The Roots of Faith: Early Life Droughts and Religious Commitment in Africa

Triana Yentzen

22 August 2025

Abstract

Religion is a fundamental aspect of societal norms and values, yet its interplay with environmental shocks, particularly in the context of climate vulnerability, remains underexplored. This study investigates the long-term impact of drought exposure on religious expression and group affiliation in African countries. Using individual-level data from the Afrobarometer survey across over 30 nations, I exploit variation in drought exposure based on age and location, finding that individuals exposed to stronger droughts are more likely to be members of a religious group and actively participate. While a short-run effect is present for adults, the analysis reveals a persistent, long-term impact driven specifically by exposure during the formative teenage years. These findings are complemented by evidence that teenage drought exposure is also associated with a greater likelihood of obtaining formal education, working in agriculture, and trusting community-based institutions, suggesting a broad adaptation strategy.

Keywords: Religion, Development, Life-cycle, Shocks.

JEL Classification: Z10, Z12, Q54, O13

1. Introduction

Among its multifaceted roles, religion influences cultural norms and values (Becker et al., 2021) and shapes societal decision-making (Nunn, 2022). As social and cultural behavior impacts economic activity, attention to religion is crucial in examining the dynamics that determine economic development. This consideration is particularly relevant for developing countries, where — in general — religion is much more prevalent (Pew Research Center, 2018). Consequently, there is extensive evidence documenting a causal negative relationship between different facets of religion and economic development (Andersen and Bentzen, 2022; McCleary and Barro, 2006; Campante and Yanagizawa-Drott, 2015; Montero and Yang, 2022; Lawson, 2018). As religious presence, adherence, and religiosity vary significantly across nations, individuals, and historical periods (Pew Research Center, 2018), understanding the drivers behind this variation in religiosity and religious practices can provide key insight into the determinants of economic development.

Various factors have been explored in understanding individuals' inclination towards religion or religious groups. Psychology literature highlights religion as a potential coping mechanism (Koenig, 2012; Pargament, 1997). Life presents individuals with numerous negative shocks, both anticipated and unforeseen. Humans may use coping mechanisms to endure all sorts of adverse situations — geography and climate events such as extreme droughts and natural disasters, sickness and death, and civil conflict, among many others. These situations can affect us at very different stages in life. In this regard, religious groups can provide relief, offering psychological solace through shared beliefs, social bonds, and potential financial advantages — such as those derived from enhanced information exchange and informal insurance mechanisms inherent to the social fabric of religious networks (Ager and Ciccone, 2017; Bentzen, 2019, 2021; Dube et al., 2022).

With this in mind, this paper studies the effect of negative shocks experienced at different stages in life on individuals' religious expression. Using individual-level data from the Afrobarometer survey and leveraging the variation in age of exposure to drought episodes based on location, I estimate the impact of drought on reported religion and membership to religious groups in a sample of over 30 African countries. My econometric

specification takes advantage of the geographical and temporal variation in drought exposure with fixed effects accounting for country-year-of-birth and location-time differences. The identifying assumption is that the age at which individuals experienced different frequencies and intensities of droughts is exogenous. With this strategy, I find that when exposed to stronger periods of drought, individuals are more likely to belong to a religious group and be active members. More importantly, I find that this effect is driven mostly by exposure in earlier stages of life.

This empirical observation — that exposure to droughts specifically during teenage years predicts a higher probability of religious group membership later in life — aligns with extensive interdisciplinary research identifying adolescence as a uniquely formative period for the enduring shaping of beliefs, values, and social affiliations. This developmental phase, typically spanning from puberty into the mid-20s, is characterized by significant brain development that leads to heightened emotional responsiveness, impulsivity, and a strong orientation towards immediate rewards and social stimuli (Blakemore, 2012; Casey et al., 2008; Giedd et al., 1999; Mills et al., 2014; Steinberg, 2005). This neurobiological foundation, often described as a "second vulnerable window" or "critical period of plasticity," makes adolescents exceptionally receptive to environmental influences, allowing experiences to exert particularly strong and lasting effects on neural pathways and essentially "hardwire" responses to significant stressors (Blakemore, 2012; Giedd et al., 1999; Mills et al., 2014; Nelson et al., 2005; Sowell et al., 2004).

Psychologically, adolescence is a critical period for identity formation, where individuals actively explore and commit to values, beliefs, and a sense of self (Erikson, 1968; Marcia, 1966; Meeus et al., 2010). A crisis like a drought intensifies the need for meaning and coping, which religious groups often provide through established frameworks and social support (Koenig, 2012; Pargament, 1997). The developing cognitive abilities of adolescents, including abstract thinking, facilitate a deeper, more internalized engagement with complex belief systems, moving beyond superficial adherence to a more personal commitment (Elkind, 1967; Piaget, 1950; Fowler, 2006). Furthermore, sociologically, adolescence involves a significant shift towards peer and community influence, making collective responses to shared adversity, such as seeking solace in religious groups,

powerful socializing forces (Nelson et al., 2005; Steinberg, 2005; Blakemore and Mills, 2014; Malti et al., 2021). The desire for social connection and approval, reinforced by the brain's reward system, helps internalize these group norms and beliefs, leading to their persistence into adulthood (Blakemore and Mills, 2014). From a behavioral economics perspective, the immediate social support, community aid, and coherent worldview offered by religious groups during a chaotic period can act as powerful "nudges," cementing religious affiliation as a deeply ingrained preference and coping mechanism for future adversity (Thaler and Sunstein, 2008). This confluence of factors explains why exposure to stressors during these formative years has a disproportionately strong and enduring impact on religious group membership.

This study contributes to the literature on economic development and religion, embedded in the study of the relationship between economic development and culture (Nunn, 2022, 2012; Algan and Cahuc, 2010; Alesina and Giuliano, 2010; Fernández and Fogli, 2009; Guiso et al., 2009, 2006). While the overall correlation between secularization and economic development has been thoroughly documented (McCleary and Barro, 2006), the direction of the theoretical causal relationship and the mechanisms through which this relationship has developed still remain uncertain. The literature shows evidence supporting both directions of this link. Particularly, there is little evidence on factors determining people's religious adherence or practice decisions. Partly because it is often hard to quantify or measure appropriately.

On one hand, there is a growing literature linking religion and particular religious practices to economic development. Lawson (2018) documents generally that rises in secularization have preceded economic growth, while Andersen and Bentzen (2022) find that religiosity hindered the transition to modern growth. In terms of religious activities, there is evidence supporting that church attendance (McCleary and Barro, 2006), longer Ramadan fasting (Campante and Yanagizawa-Drott, 2015), and religious festivals that coincide with agricultural activity (Montero and Yang, 2022) are linked to lower development levels.

Parallelly, when considering religion as a dependent variable, there is varied evidence arguing that a negative relationship exists between various measures of income, eco-

nomic development, or economic activity and religion. Broadly speaking, McCleary and Barro (2006) finds that countries with higher income levels have lower religious adherence. While there are studies that find a positive relationship between income and religious adherence due to adversity testing people's faith (Buser, 2015) or time availability for religious practices (Auriol et al., 2020), most literature seems to point in the opposite direction, with arguments and evidence supporting that negative economic shocks of different nature increase religion or religious adherence (Dube et al., 2022; Bentzen, 2021; Henrich et al., 2019; Bentzen, 2019; Ager and Ciccone, 2017; Azzi and Ehrenberg, 1975). This paper adds to this literature by providing further evidence in line with the negative relationship between positive economic shocks and religion, by showing that individuals are more likely to belong to religious groups if they experience economic hardship in the form of exposure to droughts.

Furthermore, the mixed theoretical arguments and evidence suggest that it is necessary to analyze further the mechanisms through which this relationship operates. This paper expands on the literature focused on religion as a form of financial or emotional coping mechanism (Ager and Ciccone, 2017; Bentzen, 2019, 2021; Dube et al., 2022), and on the link between religion and the tightening of social norms in response to negative shocks (Henrich et al., 2019), by providing additional evidence on negative shocks — in the forms of droughts — being linked to increased religious practices, which would represent changes on the intensive margin instead of the extensive margin of religion.

In addition to the above literature, this paper contributes to the economic literature on the heterogeneous effects of negative shocks across humans' life cycle. This literature is broad, exploring how shocks at different stages in life can impact a range of outcomes. The literature also includes papers exploring how early life conditions might have later life outcomes (Persico et al., 2004; Maccini and Yang, 2009; Yi et al., 2015), and how some particular shocks might have heterogeneous effects across the human life cycle (Salvanes et al., 2024). For instance, Persico, Postlewaite, and Silverman (2004) demonstrate that adolescent experiences, specifically teen height, have a lasting impact on labor market outcomes, with the wage premium for taller individuals being largely determined by their height during teenage years, mediated through participation in high school social

activities like sports and clubs. This paper is the first to document the fact that the link between these shocks and religiosity occurs mostly at earlier stages in life.

This paper continues as follows. First, it describes the context of the study and the data used in Sections 2 and 3. Discussions of the empirical approach can be found in Section 4. Sections 5 through 6 report the empirical findings and a discussion of mechanisms and other outcomes. Finally, Section 7 adds concluding remarks.

2. Religion and Droughts in Africa

2.1. Religion

Religion shapes societal norms and cultural frameworks, significantly influencing human behavior and decision-making processes. The empirical findings emphasized by McCleary and Barro (2006) underscore a widely known pattern: religion tends to be more prevalent in developing nations than in their developed counterparts. Notably, within the Christian community, regions such as sub-Saharan Africa, Latin America, and the United States exhibit heightened religious significance, while strong religious adherence among Muslims is observed in Africa, the Middle East, and South Asia.

Across the African continent, the distribution of religions reflects a diverse and dynamic landscape, with Islam and Christianity emerging as the two dominant faiths, alongside various indigenous and traditional belief systems (Center, 2010). Islam holds a significant presence across North Africa, the Sahel region, and parts of East Africa, with countries like Algeria, Egypt, Nigeria, and Sudan hosting sizable Muslim populations. Conversely, Christianity has established strong footholds in Sub-Saharan Africa, particularly in countries such as Nigeria, Ethiopia, South Africa, and the Democratic Republic of the Congo (Thornton, 2000). Many African nations exhibit a rich tapestry of indigenous religions, encompassing diverse spiritual practices, ancestral worship, and cultural traditions. While Islam and Christianity often constitute the primary religious affiliations, these traditional belief systems continue to influence local customs, rituals, and social structures, contributing to the religious pluralism and syncretism observed across the continent.

These diverse religious landscapes also feature distinct rites of passage that occur during childhood and adolescence, periods critical for identity and belief formation. For Muslims, male circumcision (Khitan) is a widespread practice, often performed between the ages of 7 and puberty, marking a boy's transition towards adulthood (Islam Reference). In Catholic Christianity, sacraments like Confirmation typically occur in later teenage years, signifying a personal affirmation of faith and a transition to youth or adulthood (Catholic Answers; Christian Community). Protestant Christian denominations often practice Believer's Baptism, a public declaration of faith, around early teenage years (typically age 12-13) or later, while Confirmation, affirming personal commitment, also frequently takes place during adolescence (Hillsong Church; Christianity.com; Brill). Similarly, Traditional African Religions feature significant puberty or initiation rites during adolescence, typically between ages 12 and 18, which serve to mark the transition from childhood to adulthood and impart essential knowledge and skills for adult life and community roles (Research Gate). These rituals, occurring during formative years, play a crucial role in solidifying religious identity and group affiliation.

Thus, Africa emerges as a unique region where varied and diverse religions hold considerable importance — religions which also involve important and diverse transitional stages through childhood and adolescence. This single fact underscores the necessity to deepen our understanding of not only the causal relationship between religion and development but also the underlying mechanisms driving this association. Since a significant proportion of the world's poorest nations are concentrated in Africa (The World Bank, 2022), understanding the dynamics of religion assumes critical significance in the process of elucidating the intricate interplay between religion and economic development.

2.2. Droughts

When considering the economic development of countries in Africa, both historically and today, geography — resource endowments, such as land and climate factors, among others — have long been recognized as relevant in explaining the difficulties faced by many countries in the region for achieving sustained economic development through varied mechanisms (Alesina and Giuliano, 2010; Alsan, 2015; Bloom et al., 1998; Sokoloff

and Engerman, 2000). Among these factors, drought exerts profound and multifaceted impacts on Africa, rendering them a critical concern for the continent's socio-economic development and resilience to climate change.

Globally, drought is one of the most lethal hazards (World Meteorological Organization (WMO), 2021), mainly because it increases food insecurity, which brings with it a cascade of highly damaging impacts. Due in part to climate change, incidents of drought have doubled in the last 40 years, and their geographic range has expanded (for Disaster Risk Reduction, 2023). This has reversed gains in food security and poverty reduction (FAO, n.d.a.). Between 2014 and 2020, the prevalence of moderate to severe food insecurity rose by 22% to 30% with the highest rises in Sub-Saharan Africa, Central and South Asia, and Latin America (FAO, n.d.b.). Between 1970 and 2019 Africa accounted for 34% of all reported drought events globally. The Sahel region experienced extreme droughts in the 1970s and 1980s, significantly impacting food security and livelihood. For instance, the drought in the early 1980s affected over 50 million people in this region alone. Moreover, in Southern Africa, the 2015-2016 El Niño event led to widespread drought, affecting millions of people and leading to crop failures and water shortages (United Nations Office for Disaster Risk Reduction, 2019).

The region's heavy reliance on rain-fed agriculture makes it particularly vulnerable to the adverse effects of droughts, which can lead to crop failures, food shortages, and heightened economic instability. Moreover, drought-induced water scarcity exacerbates challenges in accessing clean water for drinking, sanitation, and hygiene, further exacerbating health risks and socio-economic disparities (Field et al., 2014). Thus, the region's rich tapestry of religions and vulnerability to droughts highlight the importance of understanding the dynamics between the two, and their possible link to economic development.

3. Data

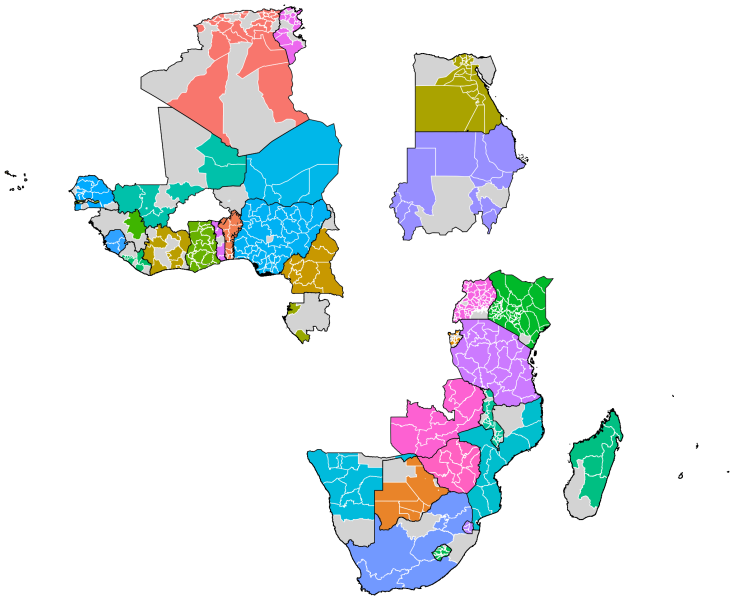
To study the effect of drought exposure on religious decisions, I combine information on individuals' religion, measures of different expressions of religiousness or religious group membership, location, and demographic characteristics — particularly date of

birth — from the Afrobarometer with spatial time series climate information that allows me to measure drought exposure in the region throughout the years.

3.1. Religious and Demographic Characteristics

This paper utilizes individual-level data from Rounds 5, 6, and 7 of the Afrobarometer survey, covering the period circa 2011 - 2018. From this dataset, I use information on individuals' age, employment status, date of survey, geographic location, sex, race, ethnicity, reported religion, and religious group membership status. The latter are the dependent variables of interest: *Religious*, *Member*, and *Active Member* — binary variables that take a value of one if the individual is religious, member of a religious group, or an active member of a religious group, and zero otherwise. The final harmonized sample for the analysis includes 113,540 observations from 452 sub-national units, referred to as *localities*, spanning 34 African countries. For a detailed explanation of the Afrobarometer survey, specific variable definitions, country coverage, and harmonization procedures, please refer to Appendix A.1.

Figure 1: Countries and Localities in the Sample



Notes: Country borders denoted with black, and locality borders with white. The sample includes all localities that appear at least twice across all Afrobarometer rounds included, determined by the location in the Afrobarometer data(Data) in combination with GADM shapefiles from the Global Administrative Areas database (Global Administrative Areas, 2022). Missing localities are colored in light grey.

3.2. *Drought Measurement*

To measure drought exposure and intensity, I utilize The Global SPEI Database, which provides the Standardized Precipitation Evapotranspiration Index (SPEI-12). This index accounts for the joint effects of temperature and precipitation on droughts over a rolling 12-month period. Following Vicente-Serrano et al. (2010), I use SPEI-12 to characterize drought events. The SPEI scale defines categories such as Slight, Moderate, Severe, and Extreme drought, and is measured in standard deviations. To identify positive increases as increases in drought, I convert negative drought values — which represent lack of water — to positive.

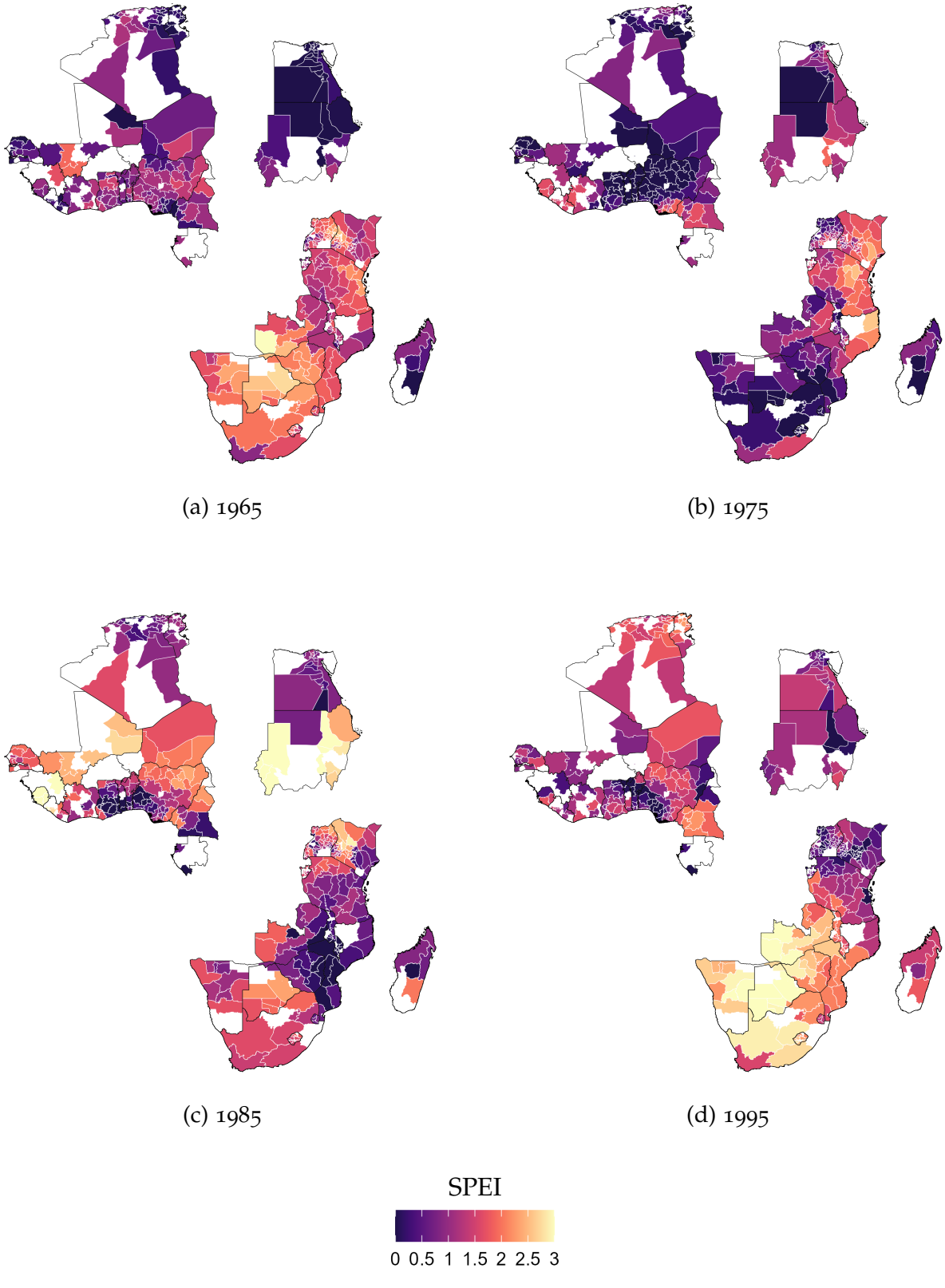
Figure 2 illustrates the data for drought levels for the relevant countries and locations across the years, highlighting that drought exposure varies greatly across locations and time, providing key identifying variation for the analysis.

For the main regression analysis, I construct Avg(Drought Exposure), which represents the average cumulative drought exposure from an individual's birth year until the survey year, based on their location. Additionally, to explore the life-cycle component, I construct a cumulative drought measure for ten distinct age brackets. For a full description of the SPEI database, drought categories, and detailed variable construction, please refer to Appendix A.2.

3.3. *Additional Data Sources*

To later account for possible migration, I incorporate Murdock (1959)'s ethnolinguistic map for the African continent — fortified with data from Murdock (1967)'s Ethnographic Atlas linked to the Human Relations Area Files to combine it with the drought data and measure drought exposure for different ethnic groups using the same process as in Section 3.2.

Figure 2: Overview of Drought Conditions from 1965 to 1995



(a) 1965

(b) 1975

(c) 1985

(d) 1995

Notes: Country borders denoted with black, and locality borders with white. The sample includes all localities that appear at least twice across all Afrobarometer rounds included, determined by the location in the Afrobarometer data(Data) in combination with GADM shapefiles from the Global Administrative Areas database (Global Administrative Areas, 2022). Missing localities are colored in white. SPEI index represented in reversed values, with positive numbers describing droughts.

3.4. Summary Statistics

In Table 1, I present summary statistics of the main variables used in the regression analysis. Relatively consistent with the age distribution across these countries, the average age — among those aged 18 and older — is around 37 years old, with a standard deviation of 14.4. As expected, the sample is evenly divided among men and women. Only 37% report being employed at the time of the survey. Around 82% of the sample report any level of formal education, but only 14% report having post-secondary education.

Table 1: Summary Statistics of the Sample

	Mean	SD	Median	Min	Max	N
Age	36.95	14.40	34.00	18.00	100.00	113,540
Male	0.50	0.50	0.00	0.00	1.00	113,540
Formal Education	0.82	0.38	1.00	0.00	1.00	113,540
Primary Education	0.31	0.46	0.00	0.00	1.00	113,540
Secondary Education	0.37	0.48	0.00	0.00	1.00	113,540
Post-secondary Education	0.14	0.35	0.00	0.00	1.00	113,540
Employed	0.37	0.48	0.00	0.00	1.00	113,540
Religious	0.97	0.18	1.00	0.00	1.00	113,540
Muslim	0.29	0.45	0.00	0.00	1.00	113,540
Christian	0.62	0.48	1.00	0.00	1.00	113,540
Other	0.06	0.23	0.00	0.00	1.00	113,540
None	0.03	0.18	0.00	0.00	1.00	113,540
Religious Group Member	0.48	0.50	0.00	0.00	1.00	113,540
Religious Group Active Member	0.33	0.47	0.00	0.00	1.00	113,540
$Avg(Exp)$	1.26	0.29	1.25	0.32	2.32	113,540

In terms of the variables related to religion, 29% report being Muslim, while 62% report being Christian, 6% say they have another religion, and only 3% report having no religion. The individuals in the survey report high membership levels to religious groups, with 48% reporting being a member, while 33% saying that they are an active member.

Regarding the drought measurements, we can see that — on average — individuals have an exposure of 1.26 of cumulative drought per year, equivalent to a moderate drought, based on the SPEI scale.

4. Identification Strategy

The identification strategy comes from the quasi-exogenous variation in exposure to droughts for individuals based on their age and location. That is, depending on the location and year when the individual was born, individuals at any point in time might have experienced more or fewer droughts, higher or lower intensity of droughts, and — more importantly — experienced these drought episodes at different stages in life. Recognizing that individuals born in different years in different countries have other inherent differences that might confound the analysis, I propose the following regression analysis:

$$y_{i(c,k,j,t)} = \alpha + \beta f\left(\mathbf{D}_{i(c,k,j,t)}\right) + \gamma \mathbf{X}_i + \delta_{j(i),t(i)} + \phi_{c(i),k(i),t(i)} + \varepsilon_{i(c,k,j,t)} \tag{1}$$

where $y_{i(c,k,j,t)}$ is the religiosity measure for individual i (from age-cohort c, location j, country k, year t). $\mathbf{D}_{i(c,k,j,t)}$ represents the drought exposure measure for individual i in location j in year t. $\mathbf{X}_i$ includes individual-level controls such as sex, education, employment status, and religion. $\delta_{j(i),t(i)}$ denotes Locality-Year Fixed Effects to capture time-varying location-specific differences, and $\phi_{c(i),k(i),t(i)}$ represents Year of Birth Cohort-Country-Year Fixed Effects, included to account for the inherent differences across individuals born in different years in different countries observed in different rounds. That is, the variation in $y_{i(c,k,j,t)}$ and $D_{i(c,k,j,t)}$ comes from variation in an individual's birth-year cohort c, sub-national location j, and year of observation t. Finally, $\varepsilon_{i(c,k,j,t)}$ represents the idiosyncratic error term, clustered at the country level to account for spatial correlation in shocks that may affect nearby localities similarly.

The religiosity measures $y_{i(c,k,j,t)}$ of interest are three binary variables: $Religious$, which takes a value of 1 if the individual reports having a religion — Muslim, Christian, or other — or 0 otherwise; $Member$, which takes a value of 1 if the individual is a member of a religious group and 0 otherwise, and $Active\ Member$, which takes a value of 1 if the individual is an *active* member of a religious group, and 0 otherwise.

The coefficient of interest in Equation (1) is β, the effect of a one standard deviation increase in the average yearly drought exposure — a variation that pushes individuals

from no drought to slight drought, slight to moderate, and moderate to severe — on the outcome of interest (e.g. probability of being member of a religious group). When examining the impacts on these religiosity measures, the hypothesis is that $\beta > 0$, that is, exposure to more severe droughts increases the probability of individuals participating in religious groups.

Including the function $f(x)$ in Equation (1) allows for capturing the relationship between the drought measure $\mathbf{D}_{i(c,k,j,t)}$ and the outcome $y_{i(c,k,j,t)}$ in a flexible manner. The main specification in this paper focuses on either (i) the yearly average drought exposure that individuals have experienced through their lifetime, $Avg(Exp)$, or (ii) a set of variables calculating the same yearly average but for different age brackets $\sum_{i=1}^{l} Avg(Exp_l)$. These functional forms enable the estimation of both the overall aggregate effect of drought exposure on religiosity and religious expression measures, as well as distinguishing the differential impact that exposure might have throughout different stages in life.

The main identifying assumption is that $E[\varepsilon_{i(c,k,j,t)}|\mathbf{D}_{i(c,k,j,t)}] = E[\varepsilon_{i(c,k,j,t)}] = 0$, that is, the drought exposure measure for individual i — from age-cohort c, location j, country k, year t — is uncorrelated with omitted variables that may also affect religiosity and religious expression conditional on both Locality - Year and Birth Cohort - Country - Year fixed effects.

4.1. Threats to Identification

One of the main threats to the identification strategy in Equation (1) is the fact that the data only allows observation of *current* location and not location through individuals' lifetimes — or at least, location at birth. This means that the exposure to drought measure is calculated assuming that each individual i has lived in location j of country k throughout their lifetime. While on first impressions, this assumption might seem strong, the first thing to notice is that most African migration still occurs within countries — mostly circular in nature, from rural to urban settings (Africa Center, 2024). This would mean that migration usually doesn't occur across long distances, increasing the possibility that the drought exposure measure calculated relatively close to the effective drought

exposure. Moreover, given the prevalence of rural-to-urban migration, the likely incorrect assignment of drought exposure is that determining urban exposure during the early years for an individual who might have faced nearby rural exposure. Since droughts are likely to cause more damage in rural areas, where dependence on agriculture is stronger, attributing the droughts in urban areas to individuals who originally lived in rural areas would be an underestimation of the true effect.

Additionally, while location throughout lifetime or birth location is not available, the Afrobarometer contains information on individuals' ethnicity. Using Murdock (1959)'s ethnolinguistic map for the African continent — fortified with data from Murdock (1967)'s Ethnographic Atlas linked to the Human Relations Area Files — I link individuals in the Afrobarometer to the Murdock data and calculate their drought exposure based on their ethnic homelands for individuals matched in the data. Approximately 35% of the main sample are matched. Then, I estimate Equation (1) using this drought exposure variable to account for the possibility of long-distance migration[1].

5. Empirical Results: Religiousness & Religious Group Membership

This section presents the empirical estimates of the impact of droughts on religiousness and religious group membership, discussing the heterogeneous effects that drought exposure has throughout the life cycle.

5.1. Droughts and Religion

Examining the impacts of drought exposure on religiousness and religious expression, Table 2 presents the estimates for Equation (1), with religiousness (columns (1) and (2)), religious group member (columns (3) and (4)) and religious group active member (columns (5) and (6)) as the dependent variables. Columns (1), (3), and (5) represent the estimates of Equation (1) using $Avg(Exp)$ — average drought exposure through an individual's lifetime — as the drought exposure measurement $\mathbf{D}_{i(c,k,j,t)}$, while columns

[1]The average distance to the homeland of the ethnic group for matched individuals is around 200 km, a small number considering that the first 40 African countries in terms of size have areas larger than 40,000km^2.

(2), (4), and (6) estimate Equation (1), where $\mathbf{D}_{i(c,k,j,t)}$ represent the average drought exposure for the ten different age brackets $\sum_{i=1}^{l} Avg(Exp_l)$.

Table 2: Impact of Droughts on Religiousness and Group Membership

	Dependent Variable:					
	Religious		Member		Active Member	
	(1)	(2)	(3)	(4)	(5)	(6)
$Avg(Exp)$	−0.002		0.087***		0.064**	
	(0.010)		(0.031)		(0.026)	
$Avg(Exp_{1-4})$		−0.000		−0.001		−0.008
		(0.002)		(0.007)		(0.006)
$Avg(Exp_{5-8})$		−0.000		0.010		0.007
		(0.002)		(0.007)		(0.006)
$Avg(Exp_{9-12})$		0.000		0.007		0.003
		(0.003)		(0.007)		(0.006)
$Avg(Exp_{13-16})$		0.001		0.015**		0.020***
		(0.003)		(0.006)		(0.006)
$Avg(Exp_{17-20})$		0.003		0.017**		0.009
		(0.002)		(0.007)		(0.006)
$Avg(Exp_{21-24})$		−0.000		0.001		0.002
		(0.002)		(0.008)		(0.007)
$Avg(Exp_{25-28})$		0.001		0.003		0.007
		(0.002)		(0.007)		(0.007)
$Avg(Exp_{29+})$		0.004		−0.004		−0.001
		(0.003)		(0.010)		(0.009)
L x Y FE	Y	Y	Y	Y	Y	Y
C x Y x YOB FE	Y	Y	Y	Y	Y	Y
Observations	113,540	113,540	113,540	113,540	113,540	113,540
Num Localities	452	452	452	452	452	452
Num Countries	34	34	34	34	34	34
Adj R^2	0.070	0.070	0.197	0.197	0.181	0.181
Outcome Mean	0.967	0.967	0.482	0.482	0.327	0.327
Outcome SD	0.178	0.178	0.500	0.500	0.469	0.469

Notes: Standard errors clustered by Country-Year in parentheses. L represents *Location*, Y represents *Year*, C represents *Country*, and YOB represents Year of Birth. Controlling for gender, education level, rural/urban, and employment status. Controlling for reported religion in (3) through (6). *Religious* takes a value of 1 if the individual reports being religious and 0 otherwise. *Member* takes a value of 1 if the individual reports being a member of a religious group and 0 otherwise. *Active Member* takes a value of 1 if the individual reports being an active member of a religious group and 0 otherwise. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Results reveal that, while drought exposure appears to have no aggregate effect on individuals' religiosity, it has a strongly positive and significant effect on the probability of being a member of a religious group and an active member. Across the different specifications, a one standard deviation increase in average drought exposure — a variation that pushes individuals from no drought to slight drought, slight to moderate, and moderate to severe — causes around an 9 percentage point increase in the probability of individuals reporting being a religious group member and a 6 percentage point increase in the probability of individuals reporting being an active member of a religious group. These coefficients are large in magnitude, considering both the size of the coefficient on membership and active membership represent approximately 20% of the respective dependent variable means.

Focusing on the results corresponding to the estimates for $\sum_{i=1}^{l} Avg(Exp_l)$., Table 2 shows that the significant aggregate effects for membership and active membership are driven by exposure during teenage years —13 to 16 and 17 to 20 for membership, and only 13 to 16 for active membership —while exposure in adulthood and early childhood seems to have no significant effect. More specifically, a one standard deviation increase in the average exposure through years 13 to 16 and 17 to 20 increases the likelihood that individuals report being members of a religious group by around 2 percentage points, almost 20% the size of the aggregate effect. For active membership, the effect for exposure during late teenage years has a similar effect in terms of magnitude, which would mean it's almost a third of the size of the aggregate effect. These results are robust to different age bracket specifications in Appendix B.1, estimating effects expanding to later age periods in Appendix B.2, and restricting the sample to those only older than the age determined by the last bracket in Appendix B.3.

5.2. Estimation Validity

To use a more exogenous variation and account for the possibility of endogenous migration beyond the common patterns of rural to urban migration most prominent in Africa, in Appendix B.4 I conduct the same analysis as in Table 2 using the measure of drought exposure that uses ethnicity to calculate exposure for ethnic homelands for individuals who report an ethnicity and are matched to the Murdock data, maintaining the same sample. The effects during teenage years, while slightly less significant — remain robust to this estimation. Moreover, while aggregate results for *Member* and *Active Member* become smaller and not significant, controlling for migration sheds light to small but positive and significant aggregate effects on individuals reporting being religious, driven mostly by effects during 17 to 20 and more recent exposure. However, without having knowledge of the timing of migration for these individuals — and whether migration occurred in their generation or before — it is impossible to distinguish clearly whether these slightly different results for exposure at stages outside of teenage years are due to migration itself or the selection of those who migrate.

5.3. Heterogeneity by Religion and Demographic Characteristics

5.3.1. Religion

Considering that one of the main reasons for understanding the relationship between economic shocks and religiousness in Africa is due to the diverse tapestry of religions present in the country, it becomes impossible to ignore the possibility of heterogeneous effects of drought exposure across different religions. In Appendix B.6, I present coefficient plots for the results from estimating Equation (1) with heterogeneous effects by religion, using the three main religion divisions in the sample: *Christian*, *Muslim*, and *Other* religion — such as Traditionalist or Indigenous. Tables B5 and B6 in Appendix B.7 reports coefficients and significance tests.

While the results on the probability of being a member or active member of a religious group do not change drastically — maintaining the pattern of effects focused during teenage years — there are slight differences across religion groups. While there are mostly no significant differences between the estimates of the effect on religious group membership of drought exposure at different age brackets for *Muslim* and *Christian* individuals, among these two only the coefficients for *Christians* are significant for the effect on *Member* of exposure at teenage years, with coefficients of similar sizes to the overall effect[2]. However, for individuals who report belonging to *Other* religions, while there is no significant effect on *Active Member*, drought exposure across ages 5 through 16 increases the probability of being a *Member* of a religious group.

5.3.2. Gender

Additionally, given that religions often have very specific differences in norms or customs across genders, I explore whether there are heterogeneous effects across genders in the coefficient plots reported in Appendix B.5, as well as tables B5 and B6 in Appendix B.7. Overall, the results show that the effects of drought exposure on religious group membership are either equal or higher for men than for women, despite the fact that, on average, men are around 3 percentage points less likely to be religious and around

[2]For *Active Member*, the effect is significant at ages 13 to 16 for both *Muslim Christian* individuals.

10 percentage points less likely to be members of a religious group. More specifically, drought exposure from ages 5 through 8 and 13 to 20 have a significant effect on the probability of being both a *Member* and an *Active Member* of a religious group for *Men*. Meanwhile, for *Women*, the effect of drought exposure is only significant for *Active Member* at ages 13 - 16, suggesting that exposure to droughts and its effect on religious group membership have differential effects for men and women at different stages in life. These patterns are likely partially linked to the differences in religious practices for men and women at different ages. For example, the performance of male circumcision for Muslim men — khitan — is preferred around age 7.

5.4. Short Run Effects: Cohort Panel

The results from Table (2) show lifetime exposure to droughts has a lasting effect on religious group membership, particularly in earlier years. But to understand these long-run patterns, it is important to study what happens in the short run. Using the Afrobarometer data, I construct a cohort panel in which cohorts are determined by age brackets, gender, and reported religion[3]. For each cohort, I obtain the share of religious group members and active members. With this information, I estimate the following equation:

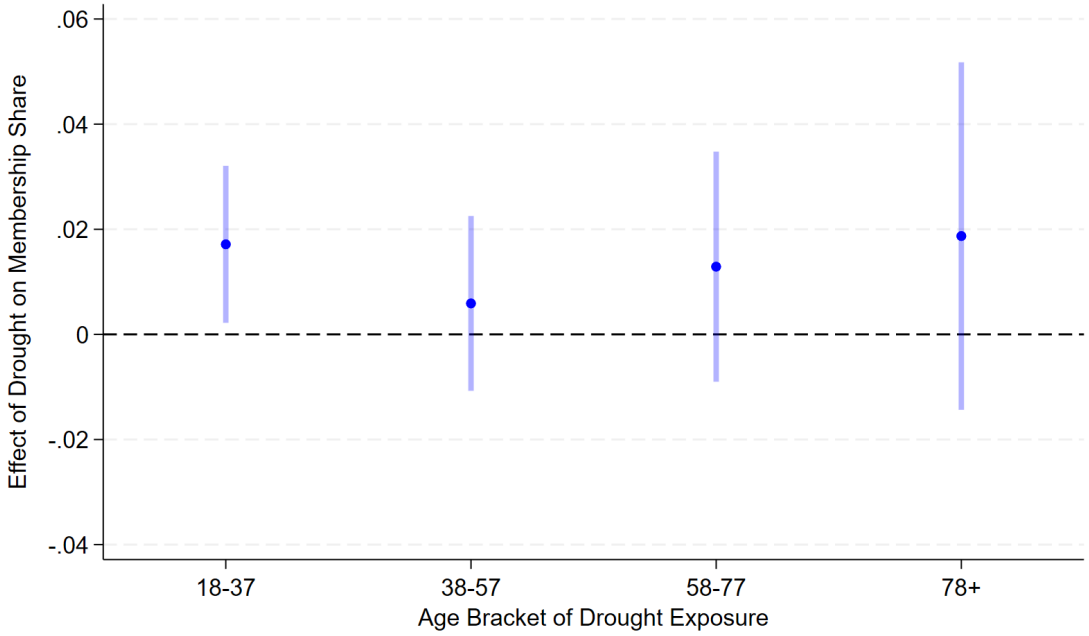
$$y_{c,j,t} = \alpha + \beta \mathbf{D}_{c,j,t-1} + \delta_t + \phi_j + \gamma_{k,t'} + \Delta_c + \varepsilon_{c,j,t}. \tag{2}$$

In this model, $y_{c,j,t}$ represents the share of religious group members from cohort c, in location j (which is within country k) in year t. The key independent variable, $\mathbf{D}_{c,j,t-1}$, measures the drought exposure for cohort c in location j during the preceding year, $t-1$. The specification includes several sets of fixed effects: δ_t captures Year effects, ϕ_j accounts for Location differences, $\gamma_{k,t'}$ incorporates Country - Survey Round fixed effects, and Δ_c represents cohort fixed effects, covering age, sex, and religion.

Figure 3 represents the results of estimating equation (2) with age cohort interactions. Due to the age of the Afrobarometer respondents, it is only possible to observe short run

[3]Summary statistics for the cohort panel are available in Appendix A.1.2

Figure 3: Short run Effects of Drought Exposure by Age Bracket



Notes: Estimation of Equation (2) with age cohort interactions. Shaded area represents 95% confidence intervals.

effects on ages 18 and above. However, we can see that in the short run, a one standard deviation increase in drought exposure for individuals ages 18 to 37 causes around a 2 percentage point increase in the share of respondents who report being members of a religious group — a small but significant increase, given the average of approximately 48%. Drought exposure does not increase the probability of being a religious group member for older individuals.

Given that the age at first birth is relatively low in Sub-Saharan Africa[4](Tekile et al., 2022; Neal et al., 2020; Westoff and Bietsch, 2015; Sibanda and Ndlovu, 2019; Gelana and Biks, 2023), increased group membership among individuals 18 to 37 would mean an increase in religious group membership of parents of children and teenagers, which could indicate the increased exposure during these formative years, and thus, the long-run effect of early life drought exposure on religious group membership.

[4]Tekile et al. (2022), analyzing data from 31 Sub-Saharan African countries, found the overall median age at first birth to be 19 years, with an interquantile range of 16-21.

6. Mechanisms and other Outcomes

To elucidate some of the factors that may be driving — or being driven — by this variation in religiousness and religious group membership induced by the negative economic experience of droughts, I explore the effect of the different measurements of drought exposure on additional sociodemographic outcomes related to *education*, *employment*, and *access to resources*; as well as religion choices and institutional trust.

Appendix B7 shows that increases in aggregate drought exposure are associated with being 6 percentage points more likely to have a formal education, with the effect mostly driven through exposure during late teenage years. While this effect might be driven by drought exposure itself or possible migration, the higher probability of formal education goes against the traditional negative link between education and religion, considering drought exposure in teenage years is associated with higher probability of being a religious group member. The patterns is also present when analyzing the probability of acquiring secondary education. However, there are no significant effects for post-secondary education.

Focusing on occupation choice, Appendix B8 presents a possible economic channel that may be linked to the religious effects, showing that drought exposure during teenage years is associated with an increased probability of individuals working in agriculture as adults, and a decreased probability of working in manual labor. This pattern is also present for exposure during early and late adulthood. While this finding may seem counterintuitive, it is consistent with the idea of a long-term, "in situ" adaptation where individuals remain in agriculture, possibly developing more resilient farming practices, rather than migrating. This economic adaptation could occur alongside the social adaptation of greater religious group membership. However, there are no significant effects on being in professional or managerial occupations.

Notably, the results from Appendix B9 show that drought exposure during formative years does not have a significant long-term impact on individuals' current access to basic resources like food, water, or medical care. The only significant effects appear in late adulthood, where exposure is associated with a decrease in the lack of access to fuel

but an increase in the lack of access to cash. This suggests that the long-term effects on religious group membership are not likely linked to differences in resources today, and that only more contemporaneous drought exposure seems to have an impact on access to resources. This suggests that the long-term effects on religious group membership are not likely linked to differences in resources today, and that only more contemporaneous drought exposure seems to have an impact on access to resources.

A deeper understanding of this coping mechanism can be found by examining the specific religious groups and social institutions that are affected. Appendix B10 explores the effect of life-cycle drought exposure on religion choice, and shows that the effects of drought exposure on religious identity are not uniform across all Christian denominations. More specifically, exposure during early childhood (ages 5 to 8) is associated with an increased likelihood of identifying as a Protestant today, while exposure in late childhood (ages 9 to 12) shows a negative effect. A positive effect also emerges for exposure during late adulthood (ages 25 to 28) on identifying as a Seventh-Day Adventist — results that might be driven by the growth of this church in the region in recent decades. The positive effect for late teenage years (ages 17 to 20) on identifying as Christian further complements the main findings, suggesting that while exposure during this period contributes to a Christian identity, it may not be tied to a specific denomination. There are no significant effects for Pentecostal denominations.

This reliance on social structures extends beyond religious groups to other community institutions. Appendix B11 provides a political and social context for the findings on religion. It shows that drought exposure during teenage years is associated with a long-term increase in trust in various community-based institutions, including local government, opposition parties, and the police. This broader pattern suggests that drought exposure in adolescence may lead to a learned reliance on a range of local institutions and non-governmental entities for support and stability. The increased likelihood of religious group membership can be seen as a part of this same, wider adaptation strategy. Alternatively, participation in religious groups might have increased individuals' networks in their communities, increasing their trust in them.

7. Conclusion

In this study, I have delved into the intricate relationship between exposure to negative shocks, particularly droughts, and individuals' religious expression across over 30 African countries. Leveraging individual-level data from the Afrobarometer survey, compelling evidence has emerged indicating that exposure to stronger periods of drought—particularly during earlier stages of life—leads to an increased likelihood of belonging to a religious group and active participation within said group. A one standard deviation increase in average drought exposure causes a significant increase in the probability of individuals reporting being a religious group member and an active member. More importantly, these significant aggregate effects are driven by exposure during teenage years.

This research contributes significantly to the literature on economic development and religion by elucidating the mechanisms through which economic shocks can shape religious practices. The findings bolster the argument that the response to these shocks primarily occurs on the intensive margin—through religious group membership and active participation—given the null effects on reported religious identification in the main specification. However, when accounting for possible migration, a significant aggregate effect on religious identification emerges, driven by exposure during late teenage years. Furthermore, by highlighting the pronounced impact of early-life exposure to negative shocks on religiosity, this study underscores the critical role of early-life conditions in shaping later-life outcomes. This empirical observation aligns with interdisciplinary research identifying adolescence as a critical period of brain plasticity and identity formation, making individuals exceptionally receptive to environmental influences. The short-run cohort panel analysis further reveals a significant increase in religious group membership among young adults (18 to 37) following drought exposure, which, given the low age of first birth in the region, suggests a plausible inter-generational mechanism where parents' increased religiosity transmits to their children. The effects of drought exposure on religious group membership are also found to be either equal or higher for men than for women, and the specific effects vary across Christian, Muslim, and other religious groups.

While the previous results on education and labor market outcomes were preliminary, the more detailed analysis highlights the intricate mechanisms driving the relationship between economic shocks and religiosity. Drought exposure during teenage years is associated with a significant increase in formal education, a result that might seem paradoxical given the traditional negative link between education and religion. The analysis of occupation choice shows that drought exposure during teenage years is associated with an increased probability of an individual working in agriculture as an adult, which can be interpreted as a form of long-term "in-situ" adaptation that runs parallel to a greater likelihood of religious group membership. Similarly, the findings on trust in institutions reveal that teenage drought exposure is associated with a long-term increase in trust in various community-based institutions, suggesting that religious group membership may be part of a broader, learned strategy of reliance on local institutions for support. These deeper insights provide an invaluable understanding of how economic conditions, social dynamics, and religious beliefs intersect.

References

Africa Center. African Migration Trends to Watch in 2024 — africacenter.org. https://africacenter.org/spotlight/african-migration-trends-to-watch-in-2024/, 2024. [Accessed 23-04-2024].

Philipp Ager and Antonio Ciccone. Agricultural Risk and the Spread of Religious Communities. *Journal of the European Economic Association*, 16(4):1021–1068, 10 2017. ISSN 1542-4766. doi: 10.1093/jeea/jvx029. URL https://doi.org/10.1093/jeea/jvx029.

Alberto Alesina and Paola Giuliano. The power of the family. *Journal of Economic growth*, 15(2):93–125, 2010.

Yann Algan and Pierre Cahuc. Inherited trust and growth. *American Economic Review*, 100(5):2060–92, 2010.

Marcella Alsan. The effect of the tsetse fly on african development. *The American Economic Review*, 105(1): 382–410, 2015. ISSN 00028282. URL http://www.jstor.org/stable/43497064.

Lars Harhoff Andersen and Jeanet Bentzen. In the Name of God! Religiosity and the Transition to Modern Growth, January 2022. URL http://papers.ssrn.com/abstract=4026842.

Emmanuelle Auriol, Julie Lassébie, Amma Panin, Eva Raiber, and Paul Seabright. God Insures those Who Pay? Formal Insurance and Religious Offerings in Ghana. *The Quarterly Journal of Economics*, 135(4):1799–1848, 07 2020. ISSN 0033-5533. doi: 10.1093/qje/qjaa015. URL https://doi.org/10.1093/qje/qjaa015.

Corry Azzi and Ronald Ehrenberg. Household allocation of time and church attendance. *Journal of Political Economy*, 83(1):27–56, 1975. doi: 10.1086/260305. URL https://doi.org/10.1086/260305.

Sascha O. Becker, Jared Rubin, and Ludger Woessmann. Chapter 20 - religion in economic history: a survey. In Alberto Bisin and Giovanni Federico, editors, *The Handbook of Historical Economics*, pages 585–639. Academic Press, 2021. ISBN 978-0-12-815874-6. doi: https://doi.org/10.1016/B978-0-12-815874-6.00029-0. URL https://www.sciencedirect.com/science/article/pii/B9780128158746000290.

Jeanet Bentzen. Acts of God? Religiosity and Natural Disasters Across Subnational World Districts. *The Economic Journal*, 129(622):2295–2321, 05 2019. ISSN 0013-0133. doi: 10.1093/ej/uez008. URL https://doi.org/10.1093/ej/uez008.

Jeanet Sinding Bentzen. In crisis, we pray: Religiosity and the COVID-19 pandemic. *Journal of Economic Behavior & Organization*, 192:541–583, December 2021. doi: 10.1016/j.jebo.2021.10.014. URL https://doi.org/10.1016/j.jebo.2021.10.014.

Sarah-Jayne Blakemore. Imaging brain development: The adolescent brain. *NeuroImage*, 61(2):397–402, 2012.

Sarah-Jayne Blakemore and Kathryn L Mills. Is adolescence a sensitive period for sociocultural processing? *Annu Rev Psychol.*, 65(1):187–207, 2014.

David E. Bloom, Jeffrey D. Sachs, Paul Collier, and Christopher Udry. Geography, demography, and economic growth in africa. *Brookings Papers on Economic Activity*, 1998(2):207–295, 1998. ISSN 00072303, 15334465. URL http://www.jstor.org/stable/2534695.

Brill. The role of confirmation in christian initiation in - brill. *Brill*. URL https://brill.com/view/journals/jyt/22/2/article-p251_006.xml.

Thomas Buser. The effect of income on religiousness. *American Economic Journal: Applied Economics*, 7(3): 178–95, July 2015. doi: 10.1257/app.20140162. URL https://www.aeaweb.org/articles?id=10.1257/app.20140162.

Filipe Campante and David Yanagizawa-Drott. Does Religion Affect Economic Growth and Happiness? Evidence from Ramadan. *The Quarterly Journal of Economics*, 130(2):615–658, 01 2015. ISSN 0033-5533. doi: 10.1093/qje/qjv002. URL https://doi.org/10.1093/qje/qjv002.

B. J. Casey, Rebecca M. Jones, and Todd A. Hare. The adolescent brain. *Annals of the New York Academy of Sciences*, 1124(1):111–125, 2008.

Catholic Answers. What is the correct age for confirmation? | catholic answers q&a. *Catholic Answers*. URL https://www.catholic.com/qa/what-is-the-correct-age-for-confirmation.

Pew Research Center. Tolerance and tension: Islam and christianity in sub-saharan africa, 2010. URL https://www.pewforum.org/2010/04/15/executive-summary-islam-and-christianity-in-sub-saharan-africa/.

Christian Community. Confirmation - the christian community in southern africa. *The Christian Community in Southern Africa*. URL https://www.thechristiancommunity.org.za/confirmation.html.

Christianity.com. Christianity.com what is a believer's baptism? - christianity.com. *Christianity.com*. URL https://www.christianity.com/church/what-is-a-believers-baptism.html.

Afrobarometer Data. All countries, rounds 5 (2011/2013), 6 (2014/2015), and 7 (2016/2018), available at . [Accessed 23-04-2024].

Oeindrila Dube, Joshua Evan Blumenstock, and Michael Callen. Measuring Religion from Behavior: Climate Shocks and Religious Adherence in Afghanistan, 2022. URL https://papers.ssrn.com/abstract=4291748.

David Elkind. Egocentrism in adolescence. *Child Development*, 38(4):1025–1034, 1967.

Erik H Erikson. *Identity: Youth and crisis*. Norton, 1968.

FAO. Drought. land & water, n.d.a. URL https://www.fao.org/land-water/water/drought/en/.

FAO. Sustainable development goals. indicator 2.1.2 prevalence of moderate or severe food insecurity in the population, based on the food insecurity experience scale, n.d.b. URL https://www.fao.org/sustainable-development-goals/.

Raquel Fernández and Alessandra Fogli. Culture: An empirical investigation of beliefs, work, and fertility. *American economic journal: Macroeconomics*, 1(1):146–77, 2009.

C.B. Field, V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White, editors. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2014.

United Nations Office for Disaster Risk Reduction. *Global Assessment Report on Disaster Risk Reduction*. United Nations, September 2023.

James W Fowler. *Stages of faith: The psychology of human development and the quest for meaning*. HarperOne, 2006.

Girum Adeba Gelana and Gashaw Andargie Biks. Time to first childbirth and its predictors among reproductive-age women in ethiopia: survival analysis of recent evidence from the edhs 2019. *Frontiers in Public Health*, 11:1165204, 2023. doi: 10.3389/frph.2023.1165204. URL https://www.frontiersin.org/journals/reproductive-health/articles/10.3389/frph.2023.1165204/full.

Jay N Giedd, Jacqueline Blumenthal, Neal O Jeffries, F Xavier Castellanos, Hong Liu, Alex Zijdenbos, Tomáš Paus, Alan C Evans, and Judith L Rapoport. Brain development during childhood and adolescence: A longitudinal mri study. *Nature Neuroscience*, 2(10):861–863, 1999.

Global Administrative Areas. Gadm database of global administrative areas, version 4.1, 7 2022. URL http://www.gadm.org.

Luigi Guiso, Paola Sapienza, and Luigi Zingales. Does culture affect economic outcomes? *Journal of Economic Perspectives*, 20(2):23–48, June 2006. doi: 10.1257/jep.20.2.23. URL https://www.aeaweb.org/articles?id=10.1257/jep.20.2.23.

Luigi Guiso, Paola Sapienza, and Luigi Zingales. Cultural Biases in Economic Exchange? *The Quarterly Journal of Economics*, 124(3):1095–1131, 08 2009. ISSN 0033-5533. doi: 10.1162/qjec.2009.124.3.1095. URL https://doi.org/10.1162/qjec.2009.124.3.1095.

Joseph Henrich, Michal Bauer, Alessandra Cassar, Julie Chytilová, and Benjamin Grant Purzycki. War increases religiosity. *Nature Human Behaviour*, 3(2):129–135, January 2019. doi: 10.1038/s41562-018-0512-3. URL https://doi.org/10.1038/s41562-018-0512-3.

Hillsong Church. Be baptised | africa - hillsong church. *Hillsong Church*. URL https://hillsong.com/southafrica/bebaptised/.

Islam Reference. Circumcision - islamreference.com. *IslamReference.com*. URL https://islamreference.com/definitions/c/circumcision/.

Harold G. Koenig. Religion, Spirituality, and Health: The Research and Clinical Implications. *ISRN Psychiatry*, 2012:278730, December 2012. ISSN 2356-7872. doi: 10.5402/2012/278730. URL https://doi.org/10.5402/2012/278730. Publisher: International Scholarly Research Network.

Damian J. Ruckand R. Alexander Bentleyand Daniel J. Lawson. Religious change preceded economic change in the 20th century. *Science Advances*, 4(7):eaar8680, 2018. doi: 10.1126/sciadv.aar8680. URL https://www.science.org/doi/abs/10.1126/sciadv.aar8680.

Sharon Maccini and Dean Yang. Under the weather: Health, schooling, and economic consequences of early-life rainfall. *American Economic Review*, 99(3):1006–26, June 2009. doi: 10.1257/aer.99.3.1006. URL https://www.aeaweb.org/articles?id=10.1257/aer.99.3.1006.

Tina Malti, Emma Galarneau, and Joanna Peplak. Moral development in adolescence. *Journal of Research on Adolescence*, 2021.

James E Marcia. Development and validation of ego-identity status. *Journal of Personality and Social Psychology*, 3(5):551–558, 1966.

Rachel M. McCleary and Robert J. Barro. Religion and economy. *Journal of Economic Perspectives*, 20(2):49–72, June 2006. doi: 10.1257/jep.20.2.49. URL https://www.aeaweb.org/articles?id=10.1257/jep.20.2.49.

Wim Meeus, Rens van de Schoot, Loes Keijsers, and Susan Branje. On the progression and stability of adolescent identity formation: A five-wave longitudinal study in early-to-middle and middle-to-late adolescence. *Child Development*, 81(5):1565–1581, 2010.

Kathryn L Mills, François Lalonde, Liv S Clasen, Jay N Giedd, and Sarah-Jayne Blakemore. Developmental changes in the structure of the social brain in late childhood and adolescence. *Soc Cogn Affect Neurosci*, 9:123–131, 2014.

Eduardo Montero and Dean Yang. Religious festivals and economic development: Evidence from the timing of mexican saint day festivals. *American Economic Review*, 112(10):3176–3214, October 2022. doi: 10.1257/aer.20211094. URL https://www.aeaweb.org/articles?id=10.1257/aer.20211094.

George P. Murdock. *Africa: Its Peoples and Their Culture History.* New York, NY: McGraw-Hill, 1959.

George Peter Murdock. Ethnographic atlas: A summary. *Ethnology*, 6(2):109–236, 1967. ISSN 00141828. URL http://www.jstor.org/stable/3772751.

Sarah Neal, Florence Wekesah, Kristen Hall, and Ernestina Coast. Trends in adolescent first births in sub-saharan africa: a tale of increasing inequity? *International Journal for Equity in Health*, 19(1):151, 2020. doi: 10.1186/s12939-020-01258-x. URL https://www.researchgate.net/publication/344140914_Trends_in_adolescent_first_births_in_sub-Saharan_Africa_a_tale_of_increasing_inequity.

Eric E Nelson, Ellen Leibenluft, Elizabeth B McClure, and Daniel S Pine. The social reorientation of adolescence: A neuroscience perspective. *Psychol Med*, 35(2):163–174, 2005.

Nathan Nunn. Culture and the historical process. *Economic History of Developing Regions*, 27(S1):108–126, 2012.

Nathan Nunn. On the dynamics of human behavior: The past, present, and future of culture, conflict, and cooperation. *AEA Papers and Proceedings*, 112:15–37, May 2022. doi: 10.1257/pandp.20221126. URL https://www.aeaweb.org/articles?id=10.1257/pandp.20221126.

Kenneth Ira Pargament. *The psychology of religion and coping: Theory, research, practice.* The psychology of religion and coping: Theory, research, practice. Guilford Press, New York, NY, US, 1997. ISBN 1-57230-214-3 (Hardcover). Pages: xii, 548.

Nicola Persico, Andrew Postlewaite, and Dan Silverman. The effect of adolescent experience on labor market outcomes: The case of height. *Journal of Political Economy*, 112(5):1019–1053, 2004. doi: 10.1086/422566.

Pew Research Center. The age gap in religion around the world. Technical report, Pew Research Center, Washington, D.C., June 2018. URL https://www.pewresearch.org/religion/2018/06/13/the-age-gap-in-religion-around-the-world/.

Jean Piaget. *The Psychology of Intelligence*. Routledge & Kegan Paul, 1950.

Research Gate. Rites of passage african traditional region. *ResearchGate*. URL https://www.researchgate.net/publication/381691552_RITES_OF_PASSAGE_AFRICAN_TRADITIONAL_REGION.

Kjell G. Salvanes, Barton Willage, and Alexander Willén. The Effect of Labor Market Shocks across the Life Cycle. *Journal of Labor Economics*, 42(1):121–160, January 2024. ISSN 0734-306X, 1537-5307. doi: 10.1086/722086. URL https://www.journals.uchicago.edu/doi/10.1086/722086.

Nompumelelo Sibanda and Lufuno Ndlovu. Determinants of age at first birth in south africa: Evidence from 1998 and 2016 demographic and health surveys. *Gender and Behaviour*, 21(1):4252–4263, 2019. URL https://journals.co.za/doi/abs/10.10520/ejc-genbeh_v21_n1_a38.

Kenneth L. Sokoloff and Stanley L. Engerman. Institutions, factor endowments, and paths of development in the new world. *Journal of Economic Perspectives*, 14(3):217–232, September 2000. doi: 10.1257/jep.14.3.217. URL https://www.aeaweb.org/articles?id=10.1257/jep.14.3.217.

Elizabeth R Sowell, Paul M Thompson, Christine M Leonard, Susan E Welcome, Andrew L Kan, and Arthur W Toga. Longitudinal mapping of cortical thickness and brain growth in normal children and adolescents. *Journal of Neuroscience*, 24(38):8223–8231, 2004.

Laurence Steinberg. Cognitive and affective development in adolescence. *Trends in Cognitive Sciences*, 9(2):69–74, 2005.

Achenef Kassa Tekile, Kindie Alemu, and Gashaw Andargie Biks. Time to first birth and its predictors among reproductive age women in high fertility countries in sub-saharan africa: Inverse weibull gamma shared frailty model. *BMC Public Health*, 22(1):2132, 2022. doi: 10.1186/s12889-022-14578-1. URL https://pmc.ncbi.nlm.nih.gov/articles/PMC9670487/.

Richard H Thaler and Cass R Sunstein. *Nudge: Improving Decisions About Health, Wealth, and Happiness*. Yale University Press, 2008.

The World Bank. Poverty and inequality platform, 2022. URL www.pip.worldbank.org.

John Thornton. The development of an african catholic church in the kingdom of kongo, 1491-1750. *Journal of African History*, 41(02):173–199, 2000.

United Nations Office for Disaster Risk Reduction. Global assessment report on disaster risk reduction. 2019. URL https://gar.unisdr.org/.

Sergio Vicente-Serrano, Santiago Beguería, Juan Moreno, Marta Angulo-Martinez, and Ahmed Kenawy. A new global 0.5° gridded dataset (1901-2006) of a multiscalar drought index: Comparison with current drought index datasets based on the palmer drought severity index. *Journal of Hydrometeorology*, 11:1033–1043, 08 2010. doi: 10.1175/2010JHM1224.1.

Charles F. Westoff and Kristin Bietsch. Estimating the current mean age of mothers at the birth of their first child from household surveys. *BMC Public Health*, 15(1):903, 2015. doi: 10.1186/s12889-015-2266-2. URL https://pmc.ncbi.nlm.nih.gov/articles/PMC4570715/.

World Meteorological Organization (WMO). WMO atlas of mortality and economic losses from weather, climate and water extremes (1970–2019). Technical report, 2021. URL https://library.wmo.int/index.php?lvl=notice_display&id=21930.

Junjian Yi, James J. Heckman, Junsen Zhang, and Gabriella Conti. Early Health Shocks, Intra-Household Resource Allocation and Child Outcomes. *The Economic Journal*, 125(588):F347–F371, November 2015. ISSN 0013-0133, 1468-0297. doi: 10.1111/ecoj.12291. URL https://academic.oup.com/ej/article/125/588/F347-F371/5077914.

Online Appendix for

The Roots of Faith: Early Life Shocks and Religious Commitment

Triana Yentzen
University of Michigan

22 August 2025

Contents

Appendix A Data Appendix **3**

A.1 Afrobarometer Survey Overview . . . 3

A.1.1 Variables and Harmonization Details . . . 3

A.1.2 Cohort Panel . . . 4

A.2 Drought Measurement . . . 4

A.2.1 The Global SPEI Database . . . 4

A.2.2 Drought Categories . . . 4

A.2.3 Drought Variable Construction . . . 5

Appendix B Additional Tables & Figures **6**

B.1 Droughts and Religiousness: Alternative Age Bracket . . . 6

B.2 Droughts and Religiousness: Full Sample . . . 7

B.3 Droughts and Religiousness: Restricted Balanced Sample . . . 8

B.4 Droughts and Religiousness: Exposure based on Ethnic Origins . . . 9

B.5 Droughts and Religiousness: Heterogeneity by Gender . . . 10

B.6 Droughts and Religiousness: Heterogeneity by Religion . . . 11

B.7 Droughts and Religiousness: Heterogeneity Summary . . . 12

B.8 Mechanisms and other Outcomes . . . 13

B.8.1 Education Results . . . 13

B.8.2 Occupation Results . . . 14

B.8.3 Economic Conditions Results . . . 15

B.8.4 Religion Results . . . 16

B.8.5 Political Results . . . 17

Appendix A. Data Appendix

A.1. Afrobarometer Survey Overview

The information on individuals' demographic characteristics, location, and religious expression for this paper comes from the Afrobarometer survey. Conducted periodically since 1999, the Afrobarometer is designed to capture public sentiments and experiences related to democracy, governance, and socioeconomic conditions of individuals aged 18 and above across the African continent. For this study, I harmonized Rounds 5, 6, and 7 of the Afrobarometer, covering the period circa 2011 - 2018. The final sample for the analysis includes 115,204 observations from 453 sub-national units spanning 34 African countries: Algeria, Benin, Botswana, Burundi, Cabo Verde, Cameroon, Côte d'Ivoire, Egypt, Eswatini, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

A.1.1. Variables and Harmonization Details

From the Afrobarometer, I use individuals' age, employment status, date of survey, location, sex, race, ethnicity, religion, and religious group membership status. For location, some boundaries changed during the period of these surveys. To account for this, I matched them according to the references of these administrative changes, mostly by aggregating them to the largest comparable area across time. The religion variable divides the sample into four categories: Muslim, Christian, Other, and None. While Round 7 includes this condensed version of the religion variable, it is unavailable in Round 6. To make them comparable, I use the religion mapping from the condensed and raw religion variables in Round 7 and apply it to the data from Round 6. The question regarding religious group membership status asks whether the individual is an official leader, an active member, an inactive member, or not a member of a religious group that meets outside of regular worship services. This question was not exclusively asked to those who report being religious; around 15% of individuals who report having no religion declared that they are a member of a religious group, either active or inactive. To combine the individual-level demographic and religion information with the climate data, which allows me to construct drought measurements for the analysis, I cleaned and harmonized the subnational division names in the Afrobarometer and used the geolocation of the surveys to match them with the shapefiles from the Global Administrative Areas, GADM (Version 4.1, released on October 21, 2020).

A.1.2. Cohort Panel

	Mean	SD	Median	Min	Max	N
Cohort 18-37	0.59	0.49	1.00	0.00	1.00	12,045
Cohort 38-57	0.30	0.46	0.00	0.00	1.00	12,045
Cohort 58-77	0.10	0.30	0.00	0.00	1.00	12,045
Cohort 78+	0.01	0.10	0.00	0.00	1.00	12,045
Male	0.50	0.50	0.00	0.00	1.00	12,045
Christian	0.61	0.49	1.00	0.00	1.00	12,045
Muslim	0.30	0.46	0.00	0.00	1.00	12,045
Other	0.06	0.24	0.00	0.00	1.00	12,045
None	0.03	0.17	0.00	0.00	1.00	12,045
$Drought_{t-1}$	1.23	0.74	1.27	-1.77	3.48	12,045

A.2. Drought Measurement

This appendix provides a detailed description of the methodology and data used to construct the drought measurements for this study.

A.2.1. The Global SPEI Database

To build my measures of drought exposure and intensity, I use The Global SPEI Database. This dataset offers comprehensive information on drought severity and duration worldwide, drawing from monthly precipitation and evapotranspiration data from the Climatic Research Unit of the University of East Anglia, to build a global gridded dataset of a multiscalar drought index — the standardized precipitation evapotranspiration index (SPEI)[5], which considers the joint effects of temperature and precipitation on droughts. Version 2.9 of the database covers the period from January 1901 to December 2022, providing a detailed record of meteorological conditions over more than a century. Following Vicente-Serrano et al. (2010), I use the 12-month Standardized Precipitation-Evapotranspiration Index (SPEI-12), to identify droughts from water deficits in a rolling 12-month period, allowing for the precise characterization of drought events and their temporal variability across the countries in the sample.

A.2.2. Drought Categories

The SPEI standardized scale defines the following categories of drought:

- Slight: $(0, -0.9)$
- Moderate: $[-0.9, -1.5)$
- Severe: $[-1.5, -2)$
- Extreme: $[-2, -\infty)$

[5]Based on the Palmer drought severity index (UCAR-PDSI, 2.5°).

A.2.3. Drought Variable Construction

For my initial regression analysis, exploring the link between overall drought exposure and religiosity, I combine the SPEI spatial information with the GADM shapefiles and the year-of-birth and location of individuals in the sample to construct different measures of drought exposure for these individuals based on their location, year of birth, and survey year: Avg(Drought Exposure). Avg(Drought Exposure) consists of the cumulative level of drought exposure by adding up the SPEI measure from the year in which the individual is born until the year of the interview[6]. I then divide by each individual's age to calculate the average exposure and intensity of exposure during their lifetime.

Additionally, to explore the life-cycle component of exposure to droughts and its relationship with religion, I construct the same cumulative measures for Drought Exposure measured for ten age brackets, which .

[6]I ignore positive values of the variable, only focusing on the driest measurement of my monthly 12-month moving average drought measurement for each pixel of the map, to later take the average across all pixels for each location.

Appendix B. Additional Tables & Figures

B.1. Droughts and Religiousness: Alternative Age Bracket

Table B1: Impact of Droughts on Religiousness and Group Membership

	Dependent Variable:					
	Religious		Member		Active Member	
	(1)	(2)	(3)	(4)	(5)	(6)
$Avg(Exp)$	−0.002		0.087***		0.064**	
	(0.010)		(0.031)		(0.026)	
$Avg(Exp_{0-2})$		−0.001		−0.002		−0.005
		(0.002)		(0.006)		(0.006)
$Avg(Exp_{3-5})$		−0.000		0.006		−0.003
		(0.003)		(0.005)		(0.005)
$Avg(Exp_{6-8})$		−0.001		0.004		0.007
		(0.002)		(0.006)		(0.005)
$Avg(Exp_{9-11})$		0.001		0.004		−0.000
		(0.002)		(0.006)		(0.005)
$Avg(Exp_{12-14})$		−0.002		0.010*		0.012**
		(0.002)		(0.005)		(0.005)
$Avg(Exp_{15-17})$		0.001		0.014**		0.014**
		(0.002)		(0.006)		(0.006)
$Avg(Exp_{18-20})$		0.002		0.011*		0.008
		(0.002)		(0.006)		(0.006)
$Avg(Exp_{21-23})$		0.000		−0.001		0.001
		(0.002)		(0.007)		(0.007)
$Avg(Exp_{24-26})$		−0.002		0.000		0.004
		(0.002)		(0.007)		(0.006)
$Avg(Exp_{27-29})$		0.004		0.009		0.010
		(0.003)		(0.006)		(0.008)
$Avg(Exp_{30+})$		0.000		−0.012		−0.006
		(0.003)		(0.009)		(0.011)
L x Y FE	Y	Y	Y	Y	Y	Y
C x Y x YOB FE	Y	Y	Y	Y	Y	Y
Observations	113,540	113,540	113,540	113,540	113,540	113,540
Num Localities	452	452	452	452	452	452
Num Countries	34	34	34	34	34	34
Adj R^2	0.070	0.070	0.197	0.197	0.181	0.181
Outcome Mean	0.967	0.967	0.482	0.482	0.327	0.327
Outcome SD	0.178	0.178	0.500	0.500	0.469	0.469

Notes: Standard errors clustered by Country-Year in parentheses. L represents *Location*, Y represents *Year*, C represents *Country*, and YOB represents Year of Birth. Controlling for gender, education level, rural/urban, and employment status. Controlling for reported religion in (3) through (6), and sample restricted to only those who report being religious. *Religious* takes a value of 1 if the individual reports being religious and 0 otherwise. *Member* takes a value of 1 if the individual reports being a member of a religious group and 0 otherwise. *Active Member* takes a value of 1 if the individual reports being an active member of a religious group and 0 otherwise. Drought exposure measure obtained using average exposure of Ethnic group using Murdock data when available and matched, and based on Afrobarometer location when individual reports no ethnic group or match unavailable. This process leads to additional individuals without missing observations in drought exposure, hence the larger sample. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.2. Droughts and Religiousness: Full Sample

Table B2: Impact of Droughts on Religiousness and Group Membership

	Dependent Variable:					
	Religious		Member		Active Member	
	(1)	(2)	(3)	(4)	(5)	(6)
$Avg(Exp)$	−0.001		0.087***		0.064**	
	(0.010)		(0.031)		(0.026)	
$Avg(Exp_{1-4})$		0.000		−0.001		−0.008
		(0.002)		(0.007)		(0.006)
$Avg(Exp_{5-8})$		0.000		0.010		0.007
		(0.002)		(0.007)		(0.006)
$Avg(Exp_{9-12})$		0.001		0.007		0.003
		(0.003)		(0.007)		(0.006)
$Avg(Exp_{13-16})$		0.002		0.014**		0.021***
		(0.002)		(0.006)		(0.006)
$Avg(Exp_{17-20})$		0.003		0.016**		0.010
		(0.002)		(0.007)		(0.006)
$Avg(Exp_{21-24})$		0.000		0.001		0.002
		(0.002)		(0.009)		(0.007)
$Avg(Exp_{25-28})$		0.001		0.002		0.006
		(0.002)		(0.007)		(0.007)
$Avg(Exp_{29-32})$		0.002		0.002		0.007
		(0.003)		(0.007)		(0.007)
$Avg(Exp_{33-36})$		−0.002		−0.006		−0.008
		(0.003)		(0.008)		(0.008)
$Avg(Exp_{37-40})$		0.011***		−0.001		0.000
		(0.003)		(0.010)		(0.008)
$Avg(Exp_{41-44})$		−0.002		−0.002		−0.003
		(0.004)		(0.011)		(0.011)
$Avg(Exp_{45+})$		0.005		−0.010		0.010
		(0.005)		(0.015)		(0.017)
L x Y FE	Y	Y	Y	Y	Y	Y
C x Y x YOB FE	Y	Y	Y	Y	Y	Y
Observations	115,204	115,204	113,540	113,540	113,540	113,540
Num Localities	453	453	452	452	452	452
Num Countries	34	34	34	34	34	34
Adj R^2	0.070	0.070	0.197	0.197	0.181	0.181
Outcome Mean	0.968	0.968	0.482	0.482	0.327	0.327
Outcome SD	0.176	0.176	0.500	0.500	0.469	0.469

Notes: Standard errors clustered by Country-Year in parentheses. L represents *Location*, Y represents *Year*, C represents *Country*, and YOB represents Year of Birth. Controlling for gender, education level, rural/urban, and employment status. Controlling for reported religion in (3) through (6), and sample restricted to only those who report being religious. *Religious* takes a value of 1 if the individual reports being religious and 0 otherwise. *Member* takes a value of 1 if the individual reports being a member of a religious group and 0 otherwise. *Active Member* takes a value of 1 if the individual reports being an active member of a religious group and 0 otherwise. Drought exposure measure obtained using average exposure of Ethnic group using Murdock data when available and matched, and based on Afrobarometer location when individual reports no ethnic group or match unavailable. This process leads to additional individuals without missing observations in drought exposure, hence the larger sample. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.3. Droughts and Religiousness: Restricted Balanced Sample

Table B3: Impact of Droughts on Religiousness and Group Membership

	Dependent Variable:					
	Religious		Member		Active Member	
	(1)	(2)	(3)	(4)	(5)	(6)
$Avg(Exp)$	−0.036**		0.117*		0.076	
	(0.017)		(0.064)		(0.053)	
$Avg(Exp_{1-4})$		−0.004		−0.001		−0.005
		(0.004)		(0.010)		(0.009)
$Avg(Exp_{5-8})$		−0.004		0.015*		0.006
		(0.003)		(0.009)		(0.009)
$Avg(Exp_{9-12})$		−0.001		0.007		−0.002
		(0.004)		(0.009)		(0.009)
$Avg(Exp_{13-16})$		0.001		0.017*		0.018**
		(0.003)		(0.009)		(0.009)
$Avg(Exp_{17-20})$		−0.000		0.014*		0.005
		(0.003)		(0.009)		(0.008)
$Avg(Exp_{21-24})$		−0.002		−0.001		0.008
		(0.003)		(0.010)		(0.009)
$Avg(Exp_{25-28})$		−0.002		0.003		0.005
		(0.003)		(0.007)		(0.008)
$Avg(Exp_{29+})$		−0.002		0.001		−0.002
		(0.005)		(0.015)		(0.013)
L x Y FE	Y	Y	Y	Y	Y	Y
C x Y x YOB FE	Y	Y	Y	Y	Y	Y
Observations	71,701	71,701	71,399	71,399	71,399	71,399
Num Localities	453	453	453	453	453	453
Num Countries	34	34	34	34	34	34
Adj R^2	0.065	0.065	0.210	0.210	0.195	0.195
Outcome Mean	0.969	0.969	0.491	0.491	0.338	0.338
Outcome SD	0.174	0.174	0.500	0.500	0.473	0.473

Notes: Standard errors clustered by Country-Year in parentheses. L represents *Location*, Y represents *Year*, C represents *Country*, and YOB represents Year of Birth. Controlling for gender, education level, rural/urban, and employment status. Controlling for reported religion in (3) through (6), and sample restricted to only those who report being religious. *Religious* takes a value of 1 if the individual reports being religious and 0 otherwise. *Member* takes a value of 1 if the individual reports being a member of a religious group and 0 otherwise. *Active Member* takes a value of 1 if the individual reports being an active member of a religious group and 0 otherwise. Drought exposure measure obtained using average exposure of Ethnic group using Murdock data when available and matched, and based on Afrobarometer location when individual reports no ethnic group or match unavailable. This process leads to additional individuals without missing observations in drought exposure, hence the larger sample. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.4. Droughts and Religiousness: Exposure based on Ethnic Origins

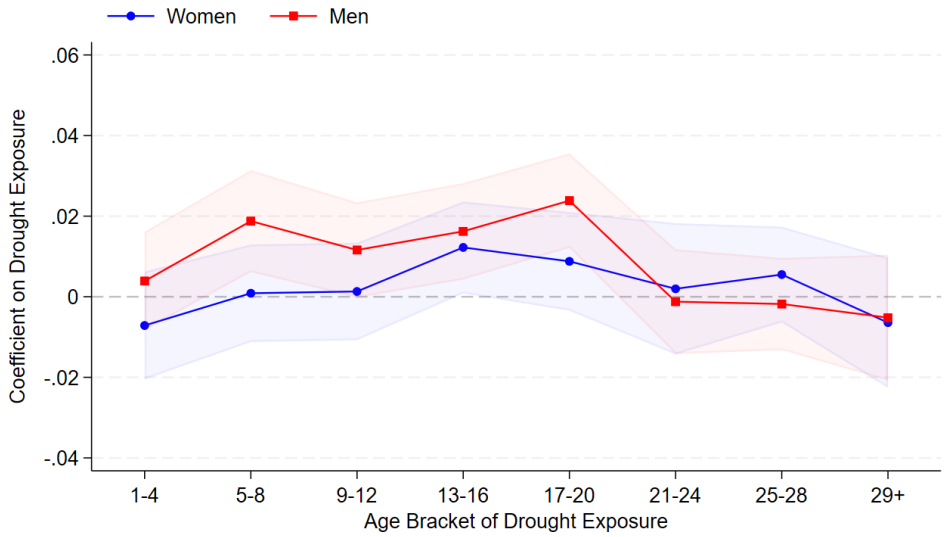
Table B4: Impact of Droughts on Religiousness and Group Membership

	Dependent Variable:					
	Religious		Member		Active Member	
	(1)	(2)	(3)	(4)	(5)	(6)
$Avg_o(Exp)$	0.016**		0.017		0.016	
	(0.007)		(0.013)		(0.011)	
$Avg(Exp_{1-4,o})$		0.003		−0.009		−0.010**
		(0.002)		(0.006)		(0.005)
$Avg(Exp_{5-8,o})$		0.002		0.006		0.009
		(0.002)		(0.006)		(0.006)
$Avg(Exp_{9-12,o})$		0.004		−0.001		−0.003
		(0.003)		(0.006)		(0.006)
$Avg(Exp_{13-16,o})$		0.001		0.010*		0.015**
		(0.002)		(0.006)		(0.007)
$Avg(Exp_{17-20,o})$		0.005***		0.014**		0.004
		(0.002)		(0.006)		(0.005)
$Avg(Exp_{21-24,o})$		−0.000		0.002		−0.001
		(0.002)		(0.007)		(0.006)
$Avg(Exp_{25-28,o})$		0.001		0.006		0.012*
		(0.002)		(0.007)		(0.006)
$Avg(Exp_{29+})$		0.006*		−0.011		−0.004
		(0.004)		(0.007)		(0.008)
L x Y FE	Y	Y	Y	Y	Y	Y
C x Y x YOB FE	Y	Y	Y	Y	Y	Y
Observations	113,540	113,540	113,540	113,540	113,540	113,540
Num Localities	452	452	452	452	452	452
Num Countries	34	34	34	34	34	34
Adj R^2	0.070	0.070	0.197	0.197	0.181	0.181
Outcome Mean	0.967	0.967	0.482	0.482	0.327	0.327
Outcome SD	0.178	0.178	0.500	0.500	0.469	0.469

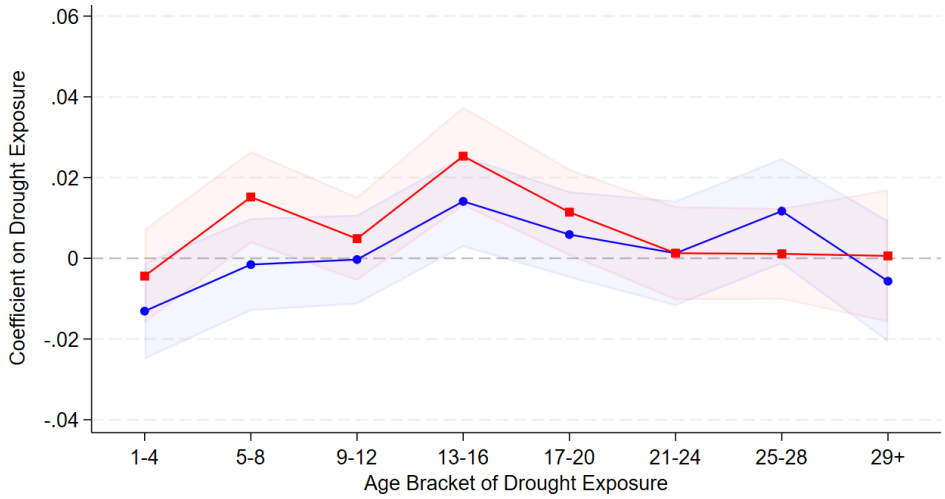
Notes: Standard errors clustered by Country-Year in parentheses. L represents *Location*, Y represents *Year*, C represents *Country*, and YOB represents Year of Birth. Controlling for gender, education level, rural/urban, and employment status. Controlling for reported religion in (3) through (6), and sample restricted to only those who report being religious. *Religious* takes a value of 1 if the individual reports being religious and 0 otherwise. *Member* takes a value of 1 if the individual reports being a member of a religious group and 0 otherwise. *Active Member* takes a value of 1 if the individual reports being an active member of a religious group and 0 otherwise. Drought exposure measure obtained using average exposure of Ethnic group using Murdock data when available and matched, and based on Afrobarometer location when individual reports no ethnic group or match unavailable. Restricted to sample of main results. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.5. Droughts and Religiousness: Heterogeneity by Gender

Figure B1: Gender Heterogeneity in Effects of Drought Exposure by Age Bracket



(a) Marginal Effects on Membership

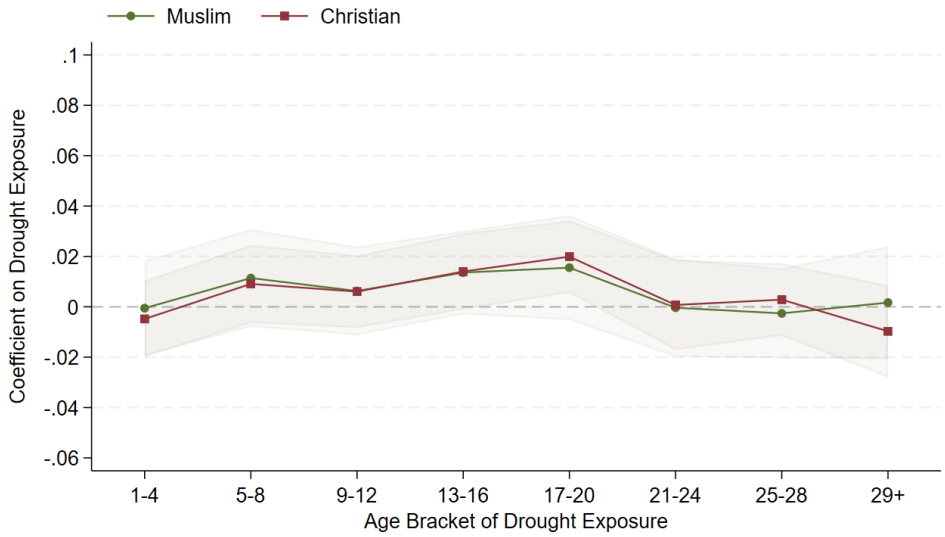


(b) Marginal Effects on Active Membership

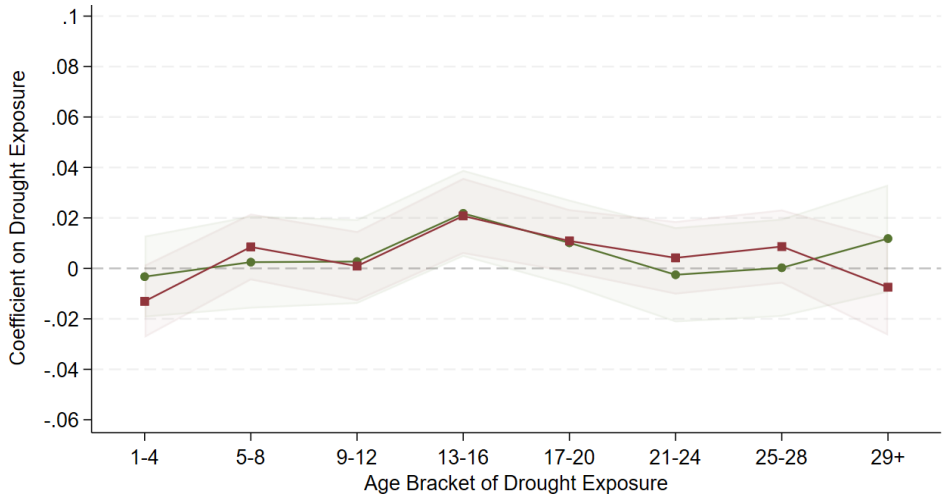
Notes: Estimation of Equation (1) with gender interactions. Shaded area represents 90% confidence intervals.

B.6. Droughts and Religiousness: Heterogeneity by Religion

Figure B2: Gender Heterogeneity in Effects of Drought Exposure by Age Bracket



(a) Marginal Effects on Membership



(b) Marginal Effects on Active Membership

Notes: Estimation of Equation (1) with Religion interactions. Shaded area represents 90% confidence intervals.

B.7. Droughts and Religiousness: Heterogeneity Summary

Table B5: Impact of Droughts on Religious Group Membership

	Gender			Religion				
	Women	Men		Muslim	Christian	Other		
	(1)	(2)	(1) vs (2)	(3)	(4)	(5)	(3) vs (4)	(3) vs (5)
1-4	−0.007	0.004	0.079	−0.001	−0.005	0.039**	0.646	0.025
	(0.008)	(0.007)		(0.010)	(0.008)	(0.017)		
5-8	0.001	0.019**	0.002	0.011	0.009	0.036**	0.829	0.204
	(0.007)	(0.008)		(0.010)	(0.008)	(0.018)		
9-12	0.001	0.012	0.096	0.006	0.006	0.029*	0.976	0.153
	(0.007)	(0.007)		(0.009)	(0.007)	(0.016)		
13-16	0.012*	0.016**	0.527	0.014	0.014*	0.043***	0.964	0.075
	(0.007)	(0.007)		(0.008)	(0.008)	(0.015)		
17-20	0.009	0.024***	0.010	0.016	0.020***	0.019	0.684	0.856
	(0.007)	(0.007)		(0.011)	(0.007)	(0.016)		
21-24	0.002	−0.001	0.550	−0.000	0.001	0.016	0.895	0.239
	(0.010)	(0.008)		(0.010)	(0.009)	(0.016)		
25-28	0.006	−0.002	0.186	−0.003	0.003	0.011	0.521	0.251
	(0.007)	(0.007)		(0.009)	(0.007)	(0.011)		
29+	−0.006	−0.005	0.766	0.002	−0.010	0.006	0.072	0.704
	(0.010)	(0.009)		(0.011)	(0.009)	(0.014)		
L x Y FE	Y	Y	Y	Y	Y	Y	Y	Y
C x Y x YOB FE	Y	Y	Y	Y	Y	Y	Y	Y

Notes: Standard errors clustered by Country-Year in parentheses. L represents *Location*, Y represents *Year*, C represents *Country*, and YOB represents Year of Birth. Controlling for gender, education level, rural/urban, and employment status. Controlling for reported religion in (3) through (6), and sample restricted to only those who report being religious. *Religious* takes a value of 1 if the individual reports being religious and 0 otherwise. *Member* takes a value of 1 if the individual reports being a member of a religious group and 0 otherwise. *Active Member* takes a value of 1 if the individual reports being an active member of a religious group and 0 otherwise. Drought exposure measure obtained using average exposure of Ethnic group using Murdock data when available and matched, and based on Afrobarometer location when individual reports no ethnic group or match unavailable. Restricted to sample of main results. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B6: Impact of Droughts on Religious Group Active Membership

	Gender			Religion				
	Women	Men		Muslim	Christian	Other		
	(1)	(2)	(1) vs (2)	(3)	(4)	(5)	(3) vs (4)	(3) vs (5)
1-4	−0.013*	−0.004	0.159	−0.003	−0.013*	0.015	0.231	0.199
	(0.007)	(0.007)		(0.008)	(0.007)	(0.015)		
5-8	−0.002	0.015**	0.002	0.002	0.008	0.003	0.505	0.946
	(0.007)	(0.007)		(0.009)	(0.007)	(0.015)		
9-12	−0.000	0.005	0.318	0.003	0.001	0.014	0.822	0.458
	(0.007)	(0.006)		(0.009)	(0.007)	(0.015)		
13-16	0.014**	0.025***	0.078	0.022**	0.021***	0.006	0.913	0.270
	(0.007)	(0.007)		(0.009)	(0.008)	(0.013)		
17-20	0.006	0.011*	0.338	0.010	0.011*	0.015	0.931	0.741
	(0.007)	(0.007)		(0.009)	(0.006)	(0.014)		
21-24	0.001	0.001	0.998	−0.003	0.004	0.009	0.456	0.326
	(0.008)	(0.007)		(0.010)	(0.007)	(0.013)		
25-28	0.012	0.001	0.046	0.000	0.009	0.008	0.323	0.421
	(0.008)	(0.007)		(0.010)	(0.007)	(0.012)		
29+	−0.006	0.001	0.113	0.012	−0.007	0.007	0.000	0.614
	(0.009)	(0.010)		(0.011)	(0.010)	(0.014)		
L x Y FE	Y	Y	Y	Y	Y	Y	Y	Y
C x Y x YOB FE	Y	Y	Y	Y	Y	Y	Y	Y

Notes: Standard errors clustered by Country-Year in parentheses. L represents *Location*, Y represents *Year*, C represents *Country*, and YOB represents Year of Birth. Controlling for gender, education level, rural/urban, and employment status. Controlling for reported religion in (3) through (6), and sample restricted to only those who report being religious. *Religious* takes a value of 1 if the individual reports being religious and 0 otherwise. *Member* takes a value of 1 if the individual reports being a member of a religious group and 0 otherwise. *Active Member* takes a value of 1 if the individual reports being an active member of a religious group and 0 otherwise. Drought exposure measure obtained using average exposure of Ethnic group using Murdock data when available and matched, and based on Afrobarometer location when individual reports no ethnic group or match unavailable. Restricted to sample of main results. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.8. Mechanisms and other Outcomes

B.8.1. Education Results

Table B7: Impact of Droughts on Education

	Dependent Variable:					
	Formal Education		Secondary		Post Secondary	
	(1)	(2)	(3)	(4)	(5)	(6)
$Avg(Exp)$	0.062*		−0.022		0.028	
	(0.032)		(0.038)		(0.039)	
$Avg(Exp_{1-4})$		−0.003		−0.002		0.005
		(0.006)		(0.006)		(0.005)
$Avg(Exp_{5-8})$		−0.005		0.003		−0.002
		(0.005)		(0.008)		(0.006)
$Avg(Exp_{9-12})$		0.001		−0.002		0.003
		(0.005)		(0.006)		(0.006)
$Avg(Exp_{13-16})$		0.002		−0.008		0.005
		(0.005)		(0.006)		(0.006)
$Avg(Exp_{17-20})$		0.011***		0.012**		0.003
		(0.004)		(0.006)		(0.006)
$Avg(Exp_{21-24})$		0.001		0.002		0.008
		(0.005)		(0.008)		(0.005)
$Avg(Exp_{25-28})$		−0.004		0.005		0.006
		(0.004)		(0.006)		(0.005)
$Avg(Exp_{29+})$		−0.021**		0.009		0.008
		(0.009)		(0.011)		(0.008)
L x Y FE	Y	Y	Y	Y	Y	Y
C x Y x YOB FE	Y	Y	Y	Y	Y	Y
Observations	113,540	113,540	113,540	113,540	113,540	113,540
Num Localities	452	452	452	452	452	452
Num Countries	34	34	34	34	34	34
Adj R^2	0.343	0.343	0.173	0.173	0.157	0.157
Outcome Mean	0.824	0.824	0.371	0.371	0.144	0.144
Outcome SD	0.381	0.381	0.483	0.483	0.351	0.351

Notes: Standard errors clustered by Country-Year in parentheses. L represents *Location*, Y represents *Year*, C represents *Country*, and YOB represents Year of Birth. Controlling for gender, education level, rural/urban, and employment status. Controlling for reported religion in (3) through (6), and sample restricted to only those who report being religious. *Religious* takes a value of 1 if the individual reports being religious and 0 otherwise. *Member* takes a value of 1 if the individual reports being a member of a religious group and 0 otherwise. *Active Member* takes a value of 1 if the individual reports being an active member of a religious group and 0 otherwise. Drought exposure measure obtained using average exposure of Ethnic group using Murdock data when available and matched, and based on Afrobarometer location when individual reports no ethnic group or match unavailable. This process leads to additional individuals without missing observations in drought exposure, hence the larger sample. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.8.2. Occupation Results

Table B8: Impact of Droughts on Occupation

	Dependent Variable:				
	Agriculture	Manual Labor	Services & Trade	Professional & Managerial	Other
	(1)	(2)	(3)	(4)	(5)
$Avg(Exp_{1-4})$	0.002	−0.007	0.004	−0.003	0.003
	(0.008)	(0.007)	(0.008)	(0.005)	(0.004)
$Avg(Exp_{5-8})$	0.005	0.004	−0.008	−0.002	0.002
	(0.007)	(0.007)	(0.007)	(0.006)	(0.005)
$Avg(Exp_{9-12})$	−0.003	−0.004	0.003	0.003	0.000
	(0.007)	(0.008)	(0.007)	(0.006)	(0.004)
$Avg(Exp_{13-16})$	0.014*	−0.014*	−0.001	−0.005	0.007
	(0.008)	(0.008)	(0.007)	(0.005)	(0.005)
$Avg(Exp_{17-20})$	0.005	−0.005	−0.008	−0.004	0.012*
	(0.008)	(0.009)	(0.009)	(0.006)	(0.006)
$Avg(Exp_{21-24})$	0.019**	−0.007	−0.011	−0.002	0.001
	(0.008)	(0.008)	(0.008)	(0.006)	(0.005)
$Avg(Exp_{25-28})$	0.003	−0.011	−0.000	0.006	0.003
	(0.009)	(0.008)	(0.009)	(0.006)	(0.004)
$Avg(Exp_{29+})$	0.033**	0.004	−0.025**	−0.011	0.001
	(0.014)	(0.013)	(0.011)	(0.010)	(0.008)
L x Y FE	Y	Y	Y	Y	Y
C x Y x YOB FE	Y	Y	Y	Y	Y
Observations	53,192	53,192	53,192	53,192	53,192
Num Localities	452	452	452	452	452
Num Countries	34	34	34	34	34
Adj R^2	0.404	0.175	0.102	0.383	0.074
Outcome Mean	0.330	0.239	0.224	0.152	0.056
Outcome SD	0.470	0.426	0.417	0.359	0.229

Notes: Standard errors clustered by Country-Year in parentheses. L represents *Location*, Y represents *Year*, C represents *Country*, and YOB represents Year of Birth. Controlling for gender, education level, rural/urban, and employment status. Controlling for reported religion in (3) through (6), and sample restricted to only those who report being religious. *Religious* takes a value of 1 if the individual reports being religious and 0 otherwise. *Member* takes a value of 1 if the individual reports being a member of a religious group and 0 otherwise. *Active Member* takes a value of 1 if the individual reports being an active member of a religious group and 0 otherwise. Drought exposure measure obtained using average exposure of Ethnic group using Murdock data when available and matched, and based on Afrobarometer location when individual reports no ethnic group or match unavailable. This process leads to additional individuals without missing observations in drought exposure, hence the larger sample. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.8.3. Economic Conditions Results

Table B9: Impact of Droughts on Lack of Access to Resources

	Dependent Variable:				
	Food	Water	Medical	Fuel	Cash
	(1)	(2)	(3)	(4)	(5)
$Avg(Exp_{1-4})$	0.005	0.006	0.003	−0.016	0.020
	(0.014)	(0.016)	(0.017)	(0.016)	(0.016)
$Avg(Exp_{5-8})$	0.013	0.004	−0.010	0.002	−0.008
	(0.015)	(0.020)	(0.017)	(0.017)	(0.014)
$Avg(Exp_{9-12})$	−0.004	−0.013	−0.006	0.009	0.010
	(0.016)	(0.017)	(0.017)	(0.015)	(0.017)
$Avg(Exp_{13-16})$	−0.007	−0.007	−0.008	−0.026	−0.017
	(0.016)	(0.019)	(0.018)	(0.016)	(0.019)
$Avg(Exp_{17-20})$	−0.013	−0.018	−0.000	−0.021	0.006
	(0.015)	(0.018)	(0.019)	(0.013)	(0.016)
$Avg(Exp_{21-24})$	−0.011	−0.032	0.001	0.009	0.003
	(0.015)	(0.023)	(0.018)	(0.014)	(0.016)
$Avg(Exp_{25-28})$	−0.009	−0.005	−0.005	−0.005	−0.030
	(0.016)	(0.022)	(0.017)	(0.014)	(0.019)
$Avg(Exp_{29+})$	−0.005	−0.039	0.001	−0.044*	0.049*
	(0.021)	(0.028)	(0.023)	(0.024)	(0.027)
L x Y FE	Y	Y	Y	Y	Y
C x Y x YOB FE	Y	Y	Y	Y	Y
Observations	113,360	113,354	113,083	113,108	113,168
Num Localities	452	452	452	452	452
Num Countries	34	34	34	34	34
Adj R^2	0.201	0.181	0.197	0.156	0.307
Outcome Mean	1.987	2.124	2.107	1.787	2.974
Outcome SD	1.187	1.372	1.260	1.139	1.378

Notes: Standard errors clustered by Country-Year in parentheses. L represents *Location*, Y represents *Year*, C represents *Country*, and YOB represents Year of Birth. Controlling for gender, education level, rural/urban, and employment status. Controlling for reported religion in (3) through (6), and sample restricted to only those who report being religious. *Religious* takes a value of 1 if the individual reports being religious and 0 otherwise. *Member* takes a value of 1 if the individual reports being a member of a religious group and 0 otherwise. *Active Member* takes a value of 1 if the individual reports being an active member of a religious group and 0 otherwise. Drought exposure measure obtained using average exposure of Ethnic group using Murdock data when available and matched, and based on Afrobarometer location when individual reports no ethnic group or match unavailable. This process leads to additional individuals without missing observations in drought exposure, hence the larger sample. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.8.4. Religion Results

Table B10: Impact of Droughts on Religion Choice

	Dependent Variable:			
	Christian	Protestant	Seventh-Day Adventist	Pentecostal
	(1)	(2)	(3)	(4)
$Avg(Exp_{1-4})$	−0.001	−0.000	0.003	−0.003
	(0.004)	(0.005)	(0.002)	(0.003)
$Avg(Exp_{5-8})$	0.001	0.016***	0.000	0.001
	(0.005)	(0.005)	(0.002)	(0.003)
$Avg(Exp_{9-12})$	−0.008	−0.010*	−0.000	−0.000
	(0.006)	(0.006)	(0.002)	(0.003)
$Avg(Exp_{13-16})$	0.005	0.004	0.002	0.001
	(0.005)	(0.005)	(0.002)	(0.004)
$Avg(Exp_{17-20})$	0.009**	0.003	−0.002	−0.005
	(0.005)	(0.007)	(0.002)	(0.003)
$Avg(Exp_{21-24})$	0.001	0.000	0.001	−0.003
	(0.005)	(0.005)	(0.002)	(0.004)
$Avg(Exp_{25-28})$	−0.000	−0.002	0.005**	−0.004
	(0.005)	(0.007)	(0.002)	(0.004)
$Avg(Exp_{29+})$	0.008	0.002	0.001	−0.007
	(0.009)	(0.010)	(0.004)	(0.004)
L x Y FE	Y	Y	Y	Y
C x Y x YOB FE	Y	Y	Y	Y
Observations	113,540	113,540	113,540	113,540
Num Localities	452	452	452	452
Num Countries	34	34	34	34
Adj R^2	0.524	0.287	0.102	0.095
Outcome Mean	0.622	0.404	0.021	0.062
Outcome SD	0.485	0.491	0.142	0.242

Notes: Standard errors clustered by Country-Year in parentheses. L represents *Location*, Y represents *Year*, C represents *Country*, and YOB represents Year of Birth. Controlling for gender, education level, rural/urban, and employment status. Controlling for reported religion in (3) through (6), and sample restricted to only those who report being religious. *Religious* takes a value of 1 if the individual reports being religious and 0 otherwise. *Member* takes a value of 1 if the individual reports being a member of a religious group and 0 otherwise. *Active Member* takes a value of 1 if the individual reports being an active member of a religious group and 0 otherwise. Drought exposure measure obtained using average exposure of Ethnic group using Murdock data when available and matched, and based on Afrobarometer location when individual reports no ethnic group or match unavailable. This process leads to additional individuals without missing observations in drought exposure, hence the larger sample. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.8.5. Political Results

Table B11: Impact of Droughts on Institutional Trust

	Dependent Variable:			
	Electoral Comission	Local Government	Opposition Parties	Police
	(1)	(2)	(3)	(4)
$Avg(Exp_{1-4})$	−0.016	−0.021	−0.006	−0.006
	(0.013)	(0.013)	(0.015)	(0.013)
$Avg(Exp_{5-8})$	−0.024	−0.003	−0.013	0.019
	(0.015)	(0.013)	(0.016)	(0.015)
$Avg(Exp_{9-12})$	0.008	0.007	−0.001	0.018
	(0.014)	(0.013)	(0.016)	(0.013)
$Avg(Exp_{13-16})$	0.005	−0.013	0.035**	0.001
	(0.015)	(0.016)	(0.014)	(0.015)
$Avg(Exp_{17-20})$	0.016	0.037**	0.008	0.032**
	(0.014)	(0.014)	(0.013)	(0.014)
$Avg(Exp_{21-24})$	−0.002	0.017	0.014	0.009
	(0.013)	(0.015)	(0.013)	(0.015)
$Avg(Exp_{25-28})$	0.017	0.013	−0.032**	0.015
	(0.017)	(0.014)	(0.014)	(0.017)
$Avg(Exp_{29+})$	−0.031*	0.006	−0.005	0.047*
	(0.018)	(0.020)	(0.022)	(0.024)
L x Y FE	Y	Y	Y	Y
C x Y x YOB FE	Y	Y	Y	Y
Observations	104,486	105,236	104,124	111,480
Num Localities	452	452	448	452
Num Countries	34	34	33	34
Adj R^2	0.172	0.156	0.100	0.173
Outcome Mean	2.559	2.489	2.200	2.537
Outcome SD	1.119	1.075	1.053	1.122

Notes: Standard errors clustered by Country-Year in parentheses. L represents *Location*, Y represents *Year*, C represents *Country*, and YOB represents Year of Birth. Controlling for gender, education level, rural/urban, and employment status. Controlling for reported religion in (3) through (6), and sample restricted to only those who report being religious. *Religious* takes a value of 1 if the individual reports being religious and 0 otherwise. *Member* takes a value of 1 if the individual reports being a member of a religious group and 0 otherwise. *Active Member* takes a value of 1 if the individual reports being an active member of a religious group and 0 otherwise. Drought exposure measure obtained using average exposure of Ethnic group using Murdock data when available and matched, and based on Afrobarometer location when individual reports no ethnic group or match unavailable. This process leads to additional individuals without missing observations in drought exposure, hence the larger sample. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.