haggblade, Hazell, and Dorosh, 2006; Deichmann, Shilpi, and Vakis, 2009). Distinguishing by sector and contractual arrangements (wage, self-employment) is important from the perspective of understanding labor adaptation. Households may be reluctant to designate members of prime working age to off-farm labor because of their contribution to farm production, even if their skills may be more transferable across sectors. In addition, contractual arrangements require different time commitments. Households with greater discount rates may be inclined to engage in daily wage employment to ensure sufficient labor for their own production throughout the year. A final point is that we find in other work that climate variability has implications on the returns of various forms of employment and thus we expect its effect on wages to further influence occupational choices (Mueller and Osgood, 2009; Mueller and Quisumbing, 2011).

We draw from the labor diversification literature to address one major shortcoming in the environmental migration literature: a lack of attention to the role of temporary migration and other forms of employment as a form of climate change adaptation. In the context of a broad array of employment choices, we aim to contextualize the importance of temporary migration (relative to other occupational choices) in reducing household vulnerability. We address this knowledge gap in the literature by conducting a cross-country analysis of labor adaptation strategies using panel surveys in multiple African countries. We test our hypothesis at a regional level by quantifying how measures of climate variability affect the probability of an individual selecting employment in seasonal migration, self-employment in agriculture and non-agriculture, and wage employment in agriculture and non-agriculture. Underlying motivations for why household members with specific attributes (e.g., gender, age, and education) are used to diversify risk are explored by characterizing relationships between climate variability, household production, and individual health.

II. Empirical Strategy

A. Data

We use one large, individual panel database representative of six African countries constructed from the Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA). The LSMS-ISA captures nationally representative information on households and their individual members over time in six African countries in the recent decade: Ethiopia (4,000 households in 2011-2, 2013-4), Malawi (3,200 households in 2010-1, 2013), Niger (4,000 households in 2011, 2014-5), Nigeria (5,000 households in 2010-1, 2012-3), Tanzania (4,000 households in 2008-9, 2010-1), and Uganda (3,200 households in 2009-1, 2010-1, 2011-2). From these surveys, we construct individual age, education, gender, occupation, migration, and health variables as well as the demographic, income and wealth variables representative of the household. Information pertaining to the survey year and location (location GPS coordinates, country, district, village variables) are used to merge the database with secondary climate data sources.

Climate data are derived from a high-resolution, independent source, MERRA, which is structured as global grids. MERRA uses a reanalysis approach to integrate data from NASA's collection of earth-observing satellites in a way that is consistent with physical models of the earth system. This produces sub-daily data at 0.5° x 0.67° lat-long resolution covering the modern satellite era (1979-2013) with regular updates (Rienecker et al. 2011). Advantages of this dataset are that the observational network is equally dense around the globe and we previously show that data from these sources predict migration in Ethiopia, Bangladesh and Pakistan (Gray and Mueller 2012a, b; Mueller, Gray, and Kosec, 2014). From these sources, we derive monthly values of total precipitation and mean temperature for the entire time series. These variables are then used to construct measures of climate anomalies and linked to the survey data using secure geolocations that are available for all surveys.

From the MERRA database, we construct two primary measures: total annual precipitation and mean annual temperature. These measures are extracted for the month prior to survey interview, the 12 months prior to interview, and the 24 months prior to interview. These three temporal windows allow us to observe both short and medium effects on labor allocation and well-being. For supplementary analyses, we also construct additional measures including (1) precipitation and temperature expressed as z-values relative to local historical norms, (2) the Standardized Precipitation-Evapotranspiration Index measuring hydrological drought (Vicente-Serrano et al. 2010), and (3) the number of days with a mean temperature above 30°C or below 0°C using daily data available from MERRA.

Additional data on exposure to flooding, another frequent climate-related disaster in the LSMS-ISA countries, are extrapolated from the DFO and EMDAT datasets. DFO provides global, spatially-explicit data on the timing and extent of major floods from 1985 to present, derived from news reports and satellite imagery, including measures of severity and estimates of the number of resulting deaths, displaced persons, and monetary damages (DFO 2014). EMDAT provides global data on the timing and location of natural disasters dating from 1900 to present derived from news reports, including similar measures of severity (EMDAT 2014). These datasets are used to create measures of exposure to flooding at the district-year scale to add to the climate database.

B. Statistical Models

We will model the determinants of a wide array of occupational choices using a multinomial logit regression (e.g., Deichmann, Shilpi, and Vakis, 2009). Focusing on the sample of adults ages 21-65, exogenous individual (gender, and age and education categorical variables) and household explanatory variables (head of household’s education, inherited land holdings, dwelling characteristics, and number of children 2-15) as well as community and time fixed effects will be included in the regression to reduce the potential influence of confounding factors on our parameters of interest. We also include different measures of climate variability (described in more detail later) to address the research question of interest. Standard errors will be clustered at the community level. To account for the possibility of spatial auto-correlation, we will also re-estimate these models using a grouped bootstrap in which years are re-sampled and replaced (Auffhammer et al. 2013).

A motive for labor diversification is to reduce vulnerability to income losses in agrarian African societies. We examine which climate factors render the household vulnerable to climate using a simple linear regression framework. As in our previous work, household agricultural income is regressed on several explanatory variables at the household level and measures of climate (Gray and Mueller 2012b, Mueller, Gray, and Kosec, 2014). We will examine the robustness of our results accounting for spatial autocorrelation (Conley 1999; Hsiang 2010).These income regression results will be juxtaposed with those obtained from the multinomial logit regressions to infer i) which climate variables are detrimental to income, and ii) whether those detrimental variables stimulate diversification out of agricultural self-employment into migration (and other forms of employment).

The income regression above motivates which climatic factors render the household vulnerable enough to engage in labor adaptation, but ignores motives for which individual household member is chosen to diversify income. In order to understand the motives behind who is asked to adapt within the household, we first stratify the samples by gender, age, and educational categories and compare labor-climate relationships across multinomial logit specifications. Households may elect women, older household members, and educated household members to migrate or work off of the farm because they have a minor contribution on the farm or their skills are transferable across sectors.

We draw on health-climate relationships to interpret how the productive potential of individual household members may affect whether they are selected within the household to diversify income. We consider "good health" as a proxy for productive potential (Graff-Zivin, and Neidell, 2014). We estimate a series of probit regressions which relate individual self-reported morbidity outcomes with climate variability measures, and climate measures interacted with gender, age, and educational categories (using additional controls and sensitivity analysis as in the labor regressions). The estimated parameters on the climate variables and their interactions will indicate how the productivity potential of certain demographic groups may be compromised by climate variability. For example, if having higher education has no impact on one's productivity with or without climate variability, but does affect occupational decisions under bad climate scenarios then it might be suggested that household members with transferable skills are used to adapt to climate. On the other hand, if the health of women and the elderly is more vulnerable than other demographic groups and worsens in extreme climate, then we might interpret the tendency for these subgroups to migrate and work off of the farm as a result of a reallocation of low productive workers out of the household.

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