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Intra-African Migration: Exploring the Role of Human Development, Institutions, and Climate Shocks

Désiré Kanga, Boileau Loko, Gomez Agou, Kangni Kpodar

WP/24/97

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**2024
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WORKING PAPER

IMF Working Paper
African Department

Intra-African Migration: Exploring the Role of Human Development, Institutions, and Climate Shocks
Prepared by Désiré Kanga, Boileau Loko, Gomez Agou, Kangni Kpodar*

Authorized for distribution by Aliona Cebotari
May 2024

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ABSTRACT: We examine *push* and *pull* factors, including demographic, geography, culture, economic and human development, politics and climate, and uncover the key determinants shaping migration patterns within Africa. Our findings emphasize the significance of political (instability, ethnic tensions) and socio-demographic (human development, common language, population size and structure) factors, climate shocks, along with economic motivations, in driving intra-African migration. Understanding these multifaceted factors is vital for policymakers in formulating effective strategies to leverage human capital mobility to promote sustainable development in the region.

JEL Classification Numbers:	F22, R23, O15, O55, Q54
Keywords:	Migration; climate shocks; human development; political risk
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* “We thank Azar Sultanov, Cedric Okou, Charalambos Tsangarides, Henk Reinders, Akito Matsumoto, Rasmene Ouedraogo for their valuable comments. Useful comments were also received from participants at the Research Therapy and at a weekly research seminar of the Ecole Nationale Supérieure de Statistique et d’Economie Appliquée (ENSEA), especially, Richard Moussa, Arouna Diallo, Evrard Akrassi, Charles Fé, Romaric Coulibaly, Nathaniel Gbenro, and Epiphane Marahoua.”

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I. Introduction

The drivers and macroeconomic implications of migration have been extensively studied in the economic literature. However, the existing studies focus predominantly on the south-north migration (hereby international migration) and within-country migration (rural to urban). This is not surprising as international migration, has been a politically charged issue in the last decades. On the other hand, the rural-to-urban migration has attracted interest as it has been seen as part of the development process for an economy undergoing structural transformation.

Less attention has been paid in the literature to south-south migration, although existing data suggests that contrary to the common perception, south-south migration is as much as extensive as south-north migration. For instance, the bulk of African migration occurs within the continent: more than half (53 percent) of Africa's migrants in 2017 lived in another African countries (Lucas, 2015; UNCTAD, 2018). This share increased substantially to more than 80 percent for sub-Saharan Africa, although porous borders, less stringent immigration requirements, and large informal sectors in the host country, make it difficult to grasp the full picture and dynamic of migration within Africa.

Understanding the key underlying drivers of migration in Africa is important for several reasons. First, there is an increasing awareness from policy makers that the full benefit from deeper trade integration would not materialize without removing impediments to labor mobility. For instance, the African Union (AU) devised in 2008 the Protocol to the Treaty Establishing the African Economic Community Relating to the Free Movement of Persons, Right of Residence and Right of Establishment, recognizing that the free movement of persons in Africa will facilitate the establishment of the Continental Free Trade Area (AfCFTA) endorsed by the AU. Beyond the trade channel, understanding the drivers of migration could help steer public policies to support the increasing role of intra-African migration in boosting growth and accelerating structural transformation in the destination country through higher labor productivity (UNCTAD, 2018).

Our paper draws on the extensive literature that has investigated the drivers of south-north migration. Key identified factors include income level (Lee, 1966; Hatton and Williamson, 2005; De Haas, 2010), conflicts and political factors (McKenzie, 2007); natural disaster shocks (Berlemann and Steinhardt, 2017), education levels (De Haas, 2010), distance and physical barriers (Lee, 1966), linguistic proximity, demographic and cultural factors (Belot and Ederveen, 2012; Adsera and Pytlikova, 2015).² A subset of the existing literature focusing on intra-African migration found that socio-economic development affecting the capacity to migrate, immigration restrictions, transportation and social networks, political factors and conflicts, as well as land productivity are the driving forces behind intra-African migrations (Ruysen and Rayp, 2014; Lucas, 2015; Flahaux and De Haas, 2016; UNCTAD, 2018; Udelsmann Rodrigues and Bjarnesen, 2020).

In this study, we offer a quantitative assessment of the drivers of migration within Africa using data for 52 African countries during the period 1990-2020. We carry out a systematic review of

² For a comprehensive survey of the theories of migration, see Lee (1966), Ghatak and Levine (1996), Borjas (1999) and Bodvarsson et al. (2015).

the drivers of intra-African migration, including by paying due consideration to climate factors. We find that demographic factors, such as the population size and structure of the home country matter for intra-African migration. Other relevant factors include political risk and ethnic tensions in the home country, income level of the destination country, and more importantly climate shocks such as natural disasters, precipitation, and temperature. Distance between the home country and destination country, and human capital development in the home country are also important factors.

Intra-African migration could represent an opportunity to reduce inequality and boost growth in Sub-Saharan Africa. However, migration-particularly “force” migration- does not necessarily come with benefits for the host and home countries. Therefore, our study calls for a strengthening of institutions to reduce political instability and ethnic tensions in order to reduce “forced” migration. Secondly, governments should invest in education and health, which may reduce the incentives to migrate, but also offer better chances of finding skilled employment to those who do migrate. Furthermore, stepping up the fight against climate change would help contain the number of “climate refugees”.

The structure of the paper is as follows. Section II covers the review of literature on the drivers of migration, while section III presents the migration data and stylized facts on intra-African migration. Section IV discusses key drivers of migration based on principal component analysis after presenting the data and the empirical model. Section V discusses the econometric results and section VI concludes.

II. The literature

Political, economic, demographic, social and environmental factors are viewed as important push and pull drivers of migration.

- *Economic drivers:* key factors identified in the literature include the level of income, employment level, poverty level, distance between departure country and destination country, and other macroeconomic conditions. For instance, using panel data for 14 OECD countries, Mayda (2005) finds that robust pull effects of mean income in host countries increase migration flows from origin countries. Using simultaneous equations on 187 departure countries and 22 OECD countries, Berthelemy et al. (2007) find that increase in income per capita above a certain threshold from departure country pushes migration as the initial investment for migration become affordable. They also find that foreign assistance from destination countries to departure countries do not dampen immigration.
- *Political factors:* Moore and Shellman (2004) underline that conflicts and political instability can lead to voluntary migration but also “forced migration” to save one’s life. Using a sample of countries over 40 years, the authors find that violence has a larger impact on migration than other variables such as political institutions or the average size of the economy. Along the same line, Dreher et al. (2011) provide evidence that terrorism is a push factor, whereas Radnitz (2006) finds that nationalism and other political factors influence migration only if people’s well-being is affected.

- *Institutional drivers*: Bertocchi and Strozzi (2008) uncover evidence that good institutions attract more migrants. Relying on a Heckman probit estimation, their results suggest that institutions matter for migration decisions. With a panel of 111 countries over 16 years, Dimant et al. (2013) confirm the role of institutions in boosting migration, in addition to other factors such as population, common language, and common border. Using a gravity model on across sectional data of 230 countries, Poprawe (2015) finds that countries with high corruption encourage emigration and discourage immigration. Cooray and Schneider's (2016) study supports this finding, particularly for non-high skilled workers.
- *Climate factors*: The relationship and direction of the association between climate change and migration are far from firmly settled (Abel et al., 2019)³. Climatic shocks may trigger, mitigate, or have no impact on migration depending on the nature of the shock and the region in which it occurs. On the one hand, the impact of the severity of the climate shock on migration depends on households' capacity and vulnerability. On the other hand, it is thought that climate-related migration is less likely to cause international migration, but rather within-country migration. Geist and Lambdin (2001) find that people who lack land and forest migrate to forest frontiers to access new land. El-Hinnawi (1985) concludes that the environmental deterioration and growing demographic create environmental refugees.

Only a very few studies have analyzed the drivers of migration among Sub Saharan Africa countries. Ryussen and Rayp (2014) examine migration flows among African countries and find that economic and socio-political factors in the host country are the main drivers. Their study also confirms the important role of migration infrastructure, including networks. Moreover, Flahaux and De Haas (2016) find that more marginal, poorer or landlocked countries tend to have lower absolute and relative levels of extra-continental migration, and their migration is primarily directed towards other African countries, whereas African countries with relatively high extracontinental migration are also those that have a higher GDP per capita and are more advanced in the demographic transition. The authors also find intra-African migration to be substantive and increasing in absolute terms, although declining in intensity.

III. The extent of intra-African migration: stylized facts

Available data suggest that about half of African migrants or 17.8 million migrants remained in Africa in 2020⁴. It is worth noting that the bulk of intra-African migration takes place in sub-Saharan Africa (Figure 1) and within regions, except for North-Africa (Figure 2). First, in the 1990s, eight out of ten migrants from sub-Saharan Africa (SSA) stayed in another SSA country. Although this proportion has been trending down over the last three decades, SSA countries continue to retain almost two-thirds of its migrants. The rest of SSA migrants move to the rest of the world, and less than two percent of them travel to North Africa (Figure 1). Second, intra-regional migration is more intense in West Africa presumably as a result of visa-free travel between ECOWAS (Economic Community of West African States) member countries and the

³ See Abel et al. (2019) and Kaczan and Orgill-Meyer (2020) for a comprehensive review of the literature.

⁴ This figure is likely to be underestimated given that not all African countries are covered by the United Nations dataset and many African countries do not track migration flows.

spread of ethnic groups across several West-African countries, which is a source of strong network connections. By contrast, in the northern part of Africa, 98 percent of migrants leave the continent. This could be attributed to North Africa's proximity to Europe, its close colonial and post-colonial ties to France, and the labor recruitment agreement signed by these countries with European countries since 1960 (Flahaux and De Haas, 2016).

Figure 1: Destination of Sub-Sharan African migrants (proportion of total migrants)

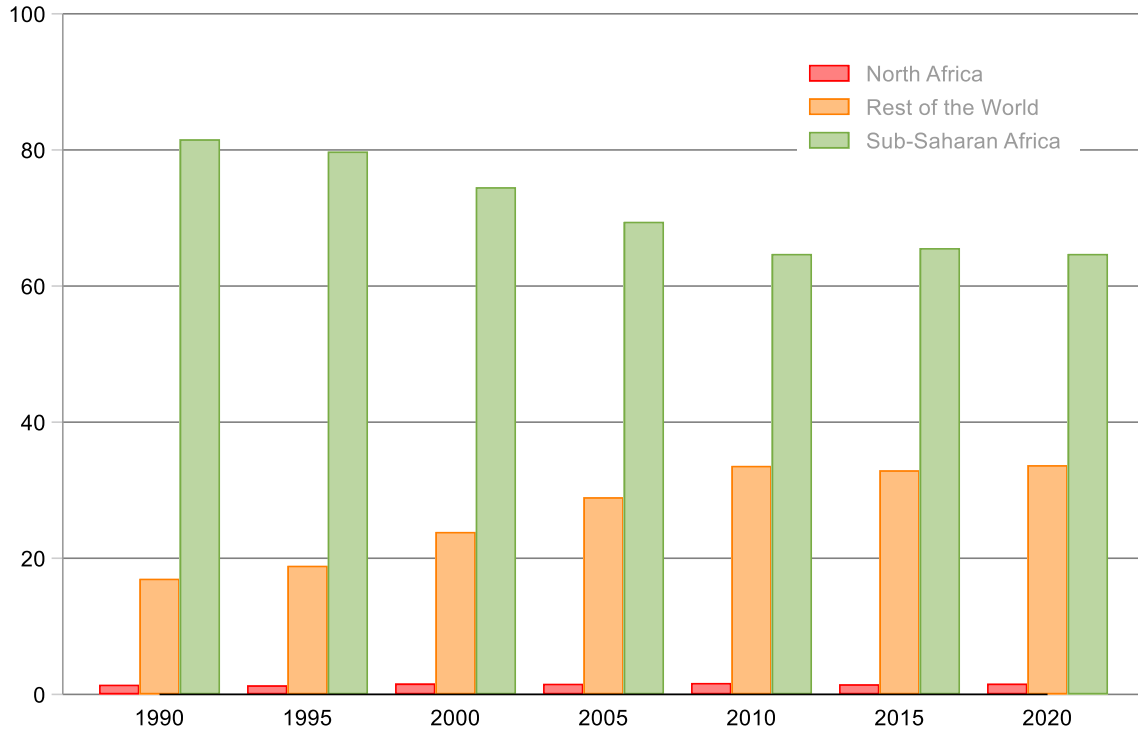
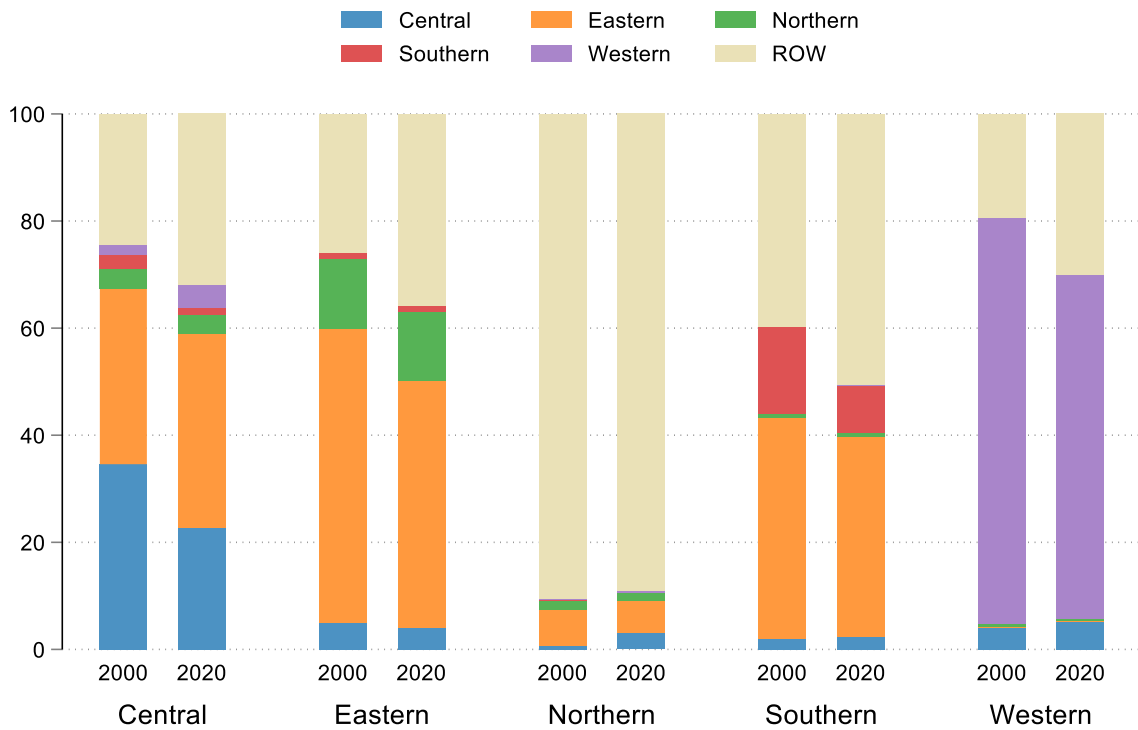


Figure 2: Intra-African migrations at regional level, 2000 and 2020



Notes: This figure show the destination of African migration. Raw data come from the United Nations Department of Economic and Social Affairs, Population Division (2020). International Migrant Stock 2020, authors' calculations. In Figure 2, Africa is divided into five regions, namely central, eastern, northern, southern, and western (see Appendix Table A.1). ROW stands for rest of the world.

IV. Data and empirical model.

This section describes the variables and sources of data used in this paper, the key hypotheses, and the empirical model.

4.1 Data sources and variables

This paper mainly uses bilateral migration data compiled by the United Nations Department of Economic and Social Affairs⁵. Given the level of informality in African economies, the lack of migration monitoring in most African countries and porous borders, we prefer this international database, with harmonized and standardized data covering more than 200 countries. This dataset provides the number of international migrants by country of birth and citizenship, sex and age from various sources, including population censuses and registers, nationally representative surveys and other official statistics. We use the total number of migrants from African countries to other African countries as our dependent variable. Even if migration data are harmonized and standardized, some measurement errors may still affect the quality of the data. Given that migration is the dependent variable in this study, this is less of a concern as measurement errors are likely to be captured by the residual. The five-year data periods span from 1990 to 2020.

In line with the literature, we consider *push* and *pull* factors related to demographic, geographic, cultural, economic, political and climate characteristics of the countries of origin and destination (Table 1).⁶ We focus on selected number of variables to characterize each factor (the full definition of the variables is available in Appendix Table A.2).

Demographic factors are measured by the size of the population in the country of origin and the share of the rural population in both origin and destination countries. Migration is supposed to increase with the size of the population. A relatively high share of the rural population in the country of destination may be associated with lower cross-border migration as the cost of migration is higher relative to expected income and rural people tends more to migrate to urban areas in the country of origin; in some cases, as an intermediate step to cross-border migration (Cirillo et al., 2022). Population data are from the World Development Indicators (WDI) of the World Bank.

The geographic and cultural variables are from the CEPII gravity database. Geographical distance is defined as the distance between the two most populated cities of the immigrants' origin and destination countries. We also use a dummy variable taking 1 if the destination and origin countries share a common border, and zero otherwise. Migration is expected to increase with contiguity and decay with distance, as greater distance implies higher transportation or psychological costs as well as a lack of information that may deter people from migrating (see Schwartz, 1973).⁷

⁵ The data are accessible here <https://www.un.org/development/desa/pd/data/global-migration-database>.

⁶ Push (pull) factors are defined from the point of view of the country of origin (destination).

⁷ The purpose of this paper is not to study the dominant channel, but only the effect of distance on migration.

Culture is proxied by (i) whether the migrants’ countries of origin and destination share a language (spoken by at least nine percent of the population, see Mayer and Zignago, 2011), and (ii) whether the migrants’ countries of origin and destination share a common official or primary language. Having a common language should increase the stock of immigrants (Ramos and Suriñach, 2017).

Table 1: Migration pull and push factors

	Pull factors	Push factors
Demographic	<ul style="list-style-type: none"> ○ Rural population 	<ul style="list-style-type: none"> ○ Population size ○ Rural population
Geography	<ul style="list-style-type: none"> ○ Distance ○ Common border 	
Culture	<ul style="list-style-type: none"> ○ Common language 	
Economic and human development	<ul style="list-style-type: none"> ○ Prospect of higher income ○ Potential for improved standard of living 	<ul style="list-style-type: none"> ○ Poverty ○ Unemployment ○ Lack of basic health and education
Politics	<ul style="list-style-type: none"> ○ Safety and security ○ Political freedom 	<ul style="list-style-type: none"> ○ Conflict, security, and violence ○ Poor governance and corruption
Climate		<ul style="list-style-type: none"> ○ Total natural disasters ○ Population affected by natural disasters ○ Level and deviation of temperature and precipitation

The economic factor is measured by the log of GDP in the countries of origin and destination provided by WDI. Economic development in the destination (origin) country should increase (decrease) immigration (emigration). Human development is proxied by the Human Development Index and its sub-components (i.e., life expectancy at birth, expected years of schooling) compiled by the United Nations Development Programme (UNDP). The more developed a region is in terms of human development – measured by income, education, and health – the more attractive it is to migrants (Kandemir, 2012).

Political factors are measured by the political risk rating and ethnic tensions indices produced by the International Country Risk Guide (ICRG). It is common that political instability and conflicts are major drivers of migration, as people escape violence, persecutions, and human right violations. The disruption in the provision of basic public goods (e.g, health, education) amid political instability and conflicts is another factor pushing people to migrate. Consequently, the impact can be either direct or indirect, the latter mediating through lower human capital accumulation and also reduced income.

The climate change-migration nexus has increasingly attracted interest from academics in the past few years (e.g., Kaczan and Orgill-Meyer, 2020). Nevertheless, the literature is far from settled on the direction of the impact of climate change on international migration as explained in the literature review. Considering that African countries are disproportionately affected by adverse climate shocks, it is worth assessing if these factors have played a role in intra-African migration. In this respect, our model encompasses a wide range of covariates capturing climate shocks, namely the total number of disasters, the share of the population affected by natural disasters (incidence), the five-year average temperature (precipitation), temperature

(precipitation) variability defined as the difference between five-year average temperature (precipitation) and a long-run average, and temperature (precipitation) anomaly calculated as temperature (precipitation) deviation divided by the long-run standard deviation⁸. The underlying climate data come from the [Emergency Events Database](#).

4.2 Correlation analysis

The correlations among the variables are reported in Appendix Table A.3.

First, the unconditional correlation shows a negative co-movement between migration and political factors, in line with the literature on conflict and migration. Second, there is a negative co-movement between migration and human development (as well as its components). Third, we find a positive correlation between migration and economic growth – measured by GDP – in the destination country, indicating that economic opportunity in the destination country could be an important pull factor. Fourth, distance and migration are negatively correlated, whereas contiguity and migration display a positive co-movement. This last result seems to indicate that geographic factors could be important in the decision to migrate. Regarding climate-related factors, the results show a positive co-movement between migration and the number of disasters, the incidence of natural disaster and the average temperature. These preliminary results indicate that climate-related factors may be contributing to intra-African migration in addition to *traditional* determinants of migration. The next section will further elaborate on the determinants of migration using an econometric analysis.

Before delving into the econometric models and results, the correlation matrix indicates a high co-movement – i.e., a significant correlation higher or equal to 0.7 – between some variables: political risk rating and ethnic tension, human development index and its components. These variables will not be simultaneously included the same regression to limit multicollinearity issues.

4.3 Empirical model

We rely on a bilateral migration data and the full specification of our model is as follows:

$$\begin{aligned}
 M_{ijt} = & \beta_1 \log(pop_{it}) + \beta_2 Rural_{it} + \beta_3 Rural_{jt} + \beta_4 \log(dist_{ij}) + \beta_5 Contig_{ij} + \beta_6 ComLang_{ij} \\
 & + \beta_7 OffLang_{ij} + \beta_8 \log(GDP_{it}) + \beta_9 \log(GDP_{jt}) + \beta_{10} hdi_{it} + \beta_{11} hdi_{jt} + \\
 & \beta_{12} EthnicTension_{it} + \beta_{13} PoliticalRisk_{it} + \beta_{14} Climate_{it} + u_i + u_j + \lambda_t + \varepsilon_{ijt}
 \end{aligned} \tag{1}$$

Where:

- pop_i is the total population (in millions) in the country of origin;
- $rural_i$ and $rural_j$ are the share of the rural population in the country of origin and destination respectively;
- $dist$ is the distance between most populated cities (km);

⁸ Long run average (standard deviation of) temperature (precipitation) is the average (standard deviation of) temperature (precipitation) from 1950.

Contig is a dummy variable taking 1 if the destination and origin countries share a common border, and zero otherwise
ComLang_{ij} is a dummy that is equal to one if both countries share a common language;
OffLang_{ij} is a dummy variable that is equal to one if both countries share common official or primary language;
GDP_i and *GDP_j* are gross domestic products (current thousands of US\$) of the origin and destination countries respectively;
hdi_i and *hdi_j* are human development indices of the origin and destination countries respectively;
EthnicTension_i measures the degree of tension within the country of origin attributable to racial, nationality, or language divisions;
PoliticalRisk_i is the political risk rating that assesses the political stability of the country of origin;
Climate_i is the vector of climate-related factors abovementioned;
u_i and *u_j* are origin and destination country fixed effects respectively;⁹
 λ_t is a time dummy to account for common global shock, and;
 ε_{ijt} is the error term.

Considering that the dependent variable is the stock of migrants, a count data estimator is chosen, namely the Poisson pseudo maximum likelihood estimator (Santos Silva and Tenreiro, 2010). This estimator allows to deal with zero values, and thus maximizes the sample size. We estimate the model for the full sample and by region as defined in the Table A.1. Given the small flow of migrants between the northern part of Africa and sub-Saharan Africa (as highlighted in the section III), we exclude North Africa from the estimation by region.

4.4 Econometric results

This section first discusses the results of the baseline regression not controlling for climate-related factors. The results, reported in the Table 2, provide evidence that population size and structure, political stability, socio-economic and geographic factors contribute to migration between African countries.

Geographic factors do matter for migration. The stock of migrants decreases with distance and increases with contiguity. The results suggest that migration takes mostly place between neighboring countries. These results are robust across all specifications.

Having a *common language* is significantly associated with an increase in the stock of migrants. Nevertheless, a common official language does not seem to play a role (not significant at the conventional level). Since the official language is often different from native or local languages spoken in many African countries, this result may be driven by ethnic groups being geographically dispersed across several countries.

⁹ The fixed effects are used to capture multilateral resistance terms highlighted in the literature (see Bertoli and Moraga, 2013 and Manzoor et al., 2021 among many others).

Table 2: Results of the baseline regressions

	(1)	(2)	(3)	(4)
Population (total, origin)	0.016*** (0.006)	0.012*** (0.004)	0.015*** (0.006)	0.010** (0.004)
Rural population (share, origin)	-0.028* (0.016)	-0.007 (0.019)	-0.016 (0.016)	-0.003 (0.017)
Rural population (share, destination)	-0.048*** (0.015)	-0.050*** (0.015)	-0.041*** (0.014)	-0.044*** (0.014)
Political risk rating (origin)	-0.028*** (0.009)	-0.019** (0.008)		
Ethnic tensions (origin)			-0.352*** (0.096)	-0.275*** (0.092)
Human development index (origin)	-6.308*** (2.075)		-7.717*** (1.767)	
Human development index (destination)	-0.078 (1.325)		-0.787 (1.348)	
Expected years of schooling (origin)		-0.055 (0.044)		-0.045 (0.041)
Expected years of schooling (destination)		-0.017 (0.065)		-0.028 (0.059)
Life expectancy at birth (origin)		-0.025 (0.017)		-0.037** (0.018)
Life expectancy at birth (destination)		-0.002 (0.010)		-0.002 (0.009)
Log GDP (origin)		-0.239* (0.139)		-0.212* (0.128)
Log GDP (destination)		0.192* (0.106)		0.239** (0.107)
Log distance (most populated cites)	-0.466*** (0.067)	-0.480*** (0.071)	-0.465*** (0.067)	-0.478*** (0.070)
Contiguity	1.877*** (0.094)	1.890*** (0.091)	1.876*** (0.093)	1.884*** (0.091)
Common language	0.757*** (0.115)	0.709*** (0.117)	0.754*** (0.114)	0.705*** (0.116)
Common official or primary language	-0.017 (0.117)	0.040 (0.120)	-0.014 (0.118)	0.038 (0.120)
Constant	9.451*** (2.495)	9.672** (4.102)	7.690*** (1.839)	8.403** (3.387)
Observations	3,040	3,240	3,040	3,210
R-squared	0.81	0.83	0.82	0.84

Notes: The dependent variable is the stock of migrants. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Rural population in the destination country correlates negatively with migration because it implies less diversified economy and fewer economic opportunity. Emigrant are seeking for higher *economic opportunity* (positive relationship between migration and GDP in the destination country). In the country of origin, the size of the rural population is negatively associated with migration as it may be difficult to migrate directly from rural areas to abroad.

Table 3: Results of the baseline regressions by sub-regions

	West Africa		East Africa		Central Africa	
	(5)	(6)	(7)	(8)	(9)	(10)
Population (total, origin)	0.011*	0.011*	0.031*	0.023	0.016	0.011
	(0.006)	(0.006)	(0.017)	(0.015)	(0.014)	(0.012)
Rural population (share, origin)	-0.038*	-0.037*	0.065*	0.079**	0.096	0.111
	(0.021)	(0.022)	(0.037)	(0.036)	(0.087)	(0.086)
Rural population (share, destination)	-0.052**	-0.053**	-0.073**	-0.058***	-0.010	-0.010
	(0.026)	(0.026)	(0.029)	(0.022)	(0.021)	(0.021)
Political risk rating (origin)	-0.035***		0.002		-0.019	
	(0.010)		(0.015)		(0.023)	
Ethnic tensions (origin)		-0.375***		-0.610***		0.004
		(0.124)		(0.229)		(0.143)
Human development index (origin)	-3.558	-3.796	-8.968**	-9.230***	-6.846	-7.124
	(3.101)	(2.942)	(3.805)	(3.164)	(7.717)	(9.210)
Human development index (destination)	-3.514	-4.041	0.632	-1.158	-0.761	-0.635
	(2.932)	(3.012)	(2.411)	(2.548)	(1.249)	(1.228)
Log distance (most populated cites)	-1.114***	-1.118***	-0.537***	-0.548***	-0.181***	-0.181**
	(0.122)	(0.126)	(0.152)	(0.153)	(0.070)	(0.071)
Contiguity	1.258***	1.260***	1.969***	1.965***	2.282***	2.280***
	(0.115)	(0.115)	(0.193)	(0.192)	(0.221)	(0.221)
Common language	0.749***	0.754***	1.181***	1.174***	-0.624*	-0.624*
	(0.159)	(0.155)	(0.254)	(0.254)	(0.373)	(0.375)
Common official or primary language	0.293*	0.286*	0.155	0.116	-0.177	-0.175
	(0.150)	(0.147)	(0.348)	(0.352)	(0.375)	(0.375)
Constant	15.609***	15.804***	2.788	1.098	0.613	-0.830
	(3.705)	(3.945)	(3.534)	(4.406)	(8.569)	(9.011)
Observations	1,301	1,301	737	741	498	498
R-squared	0.90	0.90	0.64	0.74	0.88	0.88

Notes: The dependent variable is the stock of migrants. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Migration is strongly related to *political risk* and *ethnic tensions*.¹⁰ Greater stability in the home country is associated with lower emigration. This is consistent with the literature showing a link between conflict and migration.

Finally, in addition to economic opportunity, we also find that *human development* does matter for migration. Human development is negatively associated with emigration. Especially, we find that the decision to emigrate is associated with the quality of the health care system (proxied by the life expectancy at birth).

We run the regression by sub-region and find broadly similar results in the western and eastern regions as in the full sample (Table 3).

Next, we check whether population density and inequality can also be drivers of intra-African migration¹¹. First, we find that migrants move from less populated to more densely populated countries. The combined negative effects of rural population and density in departure countries reinforce the lack of economic opportunities highlighted above. In destination countries, our results support the idea that high population density is associated with a concentration of economic activities that offer employment opportunities and attract immigrants (Li and Samimi, 2022). This also reflects agglomeration economies, which are often seen as an escape route from poverty, improving economic returns and social benefits (see Li and Samimi (2022) and Liu and Yamauchi (2014) for a discussion). Regarding inequality, we do not find a significant effect of the Gini index on the number of migrants¹². Even though inequality measured by the Gini index is not significant, the literature offers various alternatives to account for inequality¹³. According to neoclassical economic theories, the main mechanism behind migration is income disparity between countries. As a result, migrants move from poorer to richer countries, and this is already captured in our analysis. Focusing on dependency and world systems theories, political economists identify unequal terms of trade between centers and periphery as main mechanism behind migration (Faist, 2016). Accordingly, underdevelopment leads to the loss of the well-educated and skilled people, who migrate from the periphery (rural areas or poor countries) to the centers (urban areas within the underdeveloped world or industrialized countries). These factors are captured in our analysis through human development index and its sub-components.

Finally, we test whether climate-related factors affect intra-African migration. We run several regressions with various climate variables and a focus on landlocked countries (Tables 4 and 5). We find a significant relationship between climate related factors and migration.

¹⁰ We also tested the [state fragility index](#) (Marshall and Elzinga-Marshall, 2017) and the [World Uncertainty Index](#) (Ahir et al., 2022). First, we did not find significant effects (at conventional level) of these variables on intra-African migration. Second, the use of these variables reduces the size of our sample. We also added the political risk rating and ethnic tensions at destination in the estimates, and our main results hold. The results are available upon request.

¹¹ All the results (density and Gini coefficients) are available upon request from the authors.

¹² We use the Gini index estimated by [Solt \(2020\)](#), which uses household disposable income. It is worth noting that the use of the Gini coefficient significantly reduces the sample size.

¹³ See Faist (2016) for a discussion of the different theories on cross-border migration and inequality.

First, greater share of people affected by natural disaster (incidence)¹⁴ in the departure country is positively associated with higher migration (Table 4, Panel A). This suggests that in countries where natural disasters affect more inhabitants, the likelihood to migrate to another African country increases.

Second, precipitation factors are all positively associated with migration (Table 4, Panel B). In fact, precipitation level and deviation from the average, both stimulate migration. Significant deviations from long-run average increase the likelihood of either droughts or flood pushing for migration.

Third, we looked closely at the case of landlocked countries. Africa has the largest number of landlocked countries in the world (16 out of 44 landlocked countries), with many of them located in the hottest and driest areas of the continent. They are also the poorest in most cases, lack adequate infrastructure connectivity to neighboring countries, thus experiencing high transportation costs. The results suggest that higher occurrence of natural disaster in landlocked countries is positively associated with more migration (Table 5, Panel A).¹⁵ Being a landlocked country does not necessarily lead to more migration as the coefficient is positive without being significant at the conventional level. However, when hit by natural disaster, the geographical limitation of a landlocked country becomes a push factor for migration.

Fourth, temperature variables in landlocked countries are associated with migration (Table 5, Panel B). When temperature deviate from its long-run average in landlocked countries, it results in more migration. Similarly, temperatures that are abnormal push migration from landlocked countries.

We also test climate-related factors' role on migration by country income level as defined by the World Bank. Indeed, Cattaneo and Peri (2016) show differential effects of climate-related factors between low-income and lower-middle income countries. In the analysis, we differentiate between low-income countries (LICs) and middle-income countries (MICs). Our previous results are confirmed (see Appendix Table A.5, Panels A and B). Specifically, precipitation variables are more robustly associated with migration in LICs while temperature variables have greater impact on migration in MICs. The results in LICs can be explained by the effects of rainfall on agricultural production. Indeed, (rainfed) agriculture represents a higher share of GDP in LICs than in MICs, and extreme precipitation events (level, deviation, and anomaly) are recorded in LICs (see Appendix Table A.4). The positive effect of temperature on migration in MICs is consistent with Cattaneo and Peri (2016), who associate this result with the effect of temperature on agricultural productivity and income.

Endogeneity: To address potential endogeneity issues, we focus on the following set of explanatory variables: socio-demographic (total population, share of the rural population, human development index, expected years of schooling and life expectancy at birth), economic (GDP) and risk (political risk rating and ethnic tensions) factors. Three set of instruments have been

¹⁴ We also consider the log of the total number of people affected by a natural disaster instead of the incidence. We find a similar positive correlation, but the results are less robust than when using the incidence. The results are available upon request from the authors.

¹⁵ We define a binary variable (landlock) that takes one if the country is landlocked and zero otherwise.

used: (i) we compute the lagged five-year average. For example, the GDP in 2020 is instrumented by the average GDP over the period 2015-19; (ii) an alternative definition of the lagged five-year average, whereby for instance, the GDP in 2020 is instrumented by the average GDP over the period 2011-15; (iii) the value of the variable at the beginning of the period. For example, the instrument for the GDP in 2020 is the GDP in 2016. The results of the estimates reported in Appendix Table A.6 are broadly in line with our main results.

Additional robustness checks: We conduct additional robustness regressions by including the commodity exporter status of the country of destination, the presence of conflicts in the country of origin, and the quality of the institutions.

- Commodity exporters could be more attractive to intra-continental migrants. To capture this channel, we use the commodity exporter status of the destination country as a control variable. This status is defined through two dummy variables, namely energy and mining. Energy (mining) takes one if the country of destination exports mineral fuels, lubricants and related materials (minerals, ores and metals)¹⁶ and zero otherwise. The results (see Appendix Table A.7) suggest that energy and mining producers attract more migrants than other countries.
- This paper is mainly based on risk factors. One could argue that the manifestation of conflict would affect more migration than the perception of risk. To address this concern, we use data on conflict from Davies et al. (2023) and Sundberg et al. (2013). In particular, we consider two variables: (i) a dummy variable “Conflict”, which takes 1 if there is state-based conflict over the last five years and zero otherwise, and (ii) the average number of fatalities related to conflicts. The results¹⁷ suggest that the presence of conflict leads to migration without invalidating our main results on risk. This new result is in line with the literature on conflict and migration. Furthermore, the presence of conflict seems to play an important role in the migration decision than the number of fatalities.
- In addition, risk factors do not necessarily capture the quality of institutions. To address this concern, we control for institutional variables by using political stability and absence of violence, and rule of law¹⁸. We found that their coefficients are not statistically significant (see Appendix Table A.10). It means the quality of institutions does not matter in the migration decision, while the materialization of some risks (political or ethnic) is an important determinant.

¹⁶ Commodity dependence refers to the commodity exporter status of the destination country as defined in the [“state of commodity dependence 2023”](#) published by UNCTAD. Appendix Table A.8 categorized African countries according to their commodity export status based on the abovementioned report.

¹⁷ The results of the estimates are available upon request from the authors.

¹⁸ There is a strong co-movement between risk factors and quality of institutions, and we therefore do not use institutional quality variables and risk factors in the same regression (see Appendix Table A.9).

Table 4: Testing for climate-related factors

Panel A: Natural disasters and migration

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Population (total, origin)	0.016*** (0.006)	0.013*** (0.004)	0.015*** (0.006)	0.010** (0.004)	0.016*** (0.006)	0.012*** (0.004)	0.015** (0.006)	0.010** (0.004)
Rural population (share, origin)	-0.031* (0.016)	-0.006 (0.019)	-0.019 (0.016)	-0.002 (0.017)	-0.028* (0.015)	-0.007 (0.019)	-0.017 (0.015)	-0.003 (0.017)
Rural population (share, destination)	-0.049*** (0.015)	-0.050*** (0.015)	-0.041*** (0.014)	-0.045*** (0.013)	-0.045*** (0.015)	-0.048*** (0.015)	-0.039*** (0.014)	-0.042*** (0.013)
Political risk rating (origin)	-0.029*** (0.010)	-0.018** (0.008)			-0.027*** (0.009)	-0.017** (0.008)		
Ethnic tensions (origin)			-0.362*** (0.097)	-0.268*** (0.093)			-0.329*** (0.091)	-0.270*** (0.089)
Human development index (origin)	-6.628*** (2.078)		-8.051*** (1.814)		-6.712*** (2.113)		-8.059*** (1.825)	
Human development index (destination)	-0.042 (1.318)		-0.799 (1.341)		-0.248 (1.313)		-0.851 (1.338)	
Expected years of schooling (origin)		-0.049 (0.043)		-0.043 (0.040)		-0.051 (0.044)		-0.040 (0.041)
Expected years of schooling (destination)		-0.020 (0.065)		-0.028 (0.059)		-0.017 (0.064)		-0.028 (0.058)
Life expectancy at birth (origin)		-0.025 (0.017)		-0.037** (0.018)		-0.029 (0.018)		-0.042** (0.019)
Life expectancy at birth (destination)		-0.001 (0.010)		-0.002 (0.009)		-0.003 (0.010)		-0.003 (0.009)
Log GDP (origin)		-0.236* (0.138)		-0.206 (0.128)		-0.252* (0.143)		-0.224* (0.130)
Log GDP (destination)		0.183* (0.107)		0.228** (0.107)		0.194* (0.106)		0.240** (0.106)
# of disasters (origin)	0.013 (0.014)	-0.010 (0.013)	0.013 (0.013)	-0.005 (0.012)				
Incidence (origin)					1.368** (0.657)	0.629 (0.481)	0.988* (0.572)	0.761* (0.439)
Log distance (most populated cites)	-0.463*** (0.066)	-0.480*** (0.071)	-0.464*** (0.066)	-0.479*** (0.071)	-0.466*** (0.067)	-0.480*** (0.071)	-0.465*** (0.067)	-0.478*** (0.070)
Contiguity	1.879*** (0.094)	1.890*** (0.092)	1.877*** (0.093)	1.892*** (0.091)	1.875*** (0.094)	1.890*** (0.091)	1.875*** (0.093)	1.884*** (0.091)
Common language spoken by at least 9% of the population	0.757*** (0.115)	0.709*** (0.117)	0.752*** (0.114)	0.708*** (0.116)	0.756*** (0.115)	0.709*** (0.117)	0.753*** (0.114)	0.704*** (0.115)
Common official or primary language	-0.015 (0.116)	0.039 (0.120)	-0.011 (0.118)	0.041 (0.120)	-0.016 (0.117)	0.039 (0.120)	-0.014 (0.118)	0.037 (0.120)
Constant	9.858*** (2.611)	9.533** (4.052)	9.367*** (2.302)	8.641** (3.594)	9.551*** (2.404)	9.878** (4.172)	7.877*** (1.828)	8.546** (3.417)
Observations	3,045	3,240	3,040	3,240	3,040	3,240	3,040	3,210
R-squared	0.809	0.830	0.821	0.843	0.817	0.825	0.825	0.842

Panel B: Temperature and precipitation: impact on migration

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Population (total, origin)	0.016*** (0.006)	0.012*** (0.004)	0.016*** (0.006)	0.010** (0.004)	0.016*** (0.006)	0.012*** (0.004)	0.016*** (0.006)	0.010** (0.004)	0.016*** (0.006)	0.012*** (0.004)	0.015*** (0.006)	0.010** (0.004)
Rural population (share, origin)	-0.029* (0.016)	-0.008 (0.019)	-0.020 (0.016)	-0.004 (0.017)	-0.029* (0.016)	-0.008 (0.019)	-0.020 (0.016)	-0.004 (0.017)	-0.026* (0.015)	-0.006 (0.018)	-0.016 (0.016)	-0.003 (0.016)
Rural population (share, destination)	-0.047*** (0.015)	-0.050*** (0.015)	-0.040*** (0.014)	-0.045*** (0.013)	-0.047*** (0.015)	-0.049*** (0.015)	-0.040*** (0.014)	-0.044*** (0.013)	-0.047*** (0.015)	-0.050*** (0.015)	-0.040*** (0.014)	-0.045*** (0.013)
Political risk rating (origin)	-0.026*** (0.009)	-0.018** (0.008)			-0.026*** (0.009)	-0.018** (0.008)			-0.026*** (0.009)	-0.018** (0.008)		
Ethnic tensions (origin)			-0.337*** (0.091)	-0.257*** (0.087)			-0.337*** (0.091)	-0.260*** (0.086)			-0.341*** (0.090)	-0.253*** (0.086)
Human development index (origin)	-6.871*** (2.145)		-8.111*** (1.780)		-6.878*** (2.143)		-8.115*** (1.780)		-7.291*** (2.271)		-8.369*** (1.858)	
Human development index (destination)	-0.028 (1.270)		-0.776 (1.308)		-0.027 (1.270)		-0.776 (1.308)		-0.012 (1.262)		-0.752 (1.296)	
Expected years of schooling (origin)		-0.063 (0.045)		-0.051 (0.041)		-0.062 (0.045)		-0.050 (0.041)		-0.069 (0.045)		-0.056 (0.042)
Expected years of schooling (destination)		-0.014 (0.061)		-0.025 (0.057)		-0.016 (0.061)		-0.027 (0.057)		-0.015 (0.060)		-0.028 (0.057)
Life expectancy at birth (origin)		-0.025 (0.018)		-0.037** (0.018)		-0.025 (0.018)		-0.037** (0.018)		-0.028 (0.018)		-0.038** (0.019)
Life expectancy at birth (destination)		-0.002 (0.010)		-0.002 (0.009)		-0.002 (0.010)		-0.002 (0.009)		-0.002 (0.010)		-0.002 (0.009)
Log GDP (origin)		-0.228* (0.137)		-0.201 (0.128)		-0.234* (0.137)		-0.207 (0.128)		-0.228 (0.139)		-0.204 (0.129)
Log GDP (destination)		0.197* (0.106)		0.232** (0.106)		0.203* (0.106)		0.239** (0.107)		0.193* (0.106)		0.235** (0.107)
Temperature level	0.121 (0.334)	-0.022 (0.315)	0.307 (0.324)	0.012 (0.301)								
Precipitation level	0.020* (0.011)	0.016 (0.011)	0.016* (0.010)	0.008 (0.009)								
Temperature deviation					0.121 (0.334)	-0.014 (0.314)	0.307 (0.324)	0.022 (0.301)				

Precipitation deviation					0.020*	0.016	0.016*	0.008				
					(0.011)	(0.011)	(0.010)	(0.009)				
Temperature anomaly									0.095	-0.001	0.170	0.025
									(0.135)	(0.133)	(0.131)	(0.127)
Precipitation anomaly									0.238**	0.209**	0.207**	0.135
									(0.108)	(0.098)	(0.094)	(0.083)
Log distance (most populated cities)	-0.467***	-0.481***	-0.465***	-0.479***	-0.467***	-0.481***	-0.465***	-0.478***	-0.466***	-0.481***	-0.464***	-0.479***
	(0.067)	(0.071)	(0.066)	(0.071)	(0.067)	(0.071)	(0.066)	(0.070)	(0.067)	(0.071)	(0.067)	(0.070)
Contiguity	1.876***	1.888***	1.876***	1.890***	1.876***	1.882***	1.876***	1.884***	1.876***	1.890***	1.876***	1.884***
	(0.094)	(0.091)	(0.093)	(0.091)	(0.094)	(0.091)	(0.093)	(0.091)	(0.094)	(0.091)	(0.093)	(0.090)
Common language spoken by at least 9% of the population	0.758***	0.710***	0.756***	0.709***	0.758***	0.707***	0.756***	0.705***	0.757***	0.708***	0.755***	0.704***
	(0.115)	(0.117)	(0.113)	(0.116)	(0.115)	(0.117)	(0.113)	(0.116)	(0.115)	(0.118)	(0.114)	(0.116)
Common official or primary language	-0.023	0.038	-0.018	0.040	-0.023	0.035	-0.018	0.036	-0.018	0.042	-0.016	0.038
	(0.117)	(0.121)	(0.118)	(0.120)	(0.117)	(0.121)	(0.118)	(0.121)	(0.117)	(0.121)	(0.119)	(0.121)
Constant	3.663	10.267	-0.487	9.446	8.345***	9.299**	9.455***	8.401**	9.769***	9.610**	9.411***	8.440**
	(8.864)	(7.206)	(8.545)	(6.680)	(2.036)	(3.728)	(2.289)	(3.338)	(2.448)	(3.944)	(2.247)	(3.318)
Observations	3,039	3,236	3,039	3,236	3,040	3,210	3,040	3,210	3,040	3,240	3,040	3,210
R-squared	0.815	0.834	0.825	0.843	0.815	0.833	0.825	0.843	0.816	0.835	0.827	0.844

Notes: The dependent variable is the stock of migrants. Incidence stands for the share of the population affected by natural disasters. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Testing for climate-related factors in landlocked countries

Panel A: Natural disasters and migration from landlocked countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Population (total, origin)	0.017*** (0.006)	0.014*** (0.004)	0.016*** (0.006)	0.012*** (0.004)	0.016*** (0.006)	0.012*** (0.004)	0.015** (0.006)	0.011*** (0.004)
Rural population (share, origin)	-0.033** (0.016)	-0.010 (0.018)	-0.021 (0.016)	-0.007 (0.016)	-0.023 (0.015)	0.003 (0.017)	-0.013 (0.016)	0.006 (0.016)
Rural population (share, destination)	-0.047*** (0.015)	-0.047*** (0.014)	-0.040*** (0.014)	-0.042*** (0.013)	-0.038*** (0.014)	-0.038*** (0.013)	-0.033** (0.014)	-0.034*** (0.013)
Political risk rating (origin)	-0.026** (0.010)	-0.014* (0.008)			-0.024** (0.010)	-0.014* (0.008)		
Ethnic tensions (origin)			-0.341*** (0.094)	-0.253*** (0.088)			-0.310*** (0.088)	-0.220*** (0.075)
Human development index (origin)	-7.074*** (2.142)		-8.276*** (1.780)		-5.947*** (1.878)		-6.902*** (1.597)	
Human development index (destination)	-0.178 (1.325)		-0.940 (1.339)		-0.457 (1.315)		-1.138 (1.336)	
Expected years of schooling (origin)		-0.049 (0.043)		-0.040 (0.040)		-0.030 (0.039)		-0.021 (0.039)
Expected years of schooling (destination)		-0.028 (0.066)		-0.038 (0.059)		-0.024 (0.055)		-0.032 (0.051)
Life expectancy at birth (origin)		-0.043** (0.019)		-0.051*** (0.019)		-0.035* (0.019)		-0.042** (0.019)
Life expectancy at birth (destination)		0.003 (0.009)		0.002 (0.009)		-0.001 (0.010)		-0.002 (0.009)
Log GDP (origin)		-0.198 (0.135)		-0.171 (0.128)		-0.233* (0.137)		-0.208 (0.129)
Log GDP (destination)		0.186* (0.104)		0.230** (0.105)		0.173* (0.102)		0.210** (0.105)
# of disasters (origin)	-0.002 (0.017)	-0.031** (0.015)	-0.005 (0.015)	-0.027** (0.013)				
# of disasters*Landlock	0.038* (0.021)	0.063*** (0.020)	0.044** (0.019)	0.065*** (0.018)				
Incidence (origin)					4.514*** (1.670)	5.423*** (1.839)	4.260*** (1.406)	5.077*** (1.596)
Incidence*Landlock					-4.264** (1.769)	-5.650*** (1.918)	-4.373*** (1.533)	-5.113*** (1.681)
Landlock	0.929 (0.762)	-0.467 (0.588)	0.399 (0.706)	-0.495 (0.571)	1.105 (0.708)	-0.335 (0.582)	0.679 (0.675)	-0.350 (0.569)
Log distance (most populated cites)	-0.463*** (0.066)	-0.482*** (0.071)	-0.462*** (0.066)	-0.480*** (0.070)	-0.467*** (0.067)	-0.482*** (0.072)	-0.466*** (0.067)	-0.481*** (0.071)
Contiguity	1.878*** (0.094)	1.890*** (0.091)	1.877*** (0.093)	1.883*** (0.091)	1.871*** (0.093)	1.884*** (0.089)	1.872*** (0.092)	1.878*** (0.089)
Common language spoken by at least 9% of the population	0.756*** (0.115)	0.710*** (0.117)	0.752*** (0.114)	0.705*** (0.115)	0.753*** (0.114)	0.707*** (0.116)	0.750*** (0.113)	0.702*** (0.114)
Common official or primary language	-0.011 (0.117)	0.041 (0.120)	-0.005 (0.118)	0.040 (0.120)	-0.015 (0.117)	0.041 (0.121)	-0.012 (0.119)	0.038 (0.121)
Constant	8.708*** (2.112)	8.901** (3.869)	8.503*** (1.922)	7.789** (3.274)	7.418*** (1.818)	8.494** (3.619)	7.132*** (1.763)	7.262** (3.187)
Observations	3,043	3,241	3,043	3,211	3,037	3,241	3,037	3,211
R-squared	0.811	0.834	0.823	0.846	0.821	0.845	0.832	0.854

Precipitation level*Landlock	-0.022 (0.018)	-0.011 (0.017)	-0.017 (0.017)	-0.012 (0.016)								
Temperature deviation					-0.366 (0.392)	-0.746* (0.381)	-0.142 (0.366)	-0.644* (0.356)				
Temperature deviation*Landlock					1.002** (0.455)	1.336*** (0.413)	0.857** (0.368)	1.190*** (0.354)				
Precipitation deviation					0.026** (0.013)	0.018 (0.013)	0.021* (0.012)	0.012 (0.011)				
Precipitation deviation*Landlock					-0.022 (0.018)	-0.011 (0.017)	-0.017 (0.017)	-0.012 (0.016)				
Temperature anomaly									-0.021 (0.150)	-0.155 (0.149)	0.058 (0.138)	-0.121 (0.140)
Temperature anomaly*Landlock									0.384* (0.196)	0.476*** (0.177)	0.343** (0.160)	0.437*** (0.154)
Precipitation anomaly									0.268** (0.118)	0.167 (0.119)	0.221** (0.106)	0.109 (0.106)
Precipitation anomaly*Landlock									-0.170 (0.162)	-0.020 (0.154)	-0.120 (0.154)	-0.025 (0.151)
Log distance (most populated cites)	-0.467*** (0.067)	-0.483*** (0.071)	-0.465*** (0.067)	-0.482*** (0.071)	-0.466*** (0.067)	-0.482*** (0.071)	-0.465*** (0.067)	-0.481*** (0.070)	-0.465*** (0.067)	-0.481*** (0.071)	-0.464*** (0.067)	-0.480*** (0.070)
Contiguity	1.870*** (0.093)	1.887*** (0.090)	1.872*** (0.093)	1.888*** (0.090)	1.871*** (0.093)	1.879*** (0.090)	1.873*** (0.093)	1.880*** (0.090)	1.874*** (0.093)	1.889*** (0.090)	1.875*** (0.093)	1.882*** (0.090)
Common language spoken by at least 9% of the population	0.749*** (0.116)	0.704*** (0.118)	0.749*** (0.115)	0.704*** (0.117)	0.749*** (0.116)	0.700*** (0.118)	0.749*** (0.115)	0.700*** (0.117)	0.752*** (0.116)	0.705*** (0.118)	0.751*** (0.115)	0.701*** (0.117)
Common official or primary language	-0.008 (0.118)	0.052 (0.120)	-0.006 (0.119)	0.052 (0.120)	-0.008 (0.118)	0.048 (0.120)	-0.006 (0.119)	0.048 (0.120)	-0.007 (0.118)	0.051 (0.120)	-0.006 (0.119)	0.046 (0.120)
Constant	-7.095 (10.152)	24.770** (10.641)	-11.238 (9.728)	22.729** (10.024)	10.372*** (2.492)	8.913*** (3.442)	9.978*** (2.284)	8.165** (3.200)	10.424*** (2.508)	9.921*** (3.799)	9.964*** (2.282)	8.551*** (3.235)
Observations	3,038	3,244	3,038	3,244	3,040	3,210	3,040	3,210	3,040	3,240	3,040	3,210
R-squared	0.821	0.843	0.828	0.848	0.821	0.844	0.828	0.848	0.820	0.842	0.829	0.848

Notes: The dependent variable is the stock of migrants. Landlock takes one if the country is landlocked and zero otherwise. Panel B does not control landlock as an additional variable because the correlation between this variable and its interaction with the level of temperature is 0.98. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

V. Conclusion

This paper carries out a systematic assessment of factors shaping intra-African migration using a sample of 52 sub-Saharan African countries with data over the period 1990-2020. It relies on bilateral migration data and an econometric approach estimated with the Pseudo Poisson Maximum Likelihood approach, which is suitable to deal with zero migration flows and yield more efficient estimates than the standard fixed-effect estimator. The econometric results suggest factors specific to the origin country, the destination country and common to both, matter. These factors are also of a different nature: demographic, political, socioeconomics and environmental, highlighting the complex and far-reaching forces behind intra-African migration. Specifically, as population grows and become more urbanized, migration to other African countries becomes more prevalent. As expected, African countries subject to higher political risk and where ethnic tensions are elevated, exhibit a more pronounced regional migration. Poor human development in the origin country spurs migration to other African countries, which also become more attractive as their income per capita level rises. Our findings also reveal that common factors at play include contiguity, distance, and common language. More importantly, our results imply that the high exposure of African countries to climate shocks may shape the dynamic of intra-African migration, particularly that originating from landlocked countries. The incidence of natural disasters, as well as the level and variability of precipitation and temperature, drive outward migration.

Considering the potential benefits from intra-African migration, notably a better allocation of production factors, higher productivity, deeper trade integration, and ultimately higher economic growth, governments have an important role to play in facilitating movements of people across the continent, even though the decision to migrate is taken at the individual level and most of the enabling factors identified in this study are structural in nature. Strengthening institutions to curtail political instability and ethnic tensions would help reduce forced migration, which is unlikely to deliver the economic benefits voluntary migration can generate for the home and destination countries. Investing in education and health is also key, because even though it may reduce incentives for migration, it would ensure that those who migrate have better chance to find a skilled job and boost productivity in the destination country, while being able to send remittances back home. Further, better regional infrastructure would help ease the cost of migration along with strengthening regional trade integration. Finally, fighting climate change would help contain the ever-increasing number of the so-called “climate refugees”.

It is important to recognize that migration does not necessarily come with benefits for the host and home countries. Migration may, indeed, adversely affect the home country through disruptions of social networks and brain drain for instance. Likewise, the destination country may experience pressure on public services, an increase in the informal sector and low wages. While anecdotal evidence points to a net positive effect, an important direction for future research is to better delineate and quantify the benefits and costs of regional migration to assess the net outcome for both the origin and destination country.

Appendix

Table A.1: Country sample and by regions.

Central	Eastern	Northern	Southern	Western
Democratic Republic of the Congo	Kenya	Sudan	Namibia	Cabo Verde
Angola	Rwanda	Egypt	Lesotho	Nigeria
Congo	Uganda	Libya	Botswana	Mali
Chad	United Republic of Tanzania	Algeria	Eswatini	Gambia
Cameroon	Madagascar	Morocco		Ghana
Sao Tome and Principe	Ethiopia	Tunisia		Côte d'Ivoire
Equatorial Guinea	Somalia			Mauritania
Gabon	Burundi			Senegal
	Comoros			Togo
	Malawi			Guinea
	Mozambique			Benin
	Zimbabwe			Liberia
	South Sudan			Niger
	Zambia			Burkina Faso
	Eritrea			Guinea-Bissau
	Djibouti			Sierra Leone
	Seychelles			
	Mauritius			

Table A.2: Variable definitions and sources.

Symbol	Description	Source
Stock of migrants (M)	International migrant stock at mid-year, both sexes combined (thousands)	UNDESA
Population (total, origin)	Total population (in millions) in the origin	WDI
Rural population (share, origin)	Rural population (% of total population) in the origin	WDI
Rural population (share, destination)	Rural population (% of total population) in destination	WDI
Political risk rating (origin)	Political risk rating (increase with stability, origin)	ICRG
Ethnic tensions (origin)	Ethnic tension (origin: 0 = high risk; 6 = low risk)	ICRG
hdi (origin)	Human Development Index (value)	UNDP
hdi (destination)	Human Development Index (value)	UNDP
eyS (origin)	Expected Years of Schooling (years)	UNDP
eyS (destination)	Expected Years of Schooling (years)	UNDP
le (origin)	Life Expectancy at Birth (years)	UNDP
le (destination)	Life Expectancy at Birth (years)	UNDP
Log GDP (origin)	log GDP (current thousands of US\$, origin)	WDI
Log GDP (destination)	log GDP (current thousands of US\$, destination)	WDI
Log distance	Log distance between most populated cities (km)	CEPII
Contiguity	1 if the two countries are contiguous (contiguity)	CEPII
Common official or primary language	Share a common official or primary language	CEPII
Common language	Share a language spoken by at least 9 percent of the population in both countries	CEPII
# of disasters (origin)	Number of natural disasters (droughts, floods, extreme temperatures and storms)	EED
Incidence (origin)	Share of the population affected by natural disasters in the origin	EED
Temperature level	Temperature level: Five-year average	EED
Precipitation level	Precipitation level: Five-year average	EED
Temperature deviation	Temperature deviation: Difference between five-year average and the long-run average	EED
Precipitation deviation	Precipitation deviation: Difference between five-year average and the long-run average	EED
Temperature anomaly	Temperature anomalies: Difference between five-year average and the long-run average divided by the long-run standard deviation	EED
Precipitation anomaly	Precipitation anomalies: Difference between five-year average and the long-run average divided by the long-run standard deviation	EED

Note: EED stands for Emergency Events Database.

Table A.3: Correlation matrix.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
# of migrants (1)	1												
Population (2)	0.008 (0.584)	1											
Rural population (3)	0.094*** (0.000)	0.054*** (0.000)	1										
Rural population (4)	0.076*** (0.000)	-0.026* (0.080)	0.212*** (0.000)	1									
Political risk (5)	-0.111*** (0.000)	-0.171*** (0.000)	-0.184*** (0.000)	-0.060*** (0.000)	1								
Ethnic tensions (6)	-0.088*** (0.000)	-0.230*** (0.000)	-0.241*** (0.000)	-0.045*** (0.007)	0.737*** (0.000)	1							
Human development (7)	-0.104*** (0.000)	0.086*** (0.000)	-0.687*** (0.000)	-0.155*** (0.000)	0.346*** (0.000)	0.315*** (0.000)	1						
Human development (8)	-0.077*** (0.000)	0.088*** (0.000)	-0.134*** (0.000)	-0.702*** (0.000)	0.064*** (0.000)	0.046*** (0.007)	0.235*** (0.000)	1					
Expected years (9)	-0.102*** (0.000)	0.042*** (0.005)	-0.529*** (0.000)	-0.124*** (0.000)	0.346*** (0.000)	0.284*** (0.000)	0.876*** (0.000)	0.231*** (0.000)	1				
Expected years (10)	-0.076*** (0.000)	0.081*** (0.000)	-0.135*** (0.000)	-0.578*** (0.000)	0.110*** (0.000)	0.062*** (0.000)	0.236*** (0.000)	0.897*** (0.000)	0.264*** (0.000)	1			
Life expectancy (11)	-0.073*** (0.000)	-0.015 (0.314)	-0.529*** (0.000)	-0.190*** (0.000)	0.307*** (0.000)	0.229*** (0.000)	0.810*** (0.000)	0.260*** (0.000)	0.640*** (0.000)	0.252*** (0.000)	1		
Life expectancy (12)	-0.064*** (0.000)	0.103*** (0.000)	-0.189*** (0.000)	-0.567*** (0.000)	0.040** (0.014)	0.036** (0.028)	0.295*** (0.000)	0.808*** (0.000)	0.263*** (0.000)	0.633*** (0.000)	0.354*** (0.000)	1	
Log GDP (13)	0.005 (0.714)	0.671*** (0.000)	-0.253*** (0.000)	-0.116*** (0.000)	0.095*** (0.000)	-0.004 (0.828)	0.474*** (0.000)	0.217*** (0.000)	0.373*** (0.000)	0.217*** (0.000)	0.351*** (0.000)	0.267*** (0.000)	1
Log GDP (14)	0.087*** (0.000)	0.081*** (0.000)	-0.104*** (0.000)	-0.267*** (0.000)	0.033** (0.050)	0.037** (0.029)	0.218*** (0.000)	0.538*** (0.000)	0.230*** (0.000)	0.428*** (0.000)	0.273*** (0.000)	0.492*** (0.000)	0.230*** (0.000)
Log distance (15)	-0.215*** (0.000)	0.068*** (0.000)	-0.012 (0.401)	-0.047*** (0.001)	-0.011 (0.506)	0.008 (0.610)	0.108*** (0.000)	0.163*** (0.000)	0.056*** (0.000)	0.110*** (0.000)	0.120*** (0.000)	0.184*** (0.000)	0.125*** (0.000)
Contiguity (16)	0.344*** (0.000)	0.011 (0.444)	0.029** (0.045)	0.115*** (0.000)	-0.007 (0.657)	0.000 (0.998)	-0.033** (0.030)	-0.142*** (0.000)	-0.046*** (0.002)	-0.146*** (0.000)	-0.023 (0.120)	-0.110*** (0.000)	0.083*** (0.000)
Common official (17)	0.024 (0.104)	-0.022 (0.138)	-0.059*** (0.000)	-0.100*** (0.000)	0.121*** (0.000)	0.102*** (0.000)	0.126*** (0.000)	0.115*** (0.000)	0.163*** (0.000)	0.126*** (0.000)	0.096*** (0.000)	0.075*** (0.000)	0.045*** (0.003)
Common language (18)	0.020 (0.163)	-0.089*** (0.000)	0.006 (0.685)	-0.021 (0.145)	0.064*** (0.000)	0.100*** (0.000)	0.105*** (0.000)	0.036** (0.015)	0.113*** (0.000)	0.045*** (0.002)	0.069*** (0.000)	0.013 (0.387)	0.022 (0.144)
# of disasters (origin) (19)	0.034** (0.020)	0.406*** (0.000)	0.213*** (0.000)	-0.018 (0.222)	0.013 (0.431)	-0.117*** (0.000)	-0.008 (0.619)	0.172*** (0.000)	0.072*** (0.000)	0.207*** (0.000)	0.088*** (0.000)	0.177*** (0.000)	0.419*** (0.000)
Incidence (origin) (20)	0.036** (0.013)	-0.096*** (0.000)	0.141*** (0.000)	0.065*** (0.000)	-0.131*** (0.000)	-0.049*** (0.003)	-0.086*** (0.000)	0.014 (0.360)	-0.046*** (0.002)	0.008 (0.602)	-0.064*** (0.000)	0.010 (0.488)	-0.120*** (0.000)
Temperature level (21)	0.070*** (0.000)	0.049*** (0.001)	-0.089*** (0.000)	-0.114*** (0.000)	-0.252*** (0.000)	-0.278*** (0.000)	-0.206*** (0.000)	-0.003 (0.847)	-0.331*** (0.000)	-0.009 (0.552)	-0.060*** (0.000)	0.050*** (0.001)	-0.064*** (0.000)
Temperature deviation (22)	0.022 (0.126)	0.147*** (0.000)	-0.109*** (0.000)	-0.178*** (0.000)	0.210*** (0.000)	0.133*** (0.000)	0.334*** (0.000)	0.301*** (0.000)	0.382*** (0.000)	0.363*** (0.000)	0.443*** (0.000)	0.357*** (0.000)	0.384*** (0.000)
Temperature anomaly (23)	0.017 (0.236)	0.164*** (0.000)	-0.171*** (0.000)	-0.203*** (0.000)	0.168*** (0.000)	0.063*** (0.000)	0.351*** (0.000)	0.325*** (0.000)	0.441*** (0.000)	0.401*** (0.000)	0.426*** (0.000)	0.373*** (0.000)	0.384*** (0.000)
Precipitation level (24)	-0.016 (0.262)	-0.043*** (0.003)	-0.057*** (0.000)	-0.034** (0.017)	-0.153*** (0.000)	-0.224*** (0.000)	-0.120*** (0.000)	-0.014 (0.331)	0.099*** (0.000)	0.014 (0.338)	-0.239*** (0.000)	-0.034** (0.017)	-0.272*** (0.000)

Precipitation deviation (25)	0.019 (0.199)	0.126*** (0.000)	-0.027* (0.057)	-0.039*** (0.007)	0.054*** (0.001)	-0.075*** (0.000)	0.189*** (0.000)	0.116*** (0.000)	0.207*** (0.000)	0.139*** (0.000)	0.253*** (0.000)	0.149*** (0.000)	0.253*** (0.000)
Precipitation anomaly (26)	0.020 (0.165)	0.101*** (0.000)	-0.056*** (0.000)	-0.057*** (0.000)	0.029* (0.073)	-0.092*** (0.000)	0.228*** (0.000)	0.141*** (0.000)	0.280*** (0.000)	0.164*** (0.000)	0.282*** (0.000)	0.190*** (0.000)	0.209*** (0.000)

	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
Log GDP (14) (destination)	1												
Log distance (15)	0.189*** (0.000)	1											
Contiguity (16)	0.043*** (0.004)	-0.500*** (0.000)	1										
Common official or primary language (17)	0.063*** (0.000)	-0.084*** (0.000)	0.080*** (0.000)	1									
Common language (18)	-0.014 (0.360)	-0.029** (0.045)	0.098*** (0.000)	0.568*** (0.000)	1								
# of disasters (origin) (19)	0.162*** (0.000)	0.076*** (0.000)	0.036** (0.015)	-0.075*** (0.000)	-0.027* (0.065)	1							
Incidence (origin) (20)	0.022 (0.138)	0.004 (0.784)	0.012 (0.422)	-0.008 (0.575)	0.048*** (0.001)	0.167*** (0.000)	1						
Temperature level (21)	0.012 (0.407)	-0.093*** (0.000)	0.021 (0.153)	-0.108*** (0.000)	-0.138*** (0.000)	-0.047*** (0.001)	-0.076*** (0.000)	1					
Temperature deviation (22)	0.355*** (0.000)	0.020 (0.175)	0.028* (0.054)	0.012 (0.403)	0.000 (0.995)	0.341*** (0.000)	0.003 (0.847)	0.095*** (0.000)	1				
Temperature anomaly (23)	0.360*** (0.000)	0.009 (0.522)	0.011 (0.466)	-0.002 (0.901)	-0.014 (0.345)	0.388*** (0.000)	0.014 (0.323)	0.062*** (0.000)	0.932*** (0.000)	1			
Precipitation level (24)	-0.090*** (0.000)	-0.148*** (0.000)	-0.078*** (0.000)	0.042*** (0.004)	-0.086*** (0.000)	-0.198*** (0.000)	-0.089*** (0.000)	-0.013 (0.373)	-0.185*** (0.000)	-0.028* (0.055)	1		
Precipitation deviation (25)	0.155*** (0.000)	0.045*** (0.002)	0.017 (0.243)	-0.013 (0.392)	0.038*** (0.009)	0.204*** (0.000)	0.000 (0.993)	-0.045*** (0.002)	0.227*** (0.000)	0.229*** (0.000)	-0.124*** (0.000)	1	
Precipitation anomaly (26)	0.170*** (0.000)	0.019 (0.200)	-0.007 (0.638)	0.004 (0.762)	0.028* (0.056)	0.203*** (0.000)	0.030** (0.040)	-0.032** (0.024)	0.242*** (0.000)	0.248*** (0.000)	0.015 (0.287)	0.844*** (0.000)	1

Notes: Values in parentheses are p -values which reflect the significance of each correlation value. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.4: Average of each variable by income group and Landlockedness.

	Agriculture value-added (%GDP)	Temperature			Precipitation		
		Average	Deviation	Anomaly	Average	Deviation	Anomaly
Income level							
MICs	14.49	23.44	0.28	0.63	71.70	-1.21	-0.14
LICs	33.79	25.54	0.30	0.67	88.30	-1.86	-0.17
Landlockedness							
Non-landlocked	20.39	24.86	0.27	0.63	87.12	-1.78	-0.15
Landlocked	25.45	23.34	0.33	0.69	67.62	-1.14	-0.15

Notes. Mean-comparison tests are significant between the two income groups (results available upon request). Agriculture represents a higher share of production (GDP) in LICs than in MICs. Extreme temperatures and precipitation are recorded in LICs. Mean-comparison tests are significant between the two groups linked to landlockedness, except for precipitation deviation (results available upon request). Agriculture represents a higher share of production (GDP) in landlocked countries than in non-landlocked countries. Although temperatures and precipitation are higher in non-landlocked countries on average, extreme temperatures are recorded in landlocked countries.

Table A.5: Heterogeneity by income level

Panel A: Results after controlling for natural disasters

	Low-income countries								Lower and upper-income countries							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Population (total, origin)	0.025*** (0.008)	0.031*** (0.008)	0.022*** (0.008)	0.031*** (0.008)	0.024*** (0.008)	0.028*** (0.008)	0.023*** (0.008)	0.029*** (0.008)	0.007 (0.005)	0.006 (0.004)	0.007 (0.005)	0.006* (0.004)	0.008 (0.005)	0.005 (0.004)	0.008 (0.005)	0.006* (0.004)
Rural population (share, origin)	-0.069*** (0.024)	-0.034 (0.023)	-0.051** (0.023)	-0.016 (0.022)	-0.059*** (0.023)	-0.040 (0.025)	-0.042* (0.023)	-0.018 (0.021)	0.021 (0.015)	0.011 (0.016)	0.022 (0.016)	0.011 (0.016)	0.019 (0.015)	0.008 (0.016)	0.022 (0.016)	0.009 (0.016)
Rural population (share, destination)	-0.058*** (0.021)	-0.049** (0.021)	-0.051** (0.020)	-0.042** (0.018)	-0.054*** (0.020)	-0.048** (0.021)	-0.048** (0.020)	-0.040** (0.017)	-0.027** (0.013)	-0.040*** (0.015)	-0.025* (0.013)	-0.042*** (0.015)	-0.027** (0.013)	-0.040*** (0.015)	-0.025* (0.015)	-0.041*** (0.013)
Political risk rating (origin)	-0.037*** (0.010)	-0.041*** (0.009)			-0.035*** (0.010)	-0.038*** (0.009)			-0.006 (0.007)	0.001 (0.007)			-0.007 (0.007)	-0.001 (0.007)		
Ethnic tensions (origin)			-0.502*** (0.119)	-0.563*** (0.111)			-0.469*** (0.112)	-0.561*** (0.107)			-0.072 (0.069)	0.036 (0.057)			-0.082 (0.070)	0.037 (0.060)
Human development index (origin)	-6.433*** (2.476)		-5.666*** (2.123)		-5.986** (2.373)		-5.284** (2.062)		-5.701*** (1.623)		-6.334*** (1.584)		-6.022*** (1.744)		-6.727*** (1.775)	
Human development index (destination)	0.048 (1.723)		-1.235 (1.705)		-0.295 (1.671)		-1.526 (1.679)		-0.424 (1.227)		-0.449 (1.152)		-0.592 (1.234)		-0.601 (1.185)	
Expected years of schooling (origin)		-0.021 (0.048)		0.024 (0.047)		-0.034 (0.052)		0.019 (0.049)		-0.099** (0.047)		-0.103** (0.047)		-0.107** (0.047)		-0.110** (0.047)
Expected years of schooling (destination)		-0.072 (0.093)		-0.060 (0.064)		-0.066 (0.089)		-0.060 (0.060)		0.052 (0.035)		0.054 (0.036)		0.050 (0.035)		0.053 (0.036)
Life expectancy at birth (origin)		-0.031 (0.024)		-0.022 (0.025)		-0.038 (0.024)		-0.029 (0.025)		-0.036** (0.018)		-0.035** (0.017)		-0.038** (0.018)		-0.039** (0.017)
Life expectancy at birth (destination)		-0.001 (0.012)		-0.013 (0.012)		-0.002 (0.012)		-0.014 (0.011)		-0.009 (0.015)		-0.009 (0.014)		-0.011 (0.015)		-0.011 (0.014)
Log GDP (origin)		-0.364* (0.202)		-0.383** (0.184)		-0.362* (0.205)		-0.396** (0.181)		-0.024 (0.130)		-0.040 (0.131)		-0.046 (0.133)		-0.065 (0.135)
Log GDP (destination)		0.280* (0.150)		0.260* (0.145)		0.309** (0.146)		0.261* (0.138)		0.033 (0.117)		0.019 (0.120)		0.038 (0.118)		0.025 (0.120)
# of disasters (origin)	0.015 (0.018)	-0.021 (0.022)	0.019 (0.016)	-0.009 (0.018)					-0.009 (0.014)	-0.014 (0.013)	-0.009 (0.015)	-0.014 (0.013)				
Incidence (origin)					1.580* (0.922)	0.655 (0.530)	1.223 (0.770)	1.143** (0.479)					0.112 (0.508)	0.236 (0.573)	0.027 (0.524)	0.310 (0.593)
Log distance (most populated cities)	-0.764*** (0.168)	-0.842*** (0.173)	-0.763*** (0.169)	-0.850*** (0.174)	-0.767*** (0.169)	-0.839*** (0.173)	-0.768*** (0.169)	-0.848*** (0.173)	-0.216** (0.086)	-0.224** (0.088)	-0.215** (0.086)	-0.224** (0.088)	-0.216** (0.086)	-0.223** (0.088)	-0.215** (0.086)	-0.224** (0.088)
Contiguity	1.748*** (0.163)	1.664*** (0.166)	1.750*** (0.164)	1.655*** (0.163)	1.743*** (0.163)	1.668*** (0.166)	1.744*** (0.164)	1.656*** (0.163)	2.047*** (0.118)	2.075*** (0.112)	2.047*** (0.118)	2.076*** (0.112)	2.046*** (0.118)	2.075*** (0.112)	2.047*** (0.118)	2.075*** (0.112)
Common language spoken by at least 9% of the population	0.832*** (0.141)	0.775*** (0.145)	0.823*** (0.142)	0.761*** (0.142)	0.830*** (0.142)	0.774*** (0.145)	0.822*** (0.143)	0.759*** (0.142)	0.344** (0.171)	0.177 (0.160)	0.345** (0.171)	0.177 (0.160)	0.344** (0.171)	0.178 (0.160)	0.345** (0.171)	0.178 (0.160)
Common official or primary language	-0.038 (0.156)	0.041 (0.166)	-0.046 (0.159)	0.031 (0.167)	-0.040 (0.158)	0.042 (0.166)	-0.048 (0.160)	0.032 (0.166)	0.636*** (0.188)	0.793*** (0.182)	0.635*** (0.188)	0.794*** (0.182)	0.636*** (0.188)	0.793*** (0.182)	0.635*** (0.187)	0.793*** (0.182)
Constant	13.429*** (2.967)	13.087** (6.482)	12.719*** (2.587)	11.140** (5.281)	12.607*** (2.661)	13.490** (6.717)	12.281*** (2.430)	12.083** (5.261)	3.554* (1.866)	2.083 (3.271)	3.774** (1.751)	2.340 (3.352)	3.990** (1.860)	2.861 (3.271)	4.172** (1.808)	3.101 (3.430)
Observations	1,340	1,439	1,340	1,439	1,340	1,439	1,341	1,439	1,688	1,781	1,688	1,781	1,688	1,781	1,688	1,781
R-squared	0.843	0.868	0.863	0.891	0.852	0.863	0.870	0.893	0.893	0.895	0.893	0.895	0.893	0.894	0.893	0.894

Panel B: Results after controlling for temperature and precipitation (LICs)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Population (total, origin)	0.025*** (0.008)	0.028*** (0.008)	0.023*** (0.008)	0.030*** (0.008)	0.025*** (0.008)	0.028*** (0.008)	0.023*** (0.008)	0.030*** (0.008)	0.022*** (0.008)	0.024*** (0.008)	0.021*** (0.008)	0.028*** (0.008)
Rural population (share, origin)	-0.068*** (0.024)	-0.038 (0.023)	-0.050** (0.023)	-0.020 (0.021)	-0.068*** (0.024)	-0.038 (0.023)	-0.050** (0.023)	-0.020 (0.021)	-0.055** (0.023)	-0.027 (0.022)	-0.041* (0.023)	-0.015 (0.021)
Rural population (share, destination)	-0.050** (0.020)	-0.047** (0.020)	-0.045** (0.020)	-0.042** (0.018)	-0.050** (0.020)	-0.047** (0.020)	-0.045** (0.020)	-0.042** (0.018)	-0.046** (0.020)	-0.045** (0.019)	-0.042** (0.020)	-0.041** (0.017)
Political risk rating (origin)	-0.034*** (0.010)	-0.040*** (0.008)			-0.034*** (0.010)	-0.040*** (0.008)			-0.036*** (0.010)	-0.041*** (0.008)		
Ethnic tensions (origin)			-0.454*** (0.111)	-0.546*** (0.107)			-0.453*** (0.111)	-0.546*** (0.107)			-0.459*** (0.109)	-0.537*** (0.106)
Human development index (origin)	-8.189*** (2.828)		-6.934*** (2.309)		-8.219*** (2.827)		-6.923*** (2.313)		-9.593*** (2.997)		-8.189*** (2.471)	
Human development index (destination)	-0.201 (1.582)		-1.420 (1.640)		-0.205 (1.581)		-1.412 (1.639)		-0.107 (1.542)		-1.373 (1.613)	
Expected years of schooling (origin)		-0.056 (0.056)		0.005 (0.052)		-0.056 (0.056)		0.005 (0.052)		-0.068 (0.057)		-0.002 (0.052)
Expected years of schooling (destination)		-0.061 (0.078)		-0.058 (0.060)		-0.061 (0.078)		-0.058 (0.060)		-0.060 (0.075)		-0.057 (0.059)
Life expectancy at birth (origin)		-0.039 (0.024)		-0.026 (0.025)		-0.039 (0.024)		-0.026 (0.025)		-0.046* (0.024)		-0.029 (0.025)
Life expectancy at birth (destination)		-0.003 (0.012)		-0.013 (0.012)		-0.003 (0.012)		-0.013 (0.012)		-0.001 (0.012)		-0.012 (0.011)
Log GDP (origin)		-0.322* (0.195)		-0.361** (0.180)		-0.322* (0.195)		-0.361** (0.180)		-0.331* (0.198)		-0.357* (0.183)
Log GDP (destination)		0.301** (0.143)		0.269* (0.140)		0.301** (0.143)		0.269* (0.140)		0.286** (0.144)		0.265* (0.140)
Temperature level	0.225 (0.500)	0.055 (0.448)	0.255 (0.437)	0.138 (0.406)								
Precipitation level	0.037** (0.015)	0.030** (0.014)	0.024** (0.012)	0.010 (0.011)								
Temperature deviation					0.223 (0.499)	0.055 (0.448)	0.259 (0.437)	0.137 (0.406)				
Precipitation deviation					0.037** (0.015)	0.030** (0.014)	0.024** (0.012)	0.010 (0.011)				
Temperature anomaly									0.146 (0.211)	-0.009 (0.196)	0.179 (0.192)	0.028 (0.181)
Precipitation anomaly									0.471*** (0.157)	0.354*** (0.133)	0.364*** (0.130)	0.153 (0.111)
Log distance (most populated cites)	-0.766*** (0.167)	-0.845*** (0.173)	-0.766*** (0.168)	-0.851*** (0.173)	-0.765*** (0.167)	-0.844*** (0.173)	-0.762*** (0.168)	-0.850*** (0.173)	-0.766*** (0.167)	-0.845*** (0.173)	-0.764*** (0.168)	-0.851*** (0.174)
Contiguity	1.748*** (0.163)	1.660*** (0.165)	1.748*** (0.164)	1.654*** (0.163)	1.748*** (0.163)	1.661*** (0.165)	1.749*** (0.164)	1.654*** (0.163)	1.738*** (0.162)	1.658*** (0.164)	1.743*** (0.163)	1.654*** (0.163)
Common language spoken by at least 9% of the population	0.839*** (0.140)	0.777*** (0.146)	0.831*** (0.141)	0.762*** (0.142)	0.839*** (0.140)	0.778*** (0.146)	0.831*** (0.141)	0.762*** (0.142)	0.834*** (0.140)	0.775*** (0.147)	0.829*** (0.141)	0.762*** (0.143)
Common official or primary language	-0.064 (0.157)	0.031 (0.166)	-0.064 (0.159)	0.030 (0.166)	-0.058 (0.157)	0.030 (0.166)	-0.062 (0.160)	0.029 (0.167)	-0.044 (0.156)	0.038 (0.167)	-0.053 (0.159)	0.029 (0.167)
Constant	9.102 (14.171)	5.968 (13.269)	3.322 (12.177)	7.308 (12.196)	13.842*** (2.803)	12.922** (6.120)	12.868*** (2.533)	11.093** (5.209)	13.627*** (2.662)	13.201** (6.162)	13.115*** (2.457)	11.066** (5.228)
Observations	1,345	1,443	1,346	1,443	1,341	1,439	1,340	1,439	1,341	1,439	1,341	1,439
R-squared	0.855	0.876	0.869	0.891	0.855	0.876	0.869	0.891	0.857	0.877	0.871	0.891

Panel C: Results after controlling for temperature and precipitation (MICs)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Population (total, origin)	0.007 (0.005)	0.005 (0.004)	0.007 (0.005)	0.006 (0.004)	0.007 (0.005)	0.005 (0.004)	0.007 (0.005)	0.006 (0.004)	0.007 (0.005)	0.005 (0.004)	0.007 (0.005)	0.006 (0.004)
Rural population (share, origin)	0.013 (0.016)	0.005 (0.019)	0.015 (0.016)	0.007 (0.018)	0.013 (0.015)	0.006 (0.019)	0.015 (0.016)	0.007 (0.018)	0.013 (0.015)	0.004 (0.018)	0.016 (0.015)	0.005 (0.017)
Rural population (share, destination)	-0.026** (0.013)	-0.041*** (0.015)	-0.024* (0.014)	-0.042*** (0.015)	-0.026** (0.013)	-0.041*** (0.015)	-0.024* (0.014)	-0.042*** (0.015)	-0.025* (0.013)	-0.040*** (0.015)	-0.023* (0.013)	-0.041*** (0.015)
Political risk rating (origin)	-0.009 (0.008)	-0.003 (0.008)			-0.009 (0.008)	-0.003 (0.008)			-0.010 (0.008)	-0.003 (0.008)		
Ethnic tensions (origin)			-0.102 (0.070)	0.019 (0.056)			-0.104 (0.070)	0.019 (0.056)			-0.113* (0.069)	0.015 (0.055)
Human development index (origin)	-5.598*** (1.699)		-6.558*** (1.721)		-5.504*** (1.700)		-6.483*** (1.721)		-4.702*** (1.675)		-5.750*** (1.646)	
Human development index (destination)	-0.544 (1.229)		-0.571 (1.180)		-0.540 (1.227)		-0.566 (1.179)		-0.534 (1.211)		-0.580 (1.167)	
Expected years of schooling (origin)		-0.113** (0.046)		-0.115** (0.047)		-0.112** (0.046)		-0.114** (0.047)		-0.104** (0.046)		-0.106** (0.047)
Expected years of schooling (destination)		0.047 (0.035)		0.049 (0.036)		0.047 (0.034)		0.049 (0.036)		0.046 (0.034)		0.047 (0.035)
Life expectancy at birth (origin)		-0.035* (0.020)		-0.037** (0.018)		-0.035* (0.020)		-0.037** (0.018)		-0.029 (0.021)		-0.032* (0.019)
Life expectancy at birth (destination)		-0.011 (0.015)		-0.010 (0.014)		-0.011 (0.015)		-0.010 (0.014)		-0.011 (0.015)		-0.009 (0.013)
Log GDP (origin)		-0.060 (0.137)		-0.076 (0.139)		-0.061 (0.137)		-0.077 (0.139)		-0.071 (0.141)		-0.087 (0.143)
Log GDP (destination)		0.023 (0.119)		0.018 (0.121)		0.024 (0.119)		0.018 (0.121)		0.014 (0.120)		0.010 (0.122)
Temperature level	0.326 (0.305)	0.058 (0.338)	0.346 (0.305)	0.024 (0.321)								
Precipitation level	-0.005 (0.010)	-0.012 (0.009)	-0.006 (0.010)	-0.009 (0.009)								
Temperature deviation					0.332 (0.305)	0.059 (0.338)	0.351 (0.305)	0.025 (0.322)				
Precipitation deviation					-0.005 (0.010)	-0.012 (0.009)	-0.006 (0.010)	-0.011 (0.009)				
Temperature anomaly									0.225* (0.118)	0.118 (0.136)	0.231** (0.115)	0.111 (0.132)
Precipitation anomaly									-0.025 (0.097)	-0.099 (0.094)	-0.044 (0.094)	-0.090 (0.090)
Log distance (most populated cites)	-0.213** (0.086)	-0.225** (0.088)	-0.212** (0.085)	-0.226** (0.088)	-0.215** (0.086)	-0.225** (0.088)	-0.215** (0.085)	-0.225** (0.088)	-0.215** (0.086)	-0.226** (0.088)	-0.215** (0.085)	-0.226** (0.088)
Contiguity	2.049*** (0.117)	2.072*** (0.112)	2.050*** (0.117)	2.072*** (0.112)	2.048*** (0.117)	2.074*** (0.112)	2.048*** (0.117)	2.074*** (0.112)	2.046*** (0.117)	2.074*** (0.112)	2.046*** (0.117)	2.074*** (0.112)
Common language spoken by at least 9% of the population	0.340** (0.171)	0.176 (0.160)	0.342** (0.170)	0.176 (0.160)	0.344** (0.171)	0.176 (0.160)	0.347** (0.170)	0.176 (0.160)	0.343** (0.171)	0.176 (0.160)	0.345** (0.160)	0.176 (0.160)
Common official or primary language	0.640*** (0.188)	0.792*** (0.181)	0.638*** (0.187)	0.792*** (0.181)	0.636*** (0.188)	0.794*** (0.182)	0.634*** (0.188)	0.794*** (0.182)	0.637*** (0.189)	0.794*** (0.182)	0.635*** (0.188)	0.794*** (0.182)
Constant	-0.997 (5.623)	3.016 (6.283)	-1.127 (5.695)	3.697 (6.208)	3.949** (1.889)	3.470 (3.502)	4.273** (1.839)	3.514 (3.559)	3.547* (1.817)	3.506 (3.484)	3.962** (1.780)	3.597 (3.571)
Observations	1,687	1,774	1,687	1,774	1,688	1,781	1,688	1,781	1,688	1,781	1,688	1,781
R-squared	0.894	0.895	0.895	0.894	0.894	0.895	0.895	0.894	0.894	0.894	0.895	0.893

Table A.6: Baseline results – five-year average macroeconomic explanatory variables (lagged)

	Five-year average (1-year lag)		Five-year average (5-year lag)		Beginning of period	
	(1)	(2)	(3)	(4)	(5)	(6)
Population (total, origin)	0.018*** (0.006)	0.015*** (0.005)	0.018** (0.008)	0.019*** (0.006)	0.026** (0.012)	0.017** (0.007)
Rural population (share, origin)	-0.016 (0.018)	-0.004 (0.017)	-0.054*** (0.018)	-0.008 (0.017)	-0.076*** (0.024)	-0.007 (0.021)
Rural population (share, destination)	-0.034** (0.015)	-0.030** (0.014)	-0.028* (0.016)	-0.032** (0.015)	-0.037* (0.020)	-0.043** (0.018)
Political risk rating (origin)	-0.039*** (0.010)	-0.018* (0.010)	-0.024*** (0.009)	-0.007 (0.008)	-0.032*** (0.010)	-0.009 (0.009)
Human development index (origin)	-3.158* (1.713)		-2.339 (1.676)		-2.445 (1.840)	
Human development index (destination)			-0.616 (1.139)		-1.197 (1.364)	
Expected years of schooling (origin)		-0.013 (0.042)		0.010 (0.043)		0.002 (0.045)
Expected years of schooling (destination)		0.017 (0.042)		0.018 (0.041)		-0.001 (0.046)
Life expectancy at birth (origin)		-0.016 (0.020)		-0.018 (0.018)		-0.020 (0.022)
Life expectancy at birth (destination)		-0.005 (0.010)		-0.004 (0.009)		-0.002 (0.010)
Log GDP (origin)		-0.233 (0.163)		-0.327** (0.154)		-0.237 (0.167)
Log GDP (destination)		0.269** (0.127)		0.213* (0.126)		0.274** (0.137)
Log distance (most populated cities)	-0.451*** (0.069)	-0.474*** (0.074)	-0.423*** (0.070)	-0.452*** (0.075)	-0.443*** (0.075)	-0.495*** (0.083)
Contiguity	1.865*** (0.092)	1.868*** (0.091)	1.906*** (0.095)	1.881*** (0.091)	1.932*** (0.107)	1.876*** (0.100)
Common language spoken by at least 9% of the population	0.694*** (0.118)	0.696*** (0.117)	0.708*** (0.129)	0.610*** (0.128)	0.696*** (0.139)	0.592*** (0.135)
Common official or primary language	0.023 (0.117)	0.032 (0.122)	-0.027 (0.130)	0.057 (0.132)	-0.031 (0.144)	0.053 (0.143)
Constant	6.553*** (1.931)	6.500* (3.533)	6.571*** (1.533)	8.555** (4.193)	11.319*** (3.380)	6.347 (3.994)
Observations	2,643	2,846	2,556	2,784	2,067	2,297
R-squared	0.842	0.871	0.850	0.874	0.853	0.881

Notes: Total population, share of the rural population, human development index, expected years of schooling, life expectancy at birth, GDP, political risk rating and ethnic tensions are calculated using the technique described in the table header. Values in parentheses are *p*-values which reflect the significance of each correlation value. ****p*<0.01, ***p*<0.05, **p*<0.10.

Table A.7: Results of the baseline regressions with commodity exporter status

	(1)	(2)	(3)	(4)
Population (total, origin)	0.016*** (0.006)	0.012*** (0.004)	0.015*** (0.006)	0.010** (0.004)
Rural population (share, origin)	-0.028* (0.016)	-0.007 (0.019)	-0.016 (0.016)	-0.003 (0.017)
Rural population (share, destination)	-0.048*** (0.015)	-0.050*** (0.015)	-0.041*** (0.014)	-0.044*** (0.014)
Political risk rating (origin)	-0.028*** (0.009)	-0.019** (0.008)		
Ethnic tensions (origin)			-0.352*** (0.096)	-0.276*** (0.092)
Human development index (origin)	-6.308*** (2.075)		-7.717*** (1.767)	
Human development index (destination)	-0.078 (1.325)		-0.787 (1.348)	
Expected years of schooling (origin)		-0.053 (0.044)		-0.044 (0.041)
Expected years of schooling (destination)		-0.017 (0.065)		-0.028 (0.059)
Life expectancy at birth (origin)		-0.025 (0.017)		-0.037** (0.018)
Life expectancy at birth (destination)		-0.002 (0.010)		-0.002 (0.009)
Log GDP (origin)		-0.238* (0.139)		-0.211 (0.128)
Log GDP (destination)		0.193* (0.106)		0.241** (0.107)
Commodity Dependence: Energy (destination)	3.096*** (0.688)	-0.890 (0.866)	2.627*** (0.712)	-1.073 (0.782)
Commodity Dependence: Mining (destination)	1.507** (0.591)	4.106*** (1.212)	1.240** (0.612)	3.703*** (1.048)
Log distance (most populated cites)	-0.466*** (0.067)	-0.483*** (0.071)	-0.465*** (0.067)	-0.481*** (0.070)
Contiguity	1.877*** (0.094)	1.889*** (0.091)	1.876*** (0.093)	1.883*** (0.091)
Common language spoken by at least 9% of the population	0.757*** (0.115)	0.710*** (0.117)	0.754*** (0.114)	0.706*** (0.116)
Common official or primary language	-0.017 (0.117)	0.039 (0.120)	-0.014 (0.118)	0.037 (0.120)
Constant	9.451*** (2.495)	8.342** (3.406)	9.118*** (2.256)	7.542*** (2.825)
Observations	3,040	3,237	3,040	3,208
R-squared	0.810	0.829	0.821	0.842

Notes: The dependent variable is the stock of migrants. Commodity dependence refers to the commodity exporter status of the destination country as defined in the “[state of commodity dependence 2023](#)” published by UNCTAD. In this report, Togo is classified as “non-commodity dependent economy” because it was not possible to consistently identify the dominant commodity group due to the presence of large volumes of exports of manufactured products that may partially or totally be re-exports. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.8: Commodity exporter status of African countries.

Country	Commodity	Category
Algeria	Mineral fuels, lubricants and related materials exports	Energy
Angola	Mineral fuels, lubricants and related materials exports	Energy
Benin	Agricultural product exports	Agriculture
Botswana	Minerals, ores and metals exports	Mining
Burkina Faso	Minerals, ores and metals exports	Mining
Burundi	Minerals, ores and metals exports	Mining
Cabo Verde	Agricultural product exports	Agriculture
Cameroon	Mineral fuels, lubricants and related materials exports	Energy
Central African Republic	Agricultural product exports	Agriculture
Chad	Mineral fuels, lubricants and related materials exports	Energy
Comoros		No
Congo, Dem. Rep.	Minerals, ores and metals exports	Mining
Congo, Rep.	Mineral fuels, lubricants and related materials exports	Energy
Côte d'Ivoire	Agricultural product exports	Agriculture
Djibouti		No
Egypt, Arab Rep.		No
Equatorial Guinea	Mineral fuels, lubricants and related materials exports	Energy
Eritrea	Agricultural product exports	Agriculture
Eswatini		No
Ethiopia	Agricultural product exports	Agriculture
Gabon	Mineral fuels, lubricants and related materials exports	Energy
Gambia, The	Agricultural product exports	Agriculture
Ghana	Minerals, ores and metals exports	Mining
Guinea	Minerals, ores and metals exports	Mining
Guinea-Bissau	Agricultural product exports	Agriculture
Kenya	Agricultural product exports	Agriculture
Lesotho		No
Liberia	Minerals, ores and metals exports	Mining
Libya	Mineral fuels, lubricants and related materials exports	Energy
Madagascar	Agricultural product exports	Agriculture
Malawi	Agricultural product exports	Agriculture
Mali	Minerals, ores and metals exports	Mining
Mauritania	Minerals, ores and metals exports	Mining
Mauritius		No
Morocco		No
Mozambique	Mineral fuels, lubricants and related materials exports	Energy
Namibia	Minerals, ores and metals exports	Mining
Niger	Minerals, ores and metals exports	Mining
Nigeria	Mineral fuels, lubricants and related materials exports	Energy
Rwanda	Minerals, ores and metals exports	Mining
São Tomé and Príncipe		No
Senegal	Agricultural product exports	Agriculture
Seychelles	Agricultural product exports	Agriculture
Sierra Leone	Minerals, ores and metals exports	Mining
Somalia	Agricultural product exports	Agriculture
South Africa	Minerals, ores and metals exports	Mining
South Sudan	Mineral fuels, lubricants and related materials exports	Energy
Sudan	Agricultural product exports	Agriculture
Tanzania	Minerals, ores and metals exports	Mining
Togo		No
Tunisia		No
Uganda	Agricultural product exports	Agriculture
Zambia	Minerals, ores and metals exports	Mining
Zimbabwe	Minerals, ores and metals exports	Mining

Notes: Commodity dependence refers to the commodity exporter status as defined in the “[state of commodity dependence 2023](#)” published by UNCTAD. Category “No” refers to non-commodity dependent economy. In this report, Togo is classified as “non-commodity dependent economy” because it was not possible to consistently identify the dominant commodity group due to the presence of large volumes of exports of manufactured products that may partially or totally be re-exports.

Table A.9: Correlation matrix- risk factors and quality of institutions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Political risk rating (origin) (1)	1							
Ethnic tensions (origin) (2)	0.737*** (0.000)	1						
Political Stability (origin) (3)	0.848*** (0.000)	0.643*** (0.000)	1					
Rule of Law (origin) (4)	0.791*** (0.000)	0.540*** (0.000)	0.762*** (0.000)	1				
Political risk rating (destination) (5)	0.142*** (0.000)	0.093*** (0.000)	0.040** (0.033)	0.051*** (0.008)	1			
Ethnic tensions (destination) (6)	0.125*** (0.000)	0.116*** (0.000)	0.030 (0.113)	0.048** (0.012)	0.709*** (0.000)	1		
Political Stability (destination) (7)	0.069*** (0.000)	0.035* (0.077)	0.109*** (0.000)	0.086*** (0.000)	0.800*** (0.000)	0.504*** (0.000)	1	
Rule of Law (destination) (8)	0.046** (0.019)	0.037* (0.057)	0.051*** (0.003)	0.068*** (0.000)	0.771*** (0.000)	0.546*** (0.000)	0.733*** (0.000)	1

Notes: Political stability stands for Political Stability and Absence of Violence/Terrorism. Values in parentheses are *p*-values which reflect the significance of each correlation value. ****p*<0.01, ***p*<0.05, **p*<0.10.

Table A.10: Results of the baseline regressions with quality of institutions variables.

	(1)	(2)	(3)	(4)
Population (total, origin)	0.010 (0.007)	0.010 (0.007)	0.009 (0.006)	0.008 (0.007)
Rural population (share, origin)	0.003 (0.021)	0.002 (0.021)	-0.004 (0.021)	-0.004 (0.021)
Rural population (share, destination)	-0.016 (0.020)	-0.008 (0.020)	-0.012 (0.020)	-0.012 (0.020)
Political Stability (origin)	-0.090 (0.076)	-0.091 (0.076)		
Political Stability (destination)		-0.120 (0.075)		
Rule of Law (origin)			-0.001 (0.189)	-0.002 (0.188)
Rule of Law (destination)				-0.017 (0.152)
Human development index (origin)	-4.031* (2.388)	-3.967* (2.397)	-4.586 (2.799)	-4.587 (2.800)
Human development index (destination)	-0.714 (2.147)	0.251 (2.263)	-0.862 (2.144)	-0.781 (2.334)
Log distance (most populated cites)	-0.358*** (0.058)	-0.357*** (0.058)	-0.356*** (0.058)	-0.356*** (0.058)
Contiguity	1.906*** (0.097)	1.904*** (0.097)	1.895*** (0.097)	1.895*** (0.097)
Common language spoken by at least 9% of the population	0.782*** (0.113)	0.781*** (0.113)	0.782*** (0.113)	0.782*** (0.113)
Common official or primary language	-0.033 (0.130)	-0.032 (0.129)	-0.041 (0.130)	-0.041 (0.130)
Constant	6.685*** (2.453)	5.384** (2.485)	5.779*** (2.116)	5.680** (2.250)

Observations	3,094	3,094	3,048	3,048
R-squared	0.814	0.815	0.814	0.814

Notes: The dependent variable is the stock of migrants. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

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Intra-African Migration: Exploring the role of Human Development, Institutions, and Climate Shocks
Working Paper No. WP/2024/097