

The Price of Faith: Economic Costs and Religious Adaptation in Sub-Saharan Africa*

Eduardo Montero, Dean Yang, and Triana Yentzen

17 January 2025

Abstract

How do economic costs affect religious choices, and how do religious institutions adapt to economic realities? We study the Seventh-Day Adventist (SDA) church in Sub-Saharan Africa, which prohibits production of tobacco, coffee, and tea, creating salient opportunity costs for potential members in areas suitable for these crops. We construct a measure of SDA membership opportunity cost that varies over time and space based on local crop suitability and global prices. Using church administrative data and member surveys, we find that increased opportunity costs lead to lower membership growth and lower satisfaction with the church among existing members. The church responds by establishing new educational and health institutions and reducing emphasis on “healthy living” religious tenets. These findings reveal how religious organizations can show striking flexibility in balancing tradition and adaptation when faced with economic pressures. Our study provides new insights into the microeconomics of cultural change, as mediated by religious institutions.

JEL codes: D71, L31, O12, Z12

Keywords: Religion, Seventh-Day Adventist Church, Sub-Saharan Africa

*Montero: University of Chicago, NBER and BREAD (emontero@uchicago.edu); Yang: University of Michigan, NBER and BREAD (deanyang@umich.edu); Yentzen: University of Michigan (trianay@umich.edu). John Ahlin, Bobby Beckemeyer, Nick Martens, and Edgar Zhu provided exemplary research assistance. We appreciate the collaboration of the Archives, Statistics, and Research Department of the World Headquarters of the Seventh-day Adventists, in particular Dr. David Trim and Ashlee Chism. We are thankful for feedback from Michal Bauer, Sascha Becker, Zach Brown, Paula Bustos, Kevin Carney, Julie Chytilova, Bruno Conte, Jorge Garcia Hombrados, Libertad Gonzalez, Marco Gonzalez-Navarro, Jennifer Graves, Andre Gröger, Vasily Korovkin, Marcel Jansen, Stepan Jurajda, Gianmarco Leon, Etienne LeRossignol, Sharon Maccini, Nikolas Mittag, Daniel Nagy, Ana Nuevo-Chiquero, Nathan Nunn, Sebastian Ottinger, Aneesha Parvathaneni, Jean-Philippe Platteau, Giacomo Ponzetto, Rocio Sanchez Mangas, Paul Seabright, Clara Sievert, Jan Svejnar, Jon Weigel, Paolo Zacchia, and Eugenio Zucchelli, and from seminar participants at U. Autònoma Barcelona, U. Autònoma Madrid, U. British Columbia, U. California Berkeley, CERGE-EI, U. Göttingen, U. Michigan, U. Namur, PUC-Chile, U. Pompeu Fabra, Paris School of Economics, and Toulouse School of Economics. We are grateful for a University of Michigan Economics Department MITRE Research Grant. Dean Yang appreciates funding from Spain’s State Research Agency under the Maria de Maetzu Unit of Excellence Program (project CEX2020-001104-M.)

1. Introduction

Religious institutions play a major role in shaping economic behaviors, social norms, and development outcomes worldwide (Iyer, 2016; Becker et al., 2023; Seabright, 2024). When individuals consider joining religious groups, they often face explicit trade-offs between economic opportunities and religious participation. Consider a tobacco farmer in central Malawi – call her Sarah – who is drawn to joining her local Seventh-Day Adventist (SDA) church. The SDA church has a distinctive emphasis on healthy living, and prohibits members from producing tobacco. Sarah thus faces a stark choice: either give up tobacco production to join the church, or maintain her primary source of income but forgo the spiritual and social benefits of church membership. Her dilemma is particularly acute in times of high tobacco prices.

The local SDA church in central Malawi faces its own challenges. While its doctrine emphasizes healthy living and prohibits tobacco production, many potential members in the area, like Sarah, are tobacco farmers. The church must balance its religious principles with the practical reality that these prohibitions limit membership growth, especially when tobacco prices are high. The church could respond in various ways to enhance its appeal in this challenging environment: expand its evangelization efforts in other ways, create additional benefits to offset the opportunity costs of giving up tobacco, and possibly loosen its doctrinal emphasis on healthy living.

This example illustrates our paper’s central questions: How do economic costs influence individuals’ religious choices? And how do religious institutions adapt to local economic realities? Can religious institutions find ways to accommodate members’ opportunity costs without compromising their core beliefs?

We study these questions in the context of the SDA church in Sub-Saharan Africa. The region is an attractive context for our investigation, with a high prevalence of both Christian and Muslim religions and traditional religions, and substantial recent changes over time in religious composition. Sub-Saharan Africa also likely has greater sensitivity to crop price shocks than other areas of the world, giving us greater statistical power to detect effects of variation in opportunity costs.

Studying the causal impact of opportunity costs on religious group membership presents significant methodological challenges. The first challenge is simply *measurement*: the opportunity costs of membership in a particular religious group can often be difficult to quantify. In addition, there are pervasive threats to causal identification. There may be *reverse causation*: changes in religious group membership may cause changes in the opportunity costs of membership. For example, a religious group facing an exogenous negative shock to its membership numbers may respond by loosening occupational or other restrictions so as to lower the opportunity costs of membership (leading to an up-

ward bias in the association between opportunity costs and membership counts). *Omitted variable bias* is also a serious concern: third factors may determine both opportunity costs and religious group membership. For example, economic development may change opportunity costs of having to avoid certain occupations (e.g., in agriculture), and also change religious group membership (with unclear direction of bias).

We study the impact of opportunity costs on religious group membership in a context that allows us to address challenges in measurement as well as causal identification. We study one of the world's fastest-growing religions, the Seventh-Day Adventist (SDA) church, in Sub-Saharan Africa. The SDA church places heavy emphasis on healthy living, and thus prohibits or strongly discourages production of tobacco, coffee, and tea. The opportunity cost of joining the SDA church due to these production prohibitions varies over space (owing to variability in the suitability of land for these crops) and over time (as export prices of these "prohibited" crops change). We exploit temporal price variation and spatial crop-suitability variation to construct a time-varying and local measure of the opportunity cost of SDA membership in Sub-Saharan Africa.

The key right-hand-side (causal) variable in our analyses is a quantitative measure, in money terms, of the opportunity cost of membership in the SDA church in a particular location. The opportunity cost variable is the annual revenue given up per hectare from following SDA prohibitions on the production of tobacco, coffee, and tea. We construct this measure at a fine-grained level (9 km by 9 km grid cells) using (time-invariant) data from FAO GAEZ on potential crop yields as well as FAO data on (time-varying, annual) export crop prices. The measure accounts for potential yields and prices for dozens of crops, and is the difference between "unconstrained" maximized revenue on a grid cell and "constrained" maximized revenue if one follows SDA prohibitions and avoids producing tobacco, coffee, or tea. For every grid cell in Sub-Saharan Africa, in each of 32 years from 1991 to 2022, we calculate the opportunity cost of SDA membership. We then take the mean across grid cells for localities for which we have SDA membership data, year by year; this results in a measure of the opportunity cost of membership that varies over space and time (i.e., at the locality-year level).

We conduct empirical analyses with annual outcome data (from 1991-2022) at the level of sub-national localities for which the SDA provides public data on their membership counts, and other local-level statistics such as establishment of education and health institutions. The SDA church also made available to us the microdata of a survey of SDA members which we use to examine members' self-reported religious attitudes and behaviors in a country-level panel from 2017 to 2022.

Our empirical analyses involve running panel regressions on annual data at the level of localities in Sub-Saharan Africa. Our opportunity cost measure – agricultural revenue given up per hectare from following SDA crop production prohibitions – is

constructed from time-invariant geographic and climate characteristics combined with time-varying regional export prices, and so is immune from reverse causality concerns (i.e., SDA membership counts cannot plausibly affect the opportunity cost variable). The key identification assumption is that the opportunity cost measure is uncorrelated with omitted variables that may also affect local membership counts. The main concern on this front is that the opportunity cost measure is correlated with local income, particularly in areas suitable for tobacco, coffee, or tea production. If shocks to income in general affect religious group membership, this would confound our interpretation of the opportunity cost variable. We gauge the importance of this concern by including in the regression a measure of *unconstrained* maximized income at the local level, whose variation is driven by crop suitability and crop prices across *all* crops. SDA membership growth is unaffected by this variable, and the coefficient on our opportunity cost variable is also unaffected by inclusion of the unconstrained income variable. We conclude that our opportunity cost measure is not capturing effects of general income shocks, but instead should be narrowly interpreted as the impact of prohibitions from growing SDA-prohibited crops (tobacco, coffee, and tea).

We find that increases in opportunity costs lead to declines in new memberships in the SDA church. The effect is substantial in magnitude. In periods of non-zero opportunity costs, net membership growth falls by 10.4 percentage points on average, with the decline reaching 19.3 percentage points in periods when opportunity costs are in the top quartile (of the non-zero opportunity cost distribution). In addition, remaining SDA members increasingly question their membership in the church: when the economic costs of membership rise, members report less satisfaction with and less long-run commitment to the church in the SDA's own member surveys.

We then consider local SDA church responses to increases in local opportunity costs. First, we find that increases in opportunity costs lead to establishment of new educational and health institutions. Establishing such institutions may facilitate efforts to acquire new members.¹ Adventist-run education and health institutions may also be differentially attractive to members (compared to the general public), so such institutions may generate new and local benefits of membership, offsetting at least part of the increased opportunity costs of membership.

In addition, the church also responds to the increased opportunity costs by reducing the emphasis placed on the church's healthy-living prescriptions, which undergirds the prohibition on coffee, tobacco, and tea. We find that when opportunity costs rise, SDA members report hearing fewer messages about the church's "holistic living" (healthy living) prescriptions from church pastors. What's more, and strikingly, increases in

¹The SDA church – like many religions – considers education and health institutions to be fruitful contexts for evangelization (Chism et al., 2021).

opportunity costs lead to more violations of the church's prescriptions on healthy living – namely, more consumption of alcohol and tobacco. These findings provide evidence that the church responds to higher opportunity costs by reducing the emphasis on religious prohibitions that cause those opportunity costs to begin with.

Our findings shed new light on the economics of religion in an important region of the world where religious change is substantial and ongoing. Individuals take opportunity costs of membership into account when deciding whether to join a new religion. Existing members experience increased dissatisfaction with their religion in response to the same increase in opportunity cost. At the same time, churches do not remain complacent, and respond dynamically to increases in opportunity costs by providing offsetting benefits and possibly reducing emphasis on the religious prescriptions that are the source of the opportunity costs in the first place. All of these results are new in the context of the prior literature on the economics of religion.

Our findings contribute to understanding how religious organizations balance tradition and adaptation in response to economic conditions. Religious institutions are important entities shaping social norms, both for their members and in broader society. When individuals join religious groups, they typically shift their values and norms to those of the group. However, religious institutions can also change their moral prescriptions, which then influences the norms followed by their members. By studying the microeconomics of social norm change within a religious institution, we reveal an important mechanism through which social norms change more broadly.

While the literature on cultural evolution emphasizes that culture evolves in response to environmental conditions (Boyd and Richerson, 1985; Henrich, 2015), much recent work stresses that cultural norms are highly persistent and evolve slowly (Giuliano and Nunn, 2020). Our findings complement broader work on religious adaptation to economic and political conditions (Platteau, 2008, 2017). While this literature has typically focused on longer-term doctrinal evolution, we document more rapid and high-frequency adjustments by local religious institutions in response to short-run changes in economic incentives. The flexibility and adaptability we document may be key to understanding the success of today's rapidly-growing religions.

The SDA church is certainly not representative of all religious groups. We study it precisely because it has been so successful in terms of membership growth, and its flexibility and adaptability could be key factors in this success. Understanding the strategies of fast-growing groups like the Adventists is crucial for comprehending religious and cultural change, analogous to studying rapidly-growing firms to understand the microeconomics behind their success. Just as studies of successful firms have revealed key insights about market competition, productivity growth, and organizational adaptation (Foster et al., 2001; Hsieh and Klenow, 2014; Bloom et al., 2013), examining

fast-growing religious groups can illuminate underlying mechanisms of institutional and cultural change. Moreover, studying organizations during periods of rapid growth provides unique insights into adaptation and innovation that may not be visible when studying more stable incumbents (Christensen, 1997). As groups like the Adventists see differential growth in coming decades, the adaptability we document could become more widespread among religious groups.

More generally, the SDA church is not unusual in having precepts that impose opportunity costs on its members. Such opportunity costs are widespread across religions. For example, religions can prescribe the types of occupations in which adherents can and cannot work. Examples include the prohibition on usury in the early Christian church (Ihssen, 2012; Visser and McIntosh, 1998), as well as Hindu caste-based occupational prescriptions (Goghari and Kusi, 2023). In addition, they may prohibit consumption as well as production of certain foods, for example in Islamic *halal* (El-Zibdeh, 2009) and Jewish *kashrut* (Forst, 1993) dietary rules. These and other prohibitions impose opportunity costs (e.g., lost income from prohibited occupations, as well as non-monetary costs) on members of religious groups.

Our work is related to a body of research on the economics of religion (see Iyer, 2016; Becker et al., 2021, 2023; Seabright, 2024, for reviews). First, our work relates to studies of determinants of religious group membership and adherence. Prior work has explored how economic conditions and shocks influence religious adherence (e.g., Barro and McCleary, 2003; Chen, 2003; Henrich et al., 2010; Durlauf et al., 2012; Ager and Ciccone, 2018; Bentzen, 2019a,b; Auriol et al., 2020; Algan et al., 2022; Dube et al., 2022; Pope, 2024; Alfonsi et al., 2024; Corbi and Sanches, 2024; Hersey, 2024). In this paper, we examine how specific economic conditions – the opportunity costs of religious prohibitions – influence adherence and conversion in Sub-Saharan Africa.²

Our work also builds on economic analyses of religious prohibitions and organizational adaptation (Iannaccone, 1992; Berman, 2000; Berman and Iannaccone, 2006). While this literature has emphasized how religious restrictions can serve as screening devices and commitment mechanisms, we show how religious organizations actively adjust these restrictions in response to economic conditions.

Our finding that higher opportunity costs reduce member satisfaction and commitment challenges standard club goods models of religion (Iannaccone, 1992; Berman, 2000). These models predict that costly religious prohibitions should enhance member satisfaction by screening out less committed members and fostering greater participation among those remaining (Iannaccone, 1992). In some contexts, religious groups might strategically increase restrictions to enhance member commitment (Berman and Iannac-

²More broadly, our study also contributes to work on the religious landscape in sub-Saharan Africa (e.g., Nunn, 2010; Alesina et al., 2020; Le Rossignol et al., 2022).

cone, 2006). In contrast, we find that when economic costs of membership rise, even committed (remaining) members experience reduced satisfaction with and commitment to their church. This suggests important limits to the club goods framework, particularly in developing-country contexts where religious prohibitions can significantly impact members' economic livelihoods. Rather than operating purely as screening devices, the prohibitions we study appear to create genuine burdens for members.

Our paper also contributes to research on religious prescriptions and taboos (e.g., Iannaccone, 1992; Stifel et al., 2011; Levy and Razin, 2012, 2014; Campante and Yanagizawa-Drott, 2015). A related body of work has explored how religious prescriptions influence identity and religiosity (Iannaccone, 1992; Bénabou and Tirole, 2011; Chen, 2010; Atkin et al., 2021). We build on this work by providing new evidence revealing the causal impact of the opportunity cost of religious taboos – in our case, taboos on particular crops – on decisions to join a new religion, as well as on current members' attitudes and adherence to religious tenets.

Finally, we also contribute to the literature on the supply side of religion. Related work studies how economic conditions and religious market structure affect religious conversions and adherence (Iannaccone, 1991; Finke and Stark, 2005; Gruber and Hungerman, 2008; Barro et al., 2010; Hanson and Xiang, 2013; Hungerman, 2014; Caicedo et al., 2023; Barro and McCleary, 2024). Our paper is distinct in that we use detailed data on church actions such as the establishment of health and education institutions to study how economic costs influence the actions of the church. Our work is also novel in our examination of how a church's emphases on adherence to particular religious prescriptions – messages conveyed from the pulpit, as well as adherence by church members – change when the opportunity cost of those prescriptions changes.

This paper is organized as follows. In the next section, we provide an overview of recent trends in religion in Sub-Saharan Africa, as well as for the Seventh-Day Adventist Church in particular. Section 3 describes the data and Section 4 presents the empirical strategy. Section 5 presents our main results on the impact of the economic cost of membership on membership growth and church institutional responses, and also explores heterogeneity in impacts. Section 6 presents the results using surveys of SDA members to examine the impacts of changes in opportunity costs on SDA member satisfaction and commitment, and on adherence to religious tenets. Section 7 concludes.

2. Religion in Sub-Saharan Africa

The religious landscape of Africa has undergone significant transformations in recent decades, characterized by rapid growth and shifting denominational allegiances. Christianity and Islam, in particular, have seen substantial expansion across the continent,

often outpacing population growth (Zurlo, 2024). This religious boom has been especially pronounced in Sub-Saharan Africa, where Christianity has experienced remarkable growth since the mid-20th century (Jenkins, 2011). By 2020, nearly two-thirds of sub-Saharan Africans identified as Christian, making it one of the most Christian-populous regions in the world (Zurlo, 2024).

This religious expansion has been accompanied by a rise in the diversity of Christian denominations and movements across Africa. Pentecostal and Charismatic churches have seen particularly rapid growth, often blending traditional African spiritual practices with Christian theology (Anderson, 2013). Concurrently, many mainline Protestant denominations and the Catholic Church have also experienced significant growth, albeit at a slower pace (Jenkins, 2016). This religious fervor has not been limited to Christianity; Islam has also seen substantial growth in certain regions, particularly in West and East Africa (Hill, 2009). The dynamic religious environment has had profound implications for social, economic, and political spheres across the continent, influencing everything from voting patterns to economic behaviors and social norms (Ellis and Haar, 2007).

Within this dynamic religious landscape, the Seventh-Day Adventist (SDA) Church has emerged as one of the fastest-growing Christian denominations in Africa (Adogame et al., 2008; Llywelyn, 2022; University of Aberdeen, 2020). From its initial footholds established in the early 20th century, the SDA Church has expanded rapidly across the continent, with particularly strong growth in Eastern and Southern Africa (Höschele, 2007). This growth has occurred despite, or perhaps partly because of, the church's distinctive doctrines and lifestyle practices, which set it apart from many other Christian denominations in the region.

2.1. The Seventh-Day Adventist Church

The Seventh-Day Adventist Church, founded in 1863 in the United States, is a Protestant Christian denomination known for its emphasis on the Second Coming of Christ and observance of the Sabbath on Saturday (Land, 2005). Since its inception, the SDA Church has experienced significant global growth, becoming one of the fastest-growing Christian denominations worldwide. As of 2021, the church reports a global membership exceeding 21 million, with a substantial presence in Sub-Saharan Africa (Office of Archives, Statistics, and Research, 2022).

Central to SDA doctrine is the concept of holistic health and wellness, rooted in the belief that the human body is the temple of the Holy Spirit (General Conference of Seventh-day Adventists, 2024). This belief translates into a set of lifestyle practices and prohibitions that distinguish SDAs from many other Christian denominations. Among the most notable of these are strong discouragement of or prohibitions on the consump-

tion and production of tobacco, coffee, and tea (General Conference of Seventh-day Adventists, 2022).

The SDA Church strongly discourages the use of tobacco in any form, viewing it as harmful to health and incompatible with Christian stewardship of the body (General Conference of Seventh-day Adventists, 2022). This prohibition extends beyond personal use to include the cultivation and production of tobacco. Similarly, the church advises against the consumption of caffeinated beverages, particularly coffee and tea, citing concerns about their addictive properties and potential negative health effects (Wilson, 2017). While not as strictly enforced as the tobacco prohibition, many devout SDAs abstain from these beverages and their production (Brody, 1986).

These prohibitions have significant economic implications, especially in regions where tobacco, coffee, or tea are important cash crops (Prowse, 2013). In parts of Sub-Saharan Africa, where these crops are often crucial to local economies, the decision to join the SDA Church may represent a substantial economic sacrifice for individuals and communities. Despite these economic challenges, the SDA Church has seen rapid growth in Sub-Saharan Africa (Office of Archives, Statistics, and Research, 2019).

3. Data

We study the impact of opportunity costs of membership in the SDA Church on new memberships and on church actions in response. We also are interested in impacts on existing members' attitudes and adherence to religious tenets. Studying these questions requires assembling a range of datasets, many of which have not previously been used for research in economics.

3.1. Membership and Church Actions

We obtained data on membership in the SDA church from the SDA Office of Archives, Statistics, and Research (ASTR). The ASTR's public website offers a wealth of information, including official church publications and detailed datasets on the church's global presence, with data starting as early as 1863 for each available geographical area. Using the website's structure – which follows the church's organizational structure – we extracted yearly membership information at the lowest level of the SDA church's administrative divisions for each country.³ For the remainder of this paper, we will refer to these sub-national divisions of varying sizes as SDA *localities*. For each locality, the data contains counts of the stock and flow of membership, including the number of baptisms, new membership gains, transfers, and member deaths, among others, for each

³Appendix A.1.2 presents a detailed description of the SDA administrative structure.

year. Appendix Figure A1 displays an example of the web page for one locality, and Appendix Section A.1 provides definitions for each variable in the ASTR dataset.

The primary church membership outcome variables in our analyses below are 1) gains, 2) losses, and 3) net gains. Gains are defined as the total number of members added by all methods, including baptisms, former member baptisms, or professions of faith. Losses are defined as the total number of members removed from membership rolls, either by dropping membership or by being recorded as missing. Net gains are defined as gains minus losses.

The primary church response outcome variables in our analyses are the number of 1) churches and 2) health or education institutions. We obtained the first variable directly from the ASTR yearly statistics. Churches represent the total number of registered churches or “companies” (newer churches) for the locality in a given year.⁴

To obtain the counts of health and education institutions, we systematically digitized the SDA Yearbooks – a yearly publication of the central branch of the SDA that serves as a directory of the SDA’s organizational units and institutions (General Conference of Seventh-day Adventists, Archives, Statistics, and Research, 2023) – to extract the list of SDA institutions available year by year, using the listed addresses to geo-reference each institution and assign them to localities.

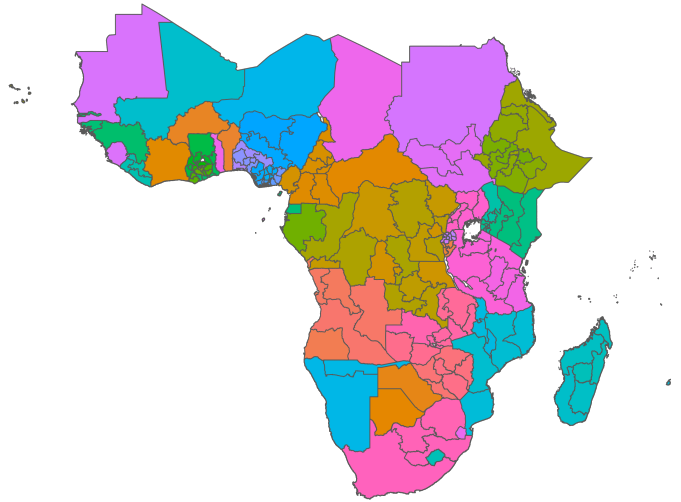
We focus on localities from 1991 onwards (through 2022 inclusive) due to completeness of data and widespread availability of data at the level of sub-national localities in Sub-Saharan Africa. To map each of these localities to countries’ administrative divisions, we extract information from the SDA Yearbooks, a yearly publication of the central branch of the SDA that serves as a directory of the SDA’s organizational units and institutions. These yearly publications contain lists of the geographic regions encompassed by each SDA organizational unit. Localities have slowly reorganized as their membership grows, usually splitting into smaller localities. This process naturally leads to an unbalanced panel. We follow each locality for as many years as it exists with the same geographical boundaries as indicated in the SDA Yearbooks. We use this information to construct unique shapefiles identifying these localities across time by combining the data with the GADM shapefiles from the Global Administrative Areas database (Global Administrative Areas, 2022).⁵ Figure 1 provides a map of the 195 SDA localities for 2020.⁶ Figure 2 presents maps on the population size of Adventist membership across SDA sub-national localities for 1995 (a), 2011 (b), and 2020 (c).

⁴See Appendix A.1 for variable details.

⁵Appendix A.2 contains a detailed description of the definition and construction of geographic definitions of SDA localities.

⁶Appendix Table B1 provides summary statistics for the religious membership data.

Figure 1: SDA Localities: 2020



Notes: Borders of the 2020 SDA sub-national localities used in our analyses. Borders determined using information from SDA Yearbooks (General Conference of Seventh-day Adventists, Archives, Statistics, and Research, 2023) in combination with GADM shapefiles from the Global Administrative Areas database (Global Administrative Areas, 2022). See Section 3.1 for details.

3.2. *Opportunity Cost of Religious Membership*

We aim to create a measure of the opportunity cost of adhering to SDA prohibitions on the production of tobacco, coffee, and tea that varies both over time and at the locality level. To do so, we use data on (time-invariant) locality-specific potential crop yields and (time-varying) global crop prices.

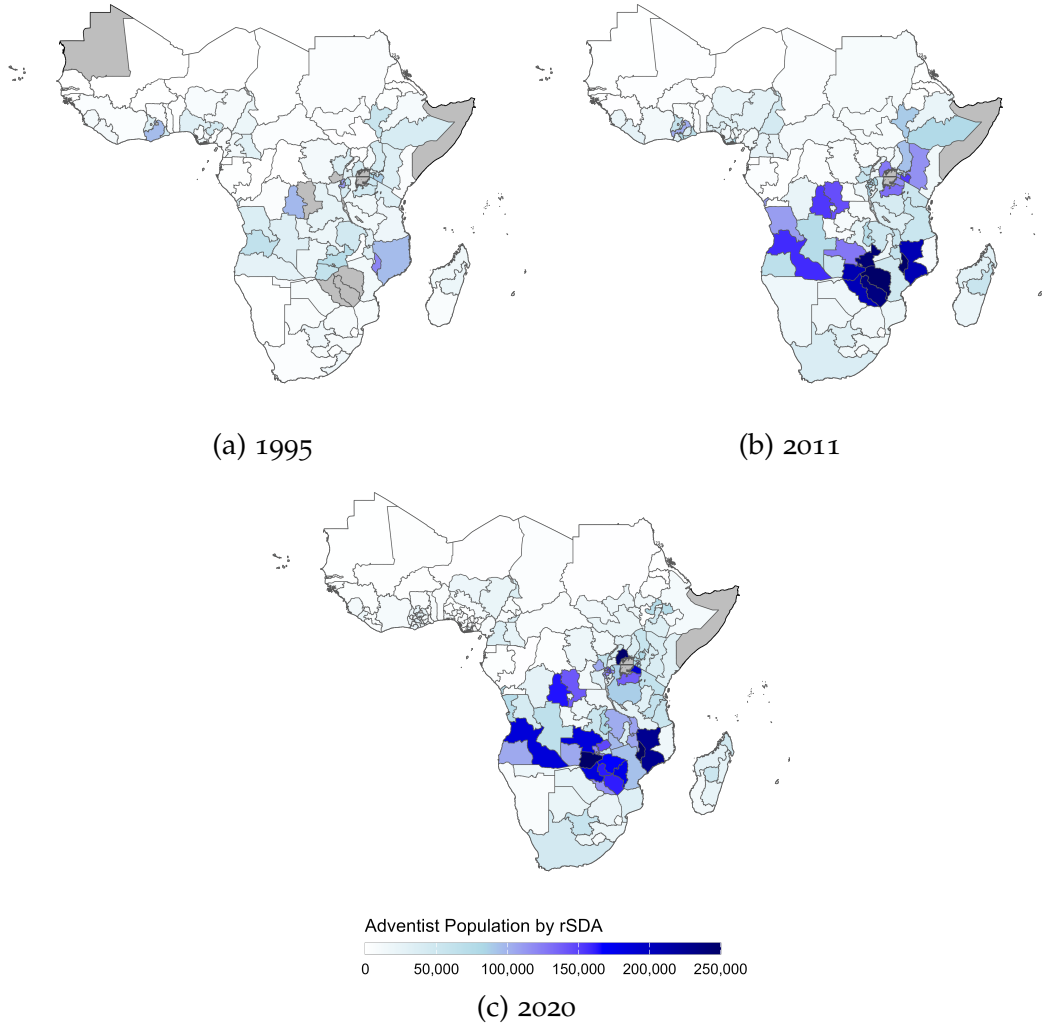
First, we use information that details at a very granular level – 9 km by 9 km grid cells – the time-invariant spatial variation in the suitability of the land for 38 different crops. These data come from the Global Agro-Ecological Zones (GAEZ v4) dataset of the Food and Agriculture Organization (FAO) of the United Nations in cooperation with the International Institute for Applied Systems Analysis.⁷ Crop yield data are in kilograms of production per hectare.

The second component needed to construct the opportunity cost measure is time-varying crop export prices from 1990 onwards.⁸ The prices are provided by the FAO's Food and Agricultural Trade Dataset (Food and Agriculture Organization of the United Nations (FAO), 2024), which includes export values and quantities at the country-year level. To mitigate the influence of country-specific economic shocks and capture broader regional trends, we use a weighted average of prices for Sub-Saharan Africa derived from

⁷GAEZ is a multi-stage model that combines geographic, soil, and climate data to produce estimates of potential yields for specific crops. See Appendix A.3 for details.

⁸Appendix Table A.4 describes the concordance between GAEZ crops and FAO products.

Figure 2: Number of SDA Members by Locality



Notes: Number of SDA members by SDA locality for select years. Borders determined as described in Figure 1 and Section 3.1. Data on SDA membership are from the SDA Office of Archives, Statistics, and Research (ASTR).

export values and quantities.⁹ Appendix Figure B3 presents a time series of average regional prices for prohibited crops (coffee, tea, and tobacco), and Appendix Figure B4 presents a time series of average regional prices for a subset of non-prohibited crops. These crop price data (and all data in money terms in this paper) are expressed in real 2010 US dollars.

With these two components – the (time-invariant) potential crop yields measures and (time-varying) annual crop prices – we calculate the opportunity cost of adhering to SDA crop prohibitions. This opportunity cost measure is the revenue given up per hectare from avoiding the production of tobacco, coffee, and tea. Specifically, let p index pixels (grid cells), t index years, and k index crops from the set of 38 crops (K) for which we have both export prices ($p_{k,t}$) and crop suitability ($s_{k,p}$). We first define the “unconstrained” maximum revenue as:

$$R_{p,t}^{max} = \max_{k \in K} (p_{k,t} \cdot s_{k,p})$$

that is, the maximized revenue per hectare on a pixel (from selecting the revenue-maximizing crop from all possible crops for cultivation, given time-invariant crop yields and time-varying crop prices). Figure 3 presents maps of the highest unconstrained revenue-yielding crop across pixels for various years.

We then define the “constrained” maximum revenue as:

$$R_{p,t}^{constrained} = \max_{k \in K \setminus \{\text{tobacco, coffee, tea}\}} (p_{k,t} \cdot s_{k,p})$$

that is, the maximized revenue per hectare if one follows SDA prohibitions and does not produce tobacco, coffee, or tea.

We then calculate the opportunity cost of adhering to SDA production prohibitions for each pixel by taking the difference between the unconstrained and constrained maximized revenue variables. We define the opportunity cost of SDA membership (in 2010 US dollars per hectare per year) as:

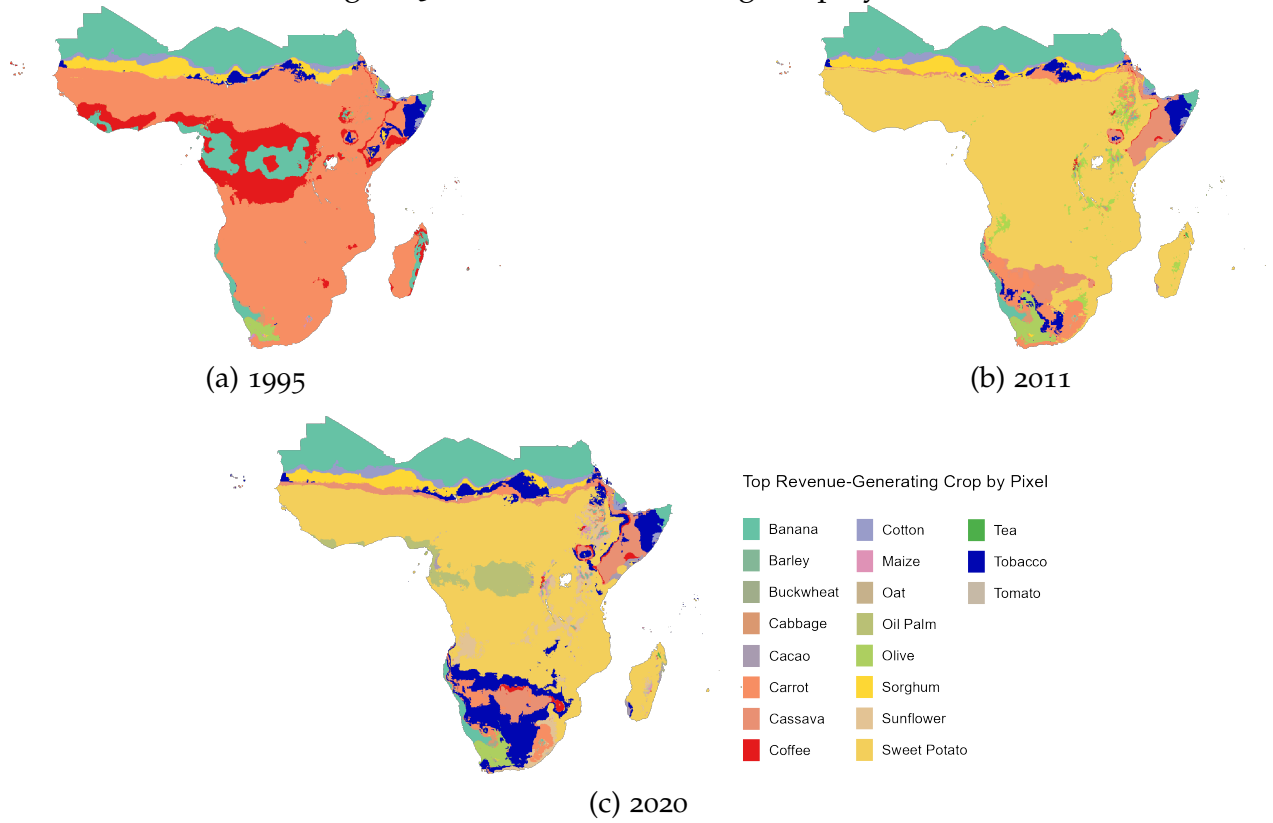
$$SDA\ Cost_{p,t} = R_{p,t}^{max} - R_{p,t}^{constrained}$$

where positive values of $SDA\ Cost_{p,t}$ indicate higher opportunity costs of religious membership. For pixel-years where the maximum revenue-generating crop is not a prohibited crop, our measure is zero, implying that adhering to SDA prohibitions does not incur any opportunity cost in those cases. Figure 4 presents maps of this opportunity cost measure ($SDA\ Cost_{p,t}$) across pixels for various years.

We aggregate this measure to the SDA locality level for each year. We take the average of the opportunity cost measure across pixels in a locality (indexed by l), where the

⁹Appendix Table A.5 provides a detailed description of the construction of export prices.

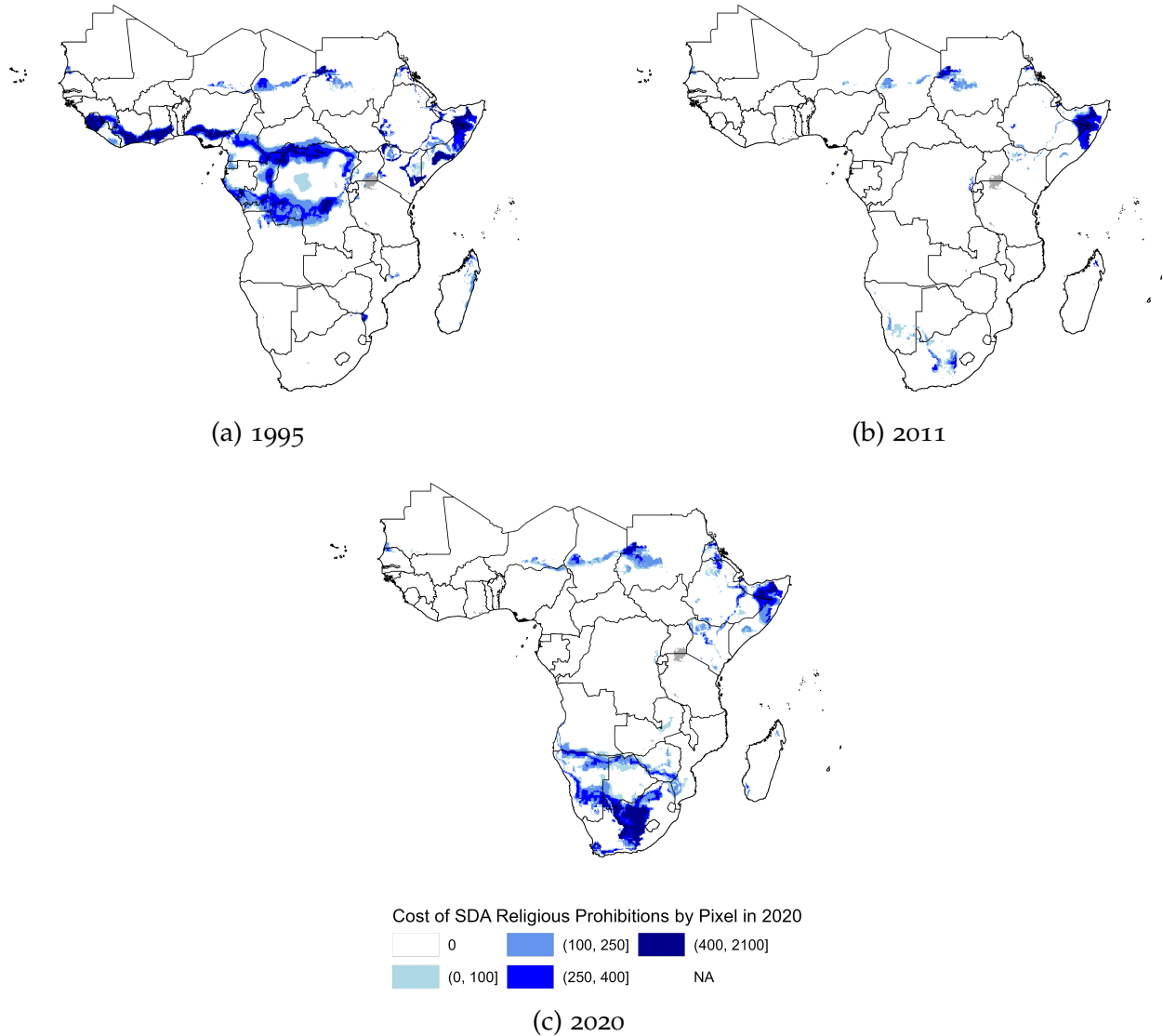
Figure 3: Revenue-Maximizing Crop by Pixel



Notes: Colors identify the revenue-maximizing crop for each of roughly 250,000 (9km square) pixels in Sub-Saharan Africa in select years. Revenue-maximizing crop is determined using data on pixel crop suitability (from the Global Agro-Ecological Zones (GAEZ v4) dataset) and crop export prices (Food and Agriculture Organization of the United Nations (FAO), 2024). See Section 3.2 for details.

average is weighted by pixel-level population to avoid placing weight on areas with little to no population.¹⁰ This is interpreted as the opportunity cost (in 2010 US dollars per hectare per year) of following SDA crop-production prohibitions in a given locality and year ($SDA Cost_{l,t}$). Figure 5 presents the opportunity cost measure across SDA localities for multiple years.

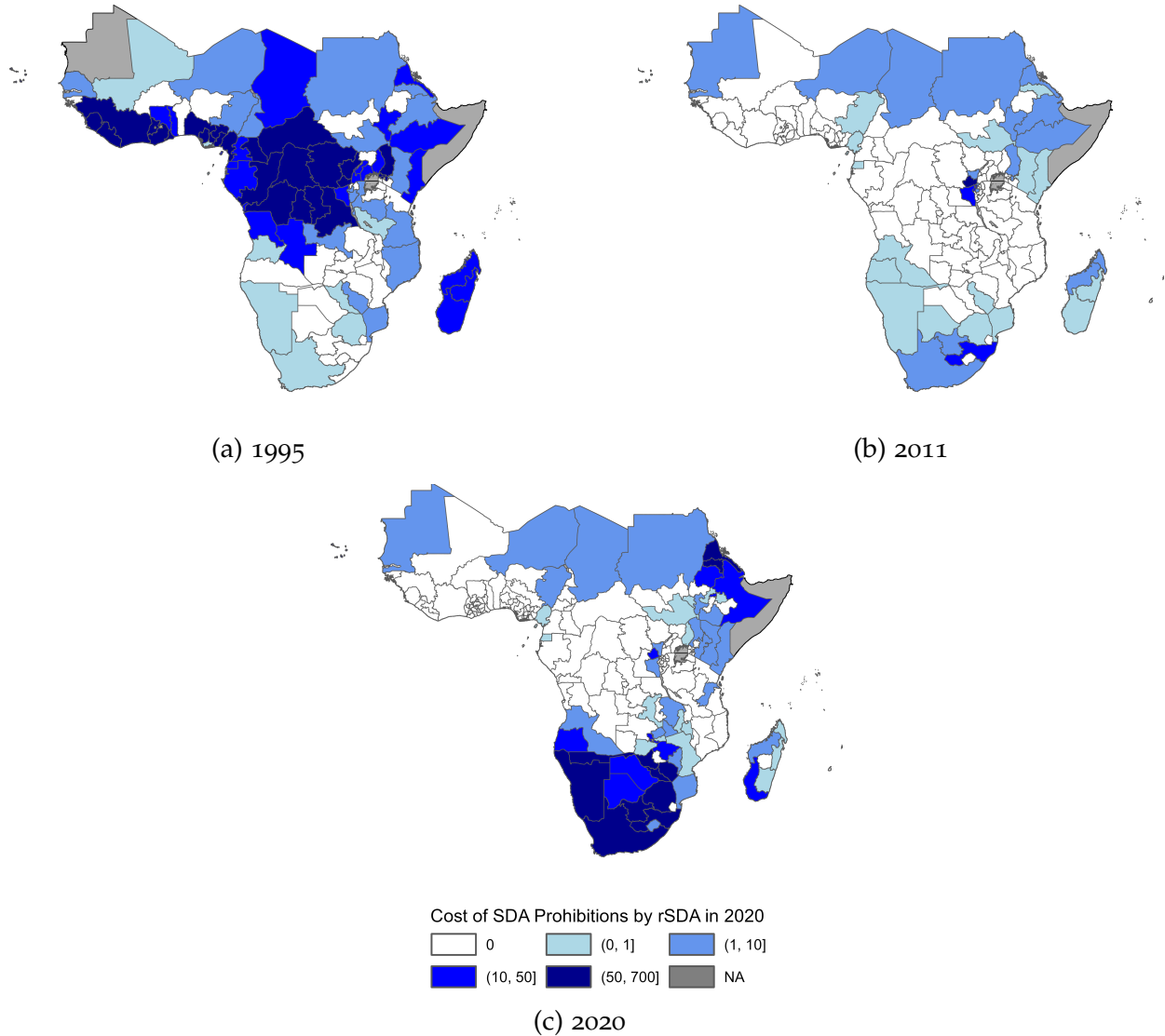
Figure 4: Opportunity Cost of SDA Crop Prohibitions by Pixel



Notes: Shades of blue quantify opportunity cost (in 2010 US dollars per hectare per year) of adhering to SDA prohibitions on production of tobacco, coffee, and tea in select years. Data is displayed for roughly 250,000 (9-km square) pixels in Sub-Saharan Africa. Opportunity cost is zero (white pixels) if the revenue-maximizing crop (displayed in Figure 3) is not an SDA-prohibited crop (tobacco, coffee, or tea). When the revenue-maximizing crop is an SDA-prohibited crop, opportunity cost is positive (shades of blue; darker is higher) and is calculated as revenue from growing an SDA-prohibited crop minus revenue from growing the highest-revenue crop that is not SDA-prohibited. See Section 3.2 for details.

¹⁰We use 1980 pixel-level population data from HYDE version 3.2.1 (Klein Goldewijk et al., 2017) to calculate the population-weighted average cost for each locality.

Figure 5: Opportunity Cost of SDA Crop Prohibitions by SDA Locality



Notes: Shades of blue quantify population-weighted mean opportunity cost (in 2010 US dollars per hectare per year) of adhering to SDA prohibitions on production of tobacco, coffee, and tea. Data is displayed for SDA localities in Sub-Saharan Africa in select years. Opportunity cost at pixel level (displayed in Figure 4) is averaged across all pixels in a locality; pixels weighted by 1980 population (from Klein Goldewijk et al. (2017)) when taking within-locality mean. See Section 3.2 for details.

3.3. SDA Member Surveys

The SDA church conducts worldwide surveys of its members, collecting information on their individual and household demographic characteristics; religious behaviors, roles, attitudes, and experiences; beliefs; and health. We focus on variables reflecting church messages in sermons, member beliefs and attitudes, such as members' satisfaction with and commitment to the church, as well as their usage of alcohol and tobacco. We use two rounds of the Global Church Member Survey (GCMS) conducted in 2017 and 2022. The lowest administrative division available in the GCMS that is comparable across multiple rounds is the respondent's country of residence, so our analyses of the GCMS data are conducted at that geographic level.

The primary outcome variables in our analyses from the GCMS survey are on whether holistic (healthy) living messages are emphasized in church services, the usage of alcohol and tobacco by members, and satisfaction with and commitment to the SDA church. We define "Holistic Message" as an indicator variable equal to one if the survey respondent answers that the Sabbath speaker in their church preaches frequently or very frequently about holistic healthful living (the importance of health for the body, mind, spirit, and social relationships), and 0 otherwise. Alcohol and tobacco usage are indicator variables equal to one if the SDA member has consumed tobacco or alcohol during the reference period of the survey. "Satisfaction" is an indicator variable equal to one if the respondent reports being satisfied or very satisfied with their local church, and 0 otherwise. "Commitment with SDA Church" is an indicator variable equal to one if the respondent reports being likely or very likely to attend a SDA Church for the rest of their lives and 0 otherwise. Appendix A.6 provides further details on the GCMS and the variables we use. Appendix Table B2 presents summary statistics.

3.4. Additional Data Sources

We use several additional data sources. We use data from Li et al. (2020) to measure average nighttime light intensity in 1992 at the locality level to measure the level of economic development at the beginning of our sample. Appendix A.7 provides additional information on the construction of the nighttime light measures. We also use data from the Global SPEI Database (Vicente-Serrano et al., 2010) to measure yearly drought severity for localities. Appendix A.8 describes the construction of our drought measure. Finally, we use pixel-level estimates of population in 1980 from the HYDE version 3.2.1 data (Klein Goldewijk et al., 2017)

4. Empirical Strategy

We seek to estimate the effect of changes in the local, time-varying opportunity cost of adhering to SDA crop-production prohibitions on outcomes such as new SDA memberships as well as church actions at the locality level. In this section, we discuss our main estimating equation. We also provide evidence to validate the opportunity cost measure by showing that it predicts changes in crop production at the national level within Sub-Saharan Africa.

4.1. Estimating Equation

We estimate the effects of changes in the opportunity cost of SDA crop-production prohibitions using the following regression equation:

$$y_{lt} = \beta f(\text{SDA Cost}_{l|t,t-k}) + \nu_l + \phi_t + X_l \times \phi_t + \epsilon_{lt} \quad (1)$$

where l indexes SDA sub-national localities, and t indexes years. y_{lt} is our outcome variable of interest (e.g., new SDA members in locality l in year t). $\text{SDA Cost}_{l|t,t-k}$ measures the average opportunity cost of abiding by SDA crop prohibitions – the difference in potential revenue per hectare from following SDA restrictions on the production of tobacco, coffee, and tea, relative to the revenue per hectare from not being constrained by the prohibitions (as defined in Section 3.2) – in locality l between year $t - k$ and year t .¹¹ ν_l are locality fixed effects to account for all time-invariant differences across localities, such as geography or ecological factors that do not vary over time. ϕ_t represent year fixed effects to account for time-varying shocks that are common to all localities, such as global price shocks. X_l is a vector of baseline characteristics (e.g., population in 1980), which are interacted with ϕ_t to flexibly control for time-varying impacts of these baseline characteristics. ϵ_{lt} represents the idiosyncratic error term, which we cluster at the country level to account for spatial correlation in shocks that could affect nearby localities similarly.

The coefficient of interest in Equation (1) is β , the effect of changes in SDA opportunity costs on our outcomes of interest (e.g., new SDA members). When examining impacts on net membership gains, we hypothesize that $\beta < 0$, that is increasing the opportunity cost of SDA membership decreases net membership gains. To interpret β as the percentage change in y_{lt} associated with changes in the opportunity cost measures, we estimate the regression using Poisson regressions. This approach is particularly suited for count or

¹¹Because agricultural decisions and their economic consequences often have lagged effects, we allow the effect of $\text{SDA Cost}_{l|t,t-k}$ to incorporate lags and measure average costs over time (e.g., between year $t - k$ and year t , where $k \in \{1, 2, 3\}$). Baseline results use $k = 2$, and we show that results are similar using alternative lag windows in Appendix B.4.

non-negative outcome variables, such as new church membership or the number of SDA institutions, instead of log transformations (Chen and Roth, 2024).

The function $f(x)$ in Equation (1) allows us to flexibly capture the relationship between the opportunity cost measure, $SDA Cost_{l|t,t-k}$, and the outcome y_{lt} . In our main specifications, $f(x)$ is either (i) an indicator function for positive opportunity costs, $\mathbb{1}(x > 0)$, or (ii) a set of indicator variables for quartiles of non-zero costs, $Q_4^+(x)$. These functional forms enable us to estimate the impacts of SDA opportunity costs somewhat non-parametrically, without imposing linearity or other strong assumptions about the relationship between costs and outcomes. By allowing for differential effects across quartiles, we also examine whether the impacts of SDA costs are concentrated at higher or lower levels of opportunity costs, thereby providing additional insights into the response function.

The main identifying assumption is that $E[\epsilon_{lct} | SDA Cost_{l|t,t-k}] = E[\epsilon_{lct}] = 0$. That is, the opportunity cost of SDA prohibitions is uncorrelated with omitted variables that may also affect SDA membership at the locality level conditional on locality and time fixed effects.

To increase the plausibility of the identifying assumption, we make several analytical choices to increase confidence that the independent variable of interest (the measure of the opportunity cost of following SDA crop prohibitions) is plausibly exogenous. We also provide empirical tests supporting the validity of this identifying assumption.

First, we construct the measure using time-varying global prices instead of using local crop prices which could influence both religious adherence and agricultural production. Second, we use cross-sectional ecological measures of potential crop yields from the FAO GAEZ that are based on geographic and climate characteristics instead of using observed crop production measures at the locality level. We then construct our opportunity cost measure as the difference between the *unconstrained* maximum potential revenue and the *constrained* maximum potential revenue if a locality follows SDA prohibitions and avoids producing tobacco, coffee, or tea. Taken together, these two choices imply that the opportunity cost measure we use is constructed using exogenous cross-sectional and time-varying measures.

Furthermore, an important concern when using shocks to potential agricultural revenues is that our opportunity cost measure will be highly correlated with local income in areas suitable for tobacco, coffee, or tea production. To address this concern, we also show results where we include the measure of *unconstrained* maximized revenue at the local level, whose variation is driven by crop suitability and crop prices across *all* crops. This allows us to study how SDA membership responds to general income shocks; it allows us to assess whether our opportunity cost measure is simply capturing the effects of general income shocks or whether it is capturing the impacts of the cost of

crop prohibitions.

Note that our measure of the opportunity costs of SDA prohibitions primarily captures production-side effects, focusing on the revenue foregone from adhering to SDA crop restrictions. However, there are also potential consumption-side mechanisms that could influence SDA membership and bias our production-side estimates downwards. For instance, higher tobacco prices may reduce the attractiveness of smoking, making it easier for individuals to quit and align with SDA prohibitions, thereby facilitating church membership. These mechanisms would bias our estimates of the relationship between opportunity growth and membership growth in a positive direction and likely lead to attenuation of our coefficient estimates: shifts in a positive direction (toward zero) would be in the opposite direction of our hypothesized negative relationship between opportunity costs and membership growth.¹²

4.2. Validating the Opportunity Cost Measure

A natural first question is: does the opportunity cost measure reflect production realities on the ground? This is a novel measure, not previously used in the economics literature, so it is important to confirm that it is associated in a reasonable way with actual production of crops (across space and over time).

In conducting this validation exercise, first note another interpretation of the opportunity cost variable defined in Section 3.2. While we emphasize its interpretation as the opportunity cost of giving up the opportunity to produce tobacco, coffee, and tea, it can also be interpreted as simply the potential *revenue gain* from producing tobacco, coffee, and tea relative to all other crops. In other words, it quantifies the increase in potential revenue one could earn from devoting land to producing tobacco, coffee, and tea in a particular year, compared to devoting land to the production of any other crop. This measure naturally takes on only positive values (it is bounded at zero) because one can always forgo the production of tobacco, coffee, or tea if it does not produce any revenue gain. Looking at the opportunity cost measure in this way, we should expect it to be *positively* correlated with the production of tobacco, coffee, and tea.

We validate our opportunity cost measure by examining how changes in it are associated with country-level production of crops that are “prohibited” (tobacco, coffee, and tea) and “non-prohibited” (all other crops). We conduct regression analyses using annual, country-level agricultural production data from the FAO.¹³ The results presented in Appendix Table B3 show that the opportunity cost variable does predict changes

¹²In Section 6, we use data from SDA member surveys to directly examine how smoking behavior actually changes when opportunity costs rise.

¹³We use annual country-level crop production measures because locality-level data on agricultural production are not available.

in agricultural production in the expected direction: increases in opportunity cost are associated with increases in the production of prohibited crops – tobacco, coffee, and tea – and decreases in the production of other crops. Thus, our measure predicts changes in the composition of production of prohibited vs. non-prohibited crops.

5. Empirical Results: Membership Decisions & Church Responses

We now present our empirical estimates of the impact of opportunity costs of SDA crop-production prohibitions on demand-side outcomes (new SDA memberships) and supply-side outcomes (church actions).

5.1. Membership Decisions

We first examine the impacts of the SDA opportunity cost measure on membership in the SDA church. Table 1 presents the estimates for equation (1), with membership net gains (columns 1 and 2), gains (columns 3 and 4), and losses (columns 5 and 6) as the dependent variables. Columns 1, 3, and 5 include results using the binary indicator equal to one if the SDA opportunity cost is non-zero, while columns 2, 4, and 6 estimate the impacts across quartiles of the SDA opportunity cost measure.

Results reveal that increases in SDA opportunity costs lead to significant decreases in new SDA memberships. Focusing first on net gains in membership, column 1 indicates that positive opportunity costs are associated with a 10.4% reduction in net membership gains. Examining the quartile estimates in column 2, we observe that the decline in net gains is largest in the highest quartile of opportunity costs (Q_4), with an estimated 19.3% reduction. These results suggest that net membership growth is most affected in areas where SDA opportunity costs are highest. Turning to gains in membership, columns 3 and 4 provide further evidence of significant impacts. Column 3 shows that a locality with positive opportunity costs experiences an 8.3% reduction in gains compared to a locality with zero costs. In column 4, the quartile-specific analysis reveals that, similar to net gains, the reduction in gains is most pronounced in the highest quartile of opportunity costs, with an estimated 17.4% decrease. Columns 5 and 6 examine the relationship between opportunity costs and losses of *existing* members. Coefficients in columns 5 and 6 are not statistically significantly different from zero, indicating no clear evidence of a relationship between opportunity costs and membership losses.

Taken together, our findings suggest that the economic costs associated with religious prohibitions have a tangible impact on individuals' decisions to join religious groups. The decision to become a new member of the SDA church appears to be significantly

influenced by the economic sacrifices required, highlighting the role of opportunity costs in decisions to affiliate with new religious groups.

Table 1: Impact of the Opportunity Cost of Religious Membership on Membership Decisions

	Dependent Variable:					
	Net Gains		Gains		Losses	
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{SDA\ Cost_{t,t-2} > 0\}$	-0.104** (0.049)		-0.083** (0.035)		0.225 (0.174)	
$Q_1^+\{SDA\ Cost_{t,t-2}\}$		-0.059 (0.041)		-0.038 (0.028)		0.436 (0.296)
$Q_2^+\{SDA\ Cost_{t,t-2}\}$		-0.097 (0.096)		-0.083 (0.072)		-0.006 (0.189)
$Q_3^+\{SDA\ Cost_{t,t-2}\}$		-0.157*** (0.046)		-0.122*** (0.038)		0.242 (0.164)
$Q_4^+\{SDA\ Cost_{t,t-2}\}$		-0.193*** (0.054)		-0.174*** (0.051)		-0.185 (0.176)
Locality Fixed Effects	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	4,238	4,238	4,238	4,238	4,175	4,175
Num SDA Localities	424	424	424	424	412	412
Num Countries	44	44	44	44	44	44
Pseudo R^2	0.856	0.856	0.905	0.905	0.663	0.668
Outcome Mean	2533.254	2533.254	3022.607	3022.607	637.481	637.481
Outcome SD	3804.671	3804.671	4253.701	4253.701	2823.458	2823.458

Notes: Observations are SDA localities in Sub-Saharan Africa between 1991 and 2022. Standard errors clustered at the country level are presented in parentheses. *Gains* is the number of reported baptisms, professions of faith, and former member baptisms in the SDA locality in a given year. *Losses* is the number of reported dropped and missing members in the SDA locality in a given year. *Net Gains* is reported gains minus losses. $SDA\ Cost_{t,t-k}$ measures the average opportunity cost of abiding by the SDA crop prohibitions: the agricultural revenue per hectare given up per hectare if *constrained* by SDA crop restrictions on coffee, tea, and tobacco—between years t and $t - k$. $\mathbb{1}(x > 0)$ represents the indicator function that equals 1 when x is greater than zero and 0 otherwise. $Q^+(x)$ represent indicator variables equal to 1 if x is in k th quartile of non-zero values of x and 0 otherwise. Estimated using Poisson regressions via pseudo-maximum likelihood; regressions exclude observations that are either singletons or separated by a fixed effect (Correia et al., 2020). Regressions control for population in each locality in 1980 interacted with year fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

As discussed in Section 4, a potential concern with the estimates in Table 1 is that the opportunity cost measure might be picking up general changes in incomes via agricultural revenues. To explore this concern, Appendix Table B5 shows the results when we control for general changes in agricultural revenue that, unlike our opportunity cost measure, are not restricted to include non-prohibited crops – the $R_{p,t}^{max}$ variable defined in Section 3.2. The estimates of the SDA opportunity cost measure are robust to the inclusion of $R_{p,t}^{max}$ as a control, suggesting that the SDA opportunity cost measure is not just picking up changes in local incomes. Instead, it specifically captures the economic trade-offs imposed by religious prohibitions.

To further validate our main findings on new memberships, we conduct a placebo test using leads of the opportunity cost measure, examining whether changes in future opportunity costs have any predictive impact on current membership outcomes. Specifically, if leads of opportunity costs were found to affect current outcomes, it would suggest the presence of omitted variables or anticipatory behavior unrelated to the direct economic costs imposed by SDA prohibitions. Appendix Table B4 presents the results for net gains (columns 1 and 2), gains (columns 3 and 4), and losses (columns 5 and 6). Across all specifications, the coefficients on both the binary indicator for positive

future opportunity costs and the quartile-specific measures are small in magnitude and statistically insignificant. This lack of association confirms that changes in opportunity costs occurring in future periods do not influence current membership decisions.

5.2. *Church Responses*

We now turn to exploring church responses to changes in opportunity costs: how the SDA church responds to the economic incentives facing their members. Table 2 presents estimates of equation (1), with the number of churches (columns 1 and 2) and the number of health and education institutions (columns 3 and 4) as the dependent variables.

Columns 1 and 2 suggest limited evidence of supply-side responses in terms of churches. The coefficients on the indicator for positive opportunity costs (column 1) and the quartiles of the opportunity cost measure (column 2) are small in magnitude and not statistically significant. This indicates that changes in the economic opportunity costs of SDA membership do not significantly influence the number of churches in an SDA locality.

In contrast, columns 3 and 4 reveal a clear and significant response in the provision of education and health institutions. Positive opportunity costs are associated with an 8.1% increase in the number of such institutions (column 3). These results suggest that the church strategically enhances its provision of services, particularly in education and health, to offset the consequences of increased opportunity costs for members and potential members.

Interestingly, the quartile-specific analysis in column 4 shows a different pattern than the membership responses in Table 1: we find little evidence that the church's responses are larger in localities with higher quartiles of opportunity costs. For instance, a locality in the second quartile of opportunity costs experiences a 7.7% increase in the number of education and health institutions, while the response diminishes at higher quartiles, with the coefficient for the highest quartile being smaller and not statistically significant. This pattern suggests that the SDA church's ability to respond by establishing health and education institutions is potentially more limited when opportunity cost increases are relatively large. Because these health and education institutions are often accessible to non-members as well, they serve a dual role: offering additional benefits to existing members while also helping to attract potential new members. This dual function potentially contributes to the church's strategy for relatively small opportunity cost increases, where such investments can more effectively retain members and draw in new ones. When opportunity costs become too large, however, even these efforts may be insufficient to

offset the economic barriers to membership.¹⁴

Overall, the results in Table 2 highlight that the SDA church strategically adjusts its institutional presence in response to changes in the opportunity costs of membership. While the number of churches remains unaffected, the church increases its investment in health and education institutions, potentially as a strategy to provide new benefits that mitigate the economic challenges associated with membership. Increases in establishment of institutions may also reflect efforts to proselytize and attract members in regions where economic costs would otherwise deter participation.

Table 2: Impact of the Opportunity Cost of Religious Membership on Church Responses

	Dependent Variable:			
	Churches		Institutions	
	(1)	(2)	(3)	(4)
$\mathbb{1}\{SDA Cost_{t,t-2} > 0\}$	-0.012 (0.022)		0.081*** (0.028)	
$Q_1^+\{SDA Cost_{t,t-2}\}$		-0.008 (0.028)		0.090*** (0.030)
$Q_2^+\{SDA Cost_{t,t-2}\}$		-0.037 (0.023)		0.077** (0.035)
$Q_3^+\{SDA Cost_{t,t-2}\}$		0.022 (0.018)		0.067* (0.035)
$Q_4^+\{SDA Cost_{t,t-2}\}$		0.015 (0.016)		0.058 (0.041)
Locality Fixed Effects	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y
Observations	4,238	4,238	2,700	2,700
Num SDA Localities	424	424	266	266
Num Countries	44	44	32	32
Pseudo R^2	0.945	0.946	0.465	0.466
Outcome Mean	319.130	319.130	3.725	3.725
Outcome SD	366.580	366.580	3.440	3.440

Notes: Observations are SDA localities in Sub-Saharan Africa between 1991 and 2022. Standard errors clustered at the country level are presented in parentheses. *Churches* is the number of reported churches and companies in the SDA locality in a given year. *Institutions* is the number of reported health or education institutions in the SDA locality in a given year in the SDA annual yearbooks. $SDA Cost_{t,t-k}$ measures the average opportunity cost of abiding by the SDA crop prohibitions: the agricultural revenue per hectare given up per hectare if *constrained* by SDA crop restrictions on coffee, tea, and tobacco between years t and $t - k$. $\mathbb{1}(x > 0)$ represents the indicator function that equals 1 when x is greater than zero and 0 otherwise. $Q^+(x)$ represent indicator variables equal to 1 if x is in k th quartile of non-zero values of x and 0 otherwise. Estimated using Poisson regressions via pseudo-maximum likelihood; regressions exclude observations that are either singletons or separated by a fixed effect (Correia et al., 2020). Regressions control for population in each locality in 1980 interacted with year fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5.3. Heterogeneity by Religious Group Size & Economic Conditions

We next examine whether there is heterogeneity in the patterns observed in Section 5.1 regarding the impacts of the opportunity cost of religious membership on membership decisions. In particular, we examine whether there is heterogeneity in responses by the size of the local SDA population or by economic conditions.

First, we explore whether the number of SDA members in a locality attenuates the impacts of the opportunity cost of membership. The value of joining a religious group

¹⁴In Appendix Table B6, we present estimates that control for the unconstrained agricultural revenue. The results remain largely unaffected by the inclusion of this control, reinforcing the conclusion that the observed patterns are not driven by general income changes but are specific to the opportunity costs associated with SDA membership.

may be larger when the group makes up a larger share of the local population (Iannaccone, 1992; Barro and McCleary, 2024; Seabright, 2024). Appendix Table B7 presents estimates for net gains (column 1), total gains (column 2), and total losses (column 3) as the dependent variables. Each specification includes an interaction term between the indicator variable for positive opportunity costs and the share of the population in a locality that is an SDA member (which ranges from 0 to 100), measured in the first year the locality is observed in our sample.

Column 1 shows that the negative impact of opportunity costs on net gains is significantly attenuated in localities with higher SDA membership density. Specifically, the interaction term suggests that the negative effect of positive opportunity costs on net gains is fully offset when approximately 14% of the population is SDA. Column 2 reveals a similar attenuation pattern for gains, suggesting that denser SDA networks reduce the deterrent effects of higher opportunity costs on new memberships.

In column 3, we observe that higher SDA membership density also has a significant effect on total losses, with the interaction term being statistically significant and negative. This indicates that in localities with denser SDA membership, higher opportunity costs are associated with fewer losses of existing members. The social cohesion and mutual support within larger SDA networks may help retain members by reducing the perceived costs of adherence or by increasing the relative benefits of remaining part of the group.

Taken together, the results in Appendix Table B7 suggest that the density of religious networks can offset the impacts of increases in the economic costs of membership for both new and existing members.

Second, we examine whether economic shocks to agriculture via droughts attenuate the impacts of changes in the opportunity cost of membership, since religious membership often offers critical economic insurance for shocks in developing countries (Bentzen, 2019a,b; Auriol et al., 2020). Appendix Table B8 presents estimates for the interaction of the indicator variable for positive SDA opportunity costs with measures of average drought severity for the locality. We measure drought severity using the standardized precipitation evapotranspiration index (SPEI), derived from Global SPEI data (see Appendix Section A.8 for details).

Column 1 shows that the negative impact of positive opportunity costs on net gains is significantly attenuated in localities that are more prone to experiencing a drought. The interaction term indicates that droughts reduce the negative impact of opportunity costs on net gains by 6.4%, suggesting that the deterrent effects of economic costs on new membership are less pronounced in contexts that face more economic hardship. Similarly, column 2 shows that the impacts on total gains is also attenuated by drought severity. These findings suggest that prospective members may perceive the economic costs of SDA membership as less burdensome in settings that face more agricultural shocks,

potentially due to the social and economic support provided by religious networks during crises. In contrast, column 3 shows no statistically significant interaction effect for total losses, suggesting that droughts do not significantly influence the relationship between opportunity costs and the retention of existing members.

Overall, the results in Appendix Table B8 provide evidence that the economic costs of membership are perceived as less costly for new members when individuals face concurrent economic shocks, such as droughts. These findings underscore the important role of religious institutions as a source of social and economic resilience during times of economic shocks.

6. Empirical Results: SDA Health Messaging and Member Satisfaction

We next examine the impacts of the SDA opportunity cost measure on messages emphasized in church services, usage of alcohol and tobacco, and satisfaction with the church. We use data from the SDA Global Church Member Survey (GCMS) on SDA members and examine two main sets of outcomes. First, we examine how changes in the cost of prohibitions impact the healthy living messages emphasized by the church and actual health behaviors by SDA members, specifically usage of tobacco and alcohol. Second, we examine the impacts on members' satisfaction with and commitment to the SDA church.

6.1. Estimating Equation

The SDA Global Church Member Survey (GCMS) does not include information on respondents' sub-national localities, only their countries. We therefore conduct these analyses at the country level, and similarly aggregate our opportunity cost measure to the country level.

To examine the impacts of opportunity costs on outcomes in the SDA GCMS, we estimate the following modification of equation (1):

$$y_{ict} = \beta f(\text{SDA Cost}_{c|t,t-k}) + \nu_c + \phi_t + \mathbf{X}_{ict}\Gamma + \epsilon_{ict} \quad (2)$$

where i indexes individuals, c indexes countries, and t indexes years. y_{ict} is our outcome variable of interest (e.g., SDA member i 's attitudes in country c in year t). $\text{SDA Cost}_{c|t,t-k}$ is the country-level measure of the average opportunity cost of abiding by SDA crop prohibitions in country c between year $t - k$ and year t . As in Section 4, $f(x)$ is either (i) an indicator function for positive opportunity costs, $\mathbb{1}(x > 0)$, or (ii) a set of indicator variables for quartiles of positive costs, $\mathbf{Q}_4(x > 0)$. ν_c represent country fixed effects to account for time-invariant differences across countries, such as geography or cultural factors that do not vary over time. ϕ_t represent survey-year fixed effects to account for

time-varying shocks that are common to all countries, such as global price shocks. X_{ict} is a vector of individual-level covariates (age, age squared, gender, and education level). ϵ_{ict} is the error term. We present standard errors clustered at the country level.

Appendix Table B2 presents summary statistics for outcomes in the SDA GCMS survey data.

6.2. SDA Emphasis on Healthy Living

We first examine the impacts of the opportunity cost of membership on the emphasis by the church on healthy living prescriptions and member adherence. These prescriptions include prohibitions on alcohol and tobacco consumption, as well as strong discouragement of consumption of caffeinated beverages such as coffee and tea. Table 3 presents estimates of equation (2) where the dependent variables include whether church sermons emphasize a holistic approach to health (columns 1-2), and members' self-reported usage of tobacco (columns 3-4) and alcohol (columns 5-6). (The SDA GCMS surveys do not ask about coffee or tea consumption, or production of any good.) The estimates suggest that higher opportunity costs are significantly associated with a reduced emphasis on holistic health messages in church services (columns 1 and 2). Additionally, columns 3-6 reveal that higher opportunity costs are significantly associated with more violations of the church's prescriptions on healthy living – namely, a higher likelihood of reporting alcohol and tobacco consumption. These findings suggest that as the economic costs of adhering to SDA prohibitions increase, the church reduces emphasis on holistic health messaging, and members are more likely to engage in health behaviors discouraged by the church.

6.3. Member Satisfaction and Commitment

We next examine the impacts of opportunity costs on members' satisfaction with and commitment to the church. Table 4 presents estimates of equation (2) for these outcomes. The results show that higher opportunity costs significantly decrease both satisfaction with the SDA church (columns 1-2) and members' self-reported commitment to the church (columns 3-4). Specifically, the coefficient in column 1 indicates a 4.8% decline in satisfaction, while column 3 shows a 2.2% decline in commitment. These results suggest that rising opportunity costs associated with SDA prohibitions erode members' attachment to the church.¹⁵

¹⁵Interestingly, this is in contrast to the predictions of club goods models of religions (e.g., Iannaccone, 1992), which suggest that increases in the costs of religious participation might actually increase satisfaction and commitment of remaining members.

Table 3: Impact of the Opportunity Cost of Religious Membership on Health Messaging

	Dependent Variable:					
	Holistic Message		Tobacco		Alcohol	
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{SDA\ Cost_{t,t-2} > 0\}$	-0.081** (0.031)		0.021*** (0.007)		0.040*** (0.005)	
$Q_1^+\{SDA\ Cost_{t,t-2}\}$		-0.079 (0.060)		0.012 (0.009)		0.032*** (0.009)
$Q_2^+\{SDA\ Cost_{t,t-2}\}$		-0.108*** (0.035)		0.021*** (0.006)		0.038*** (0.007)
$Q_3^+\{SDA\ Cost_{t,t-2}\}$		-0.069 (0.044)		0.017** (0.007)		0.040*** (0.007)
$Q_4^+\{SDA\ Cost_{t,t-2}\}$		-0.017 (0.043)		0.022*** (0.008)		0.043*** (0.010)
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	30,645	30,645	32,286	32,286	32,513	32,513
Num Countries	34	34	34	34	34	34
Adjusted R^2	0.020	0.021	0.006	0.006	0.050	0.050
Outcome Mean	0.745	0.745	0.028	0.028	0.075	0.075
Outcome SD	0.436	0.436	0.165	0.165	0.263	0.263

Notes: Observations are individual respondents in the SDA Global Church Member Survey (GCMS) in Sub-Saharan Africa. Standard errors clustered at the country level are presented in parentheses. All regressions control for respondent age, age squared, and gender, and an indicator variable equal to 1 if the respondent is missing age or gender information. *Holistic Message* is a binary variable that takes a value of one if the respondent answers that the Sabbath speaker in their church preaches frequently or very frequently about *holistic healthful living* (the importance of health for the body, mind, spirit, and social relationships), and 0 if seldom or never. *Tobacco* and *Alcohol* are binary variables that indicate whether the respondent has consumed alcohol or tobacco in the past 12 months. $SDA\ Cost_{t,t-k}$ measures the average country-level opportunity cost of abiding by the SDA crop prohibitions—the agricultural revenue per hectare given up per hectare if *constrained* by SDA crop restrictions on coffee, tea, and tobacco—between years t and $t - k$. $\mathbb{1}(x > 0)$ represents the indicator function that equals 1 when x is greater than zero and 0 otherwise. $Q^+(x)$ represent indicator variables equal to 1 if x is in k th quartile of non-zero values of x and 0 otherwise. Estimated using Poisson regressions via pseudo-maximum likelihood; regressions exclude observations that are either singletons or separated by a fixed effect (Correia et al., 2020). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

One important consideration when interpreting the results from the SDA Global Church Member Survey is that the sample is self-selected – it includes only individuals who remained members of the SDA church at the time of the survey. Since our prior findings demonstrate that higher opportunity costs reduce new church membership, it is likely that, in countries with higher opportunity costs, the surveyed population is smaller and more positively selected in terms of religious commitment. That is, those who remain in the church despite higher costs may be the most devout or committed members, potentially creating a bias against finding higher levels of dissatisfaction (in Table 4) or more violations of church prohibitions (in Table 3). If anything, this selection mechanism would lead us to underestimate the negative impacts of higher opportunity costs on satisfaction and adherence. Given this, it is striking that we observe significant increases in tobacco and alcohol use, as well as lower satisfaction and commitment, despite this likely positive selection. It is likely that if we had been able to conduct this analysis in a population of current *and* prior members, the estimated impacts of opportunity costs on satisfaction and commitment would have been even more negative.

Taken together, the results from SDA member surveys highlights the challenges the SDA church faces in retaining members when opportunity costs of adherence increase and how the church attempts to offset these costs by reducing its emphasis on its healthy living prescriptions. This strategy may reflect an effort to adapt its messaging and priorities in response to the rising economic burdens faced by its members, even as these efforts appear insufficient to fully counteract the decline in satisfaction and commitment.

Table 4: Impact of the Opportunity Cost of Religious Membership on Satisfaction and Commitment

	Dependent Variable:			
	Satisfaction		Commitment with SDA Church	
	(1)	(2)	(3)	(4)
$\mathbb{1}\{SDA Cost_{t,t-2} > 0\}$	-0.048*** (0.010)		-0.022*** (0.006)	
$Q_1^+\{SDA Cost_{t,t-2}\}$		-0.019 (0.021)		-0.003 (0.008)
$Q_2^+\{SDA Cost_{t,t-2}\}$		-0.038** (0.016)		-0.017** (0.007)
$Q_3^+\{SDA Cost_{t,t-2}\}$		-0.049*** (0.010)		-0.022*** (0.004)
$Q_4^+\{SDA Cost_{t,t-2}\}$		-0.065*** (0.020)		-0.032*** (0.006)
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	32,690	32,690	32,739	32,739
Num Countries	34	34	34	34
Adjusted R^2	0.043	0.043	0.033	0.033
Outcome Mean	0.810	0.810	0.952	0.952
Outcome SD	0.392	0.392	0.214	0.214

Notes: Observations are individual respondents in the SDA Global Church Member Survey (GCMS) in Sub-Saharan Africa. Standard errors clustered at the country level are presented in parentheses. All regressions control for respondent age, age squared, and gender, and an indicator variable equal to 1 if the respondent is missing age or gender information. *Satisfaction* is a binary variable that takes a value of 1 if the respondent reports being satisfied or very satisfied with their local church, and 0 otherwise. *Commitment with SDA Church* is a binary variable that takes a value of 1 if the respondent reports being likely or very likely to attend a SDA Church for the rest of their lives and 0 otherwise. $SDA Cost_{t,t-k}$ measures the average country-level opportunity cost of abiding by the SDA crop prohibitions—the agricultural revenue per hectare given up per hectare if *constrained* by SDA crop restrictions on coffee, tea, and tobacco—between years t and $t-k$. $\mathbb{1}(x > 0)$ represents the indicator function that equals 1 when x is greater than zero and 0 otherwise. $Q^+(x)$ represent indicator variables equal to 1 if x is in k th quartile of non-zero values of x and 0 otherwise. Estimated using Poisson regressions via pseudo-maximum likelihood; regressions exclude observations that are either singletons or separated by a fixed effect (Correia et al., 2020). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

7. Conclusion

The evidence presented in this study reveals how economic incentives shape religious participation and institutional adaptation in Sub-Saharan Africa. Through our analysis of the Seventh-Day Adventist church, we demonstrate that economic costs significantly influence both individual religious choices and institutional responses. When the opportunity costs of religious adherence rise – specifically, the foregone agricultural revenue from adhering to prohibitions on tobacco, coffee, and tea production – we find substantial declines in new membership and increased dissatisfaction among existing members.

However, religious institutions do not remain passive in the face of these economic pressures. Our findings reveal sophisticated adaptive responses by the SDA church: establishing new educational and health institutions (to enhance proselytization efforts and to provide offsetting benefits to members), and notably, reducing emphasis on the very religious prescriptions that generate these economic costs. This institutional flexibility – maintaining core religious identity while adapting to local economic conditions – may help explain the remarkable growth of religious movements like the SDA church in Sub-Saharan Africa.

Our findings have implications well beyond the specific context we study. First, they demonstrate how economic incentives can drive religious change through multiple channels: directly affecting individual choices about religious participation, and indirectly by inducing institutional adaptation. Second, they reveal religious institutions as dynamic actors that strategically adjust their practices and messaging in response to local conditions, while maintaining their fundamental identity. This adaptability may be particularly important in developing regions where religious prescriptions can significantly impact economic livelihoods.

More broadly, our research illuminates mechanisms of institutional and cultural change. While much work emphasizes the persistence of cultural practices, we document how religious institutions can facilitate relatively rapid adaptation to economic conditions. This suggests that successful religious movements may act as mediators of cultural change, selectively relaxing certain prescriptions while maintaining their core identity and values. In an era of rapid economic transformation across the developing world, understanding these dynamics of religious and cultural adaptation becomes increasingly important.

Future research could extend our approach to other religious groups and contexts, examining how different types of economic costs affect religious participation and institutional responses. The interaction between economic development, religious practice, and institutional adaptation we document may be especially relevant for understanding religious change in other developing regions experiencing rapid economic transforma-

tion. More broadly, our findings suggest the importance of studying how cultural and religious institutions adapt to changing economic conditions while maintaining their essential character and appeal to adherents.

These results ultimately contribute to our understanding of how religious organizations navigate the fundamental tension between maintaining traditional practices and adapting to economic realities. The sophisticated responses we document – offsetting costs through new benefits while selectively adapting religious emphasis – may represent a broader pattern of successful religious adaptation in the face of economic change. Understanding these dynamics is crucial as religious institutions continue to play vital roles in economic development and social transformation across the developing world.

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ONLINE APPENDIX FOR

**The Price of Faith:
Economic Costs and Religious Adaptation
in Sub-Saharan Africa**

Eduardo Montero
University of Chicago

Dean Yang
University of Michigan

Triana Yentzen
University of Michigan

17 January 2025

Contents

Appendix A Data Appendix	3
A.1 Office of Archives, Statistics, and Research (ASTR) Data	3
A.1.1 Variable Definitions	3
A.1.2 SDA Organizational Structure	5
A.2 Localities	6
A.3 GAEZ	7
A.4 Concordance of GAEZ crops with Crops in FAO Production Data	7
A.5 FAO Export Prices	9
A.6 Seventh-Day Adventist Global Church Member Survey (GCMS)	9
A.7 Nighttime Lights	11
A.8 Droughts	11
Appendix B Additional Tables & Figures	12
B.1 Summary Statistics	12
B.2 Price Time Series	14
B.3 Production	16
B.4 Alternative Specifications	17
B.5 Accounting for Maximum Unconstrained Revenue	17
B.6 Heterogeneity	19

Appendix A. Data Appendix

A.1. Office of Archives, Statistics, and Research (ASTR) Data

Figure A1: Sample Page from Office of Archives, Statistics, and Research (ASTR) Website of the Seventh-Day Adventist Church

Central Malawi Conference <i>Yearly Statistics (1995-2022)</i>																					
(Back to Field Summary)																					
Click for chart, and for description																					
Year	Churches	Companies	Beginning Membership	Baptisms	Former Member Baptisms	Professions of Faith	Transfers In	Transfers Out	Deaths	Dropped	Missing	Total Gains	Total Losses	Adjust	Net Growth	Ending Membership	Growth Rate	Accession Rate	Death Rate	Ordained Ministers	Licensed Ministers
1995	103		29492	4327			412	449	243	378		4739	1070		3669	33161	12.44%	14.67%	0.82%	25	15
1996	105		33161	5559			694	1899	338	1145		6253	3382		2871	36032	8.66%	16.76%	1.02%	25	14
1997	105	214	36032	4934			1153	1546	235	1460		6087	3241		2846	38878	7.90%	13.69%	0.65%	25	13
1998	132	322	38878	4012		66	635	827	336	751	59	4713	1973	-14698	-11958	26920	-30.76%	10.49%	0.86%	14	29
1999	140	351	26920	6108		509	751	1888	304	734	117	7368	3043	258	4583	31503	17.02%	24.58%	1.13%	19	25
2000	171	338	31503	4716		236	961	1429	267	866	655	5913	3217	0	2696	34199	8.56%	15.72%	0.85%	22	28
2001	178	382	34199	4340		508	859	999	285	1307	983	5707	3574	-470	1663	35862	4.86%	14.18%	0.83%	23	28
2002	172	387	35862	4170		185	615	1323	401	1244	1132	4970	4100	356	1226	37088	3.42%	12.14%	1.12%	23	28
2003	169	384	37088	3734		399	771	742	231	2521	946	4904	4440	0	464	37552	1.25%	11.14%	0.62%	25	31
2004	173	388	37552	5981		382	1039	1617	299	1391	617	7402	3924	0	3478	41030	9.26%	16.94%	0.80%	48	10
2005	172	393	41030	4035		194	681	1044	312	841	352	4910	2549	-1521	840	41870	2.05%	10.31%	0.76%	38	20
2006	172	394	41870	4404		75	1140	1133	311	1262	287	5619	2993	-1763	863	42733	2.06%	10.70%	0.74%	46	27
2007	200	424	42733	4966		337	1091	1048	859	1276	603	6394	3786	318	2926	45659	6.85%	12.41%	2.01%	35	17
2008	205	417	45659	6056		228	857	633	238	1007	679	7141	2557	-877	3707	49366	8.12%	13.76%	0.52%	36	17
2009	214	406	49366	5528		70	1136	1249	245	1406	910	6734	3810	213	3137	52503	6.35%	11.34%	0.50%	46	19
2010	229	416	52503	8600		145	813	1547	344	1425	1545	9558	4861	-1248	3449	55952	6.57%	16.66%	0.66%	36	24
2011	227	414	55952	7802		240	1062	1502	297	1323	1204	9104	4326	-464	4314	60266	7.71%	14.37%	0.53%	30	24
2012	242	446	60266	7345		70	1248	1783	261	1223	728	8663	3995	-992	3676	63942	6.10%	12.30%	0.43%	37	13
2013	249	487	63942	6867		154	1379	2384	210	1469	1044	8400	5107	908	4201	68143	6.57%	10.98%	0.33%	6	19
2014	251	504	68143	6424		62	773	1365	291	1144	2454	7259	5254	115	2120	70263	3.11%	9.52%	0.43%	36	12
2015	259	523	70263	9281		70	871	1305	264	1854	1016	10222	4439	312	6095	76358	8.67%	13.31%	0.38%	57	11
2016	270	554	76358	10625		65	871	1222	266	1110	155	11561	2753	0	8808	85166	11.54%	14.00%	0.35%	59	9
2017	299	556	85166	9362	74	109	682	1495	275	2208	428	10227	4406	0	5821	90987	6.83%	11.12%	0.32%	57	9
2018	308	576	90987	7337	0	35	446	1169	267	871	418	7818	2725	0	5093	96080	5.60%	8.10%	0.29%	58	10
2019	352	579	96080	8440	0	30	1218	1555	227	986	320	9688	3088	0	6600	102680	6.87%	8.82%	0.24%	59	8
2020	363	603	102680	5307	0	251	953	1130	246	1271	73	6511	2720	0	3791	106471	3.69%	5.41%	0.24%		
2021	391	623	106471	9639	0	22	1089	1535	325	1157	262	10750	3279	-451	7020	113491	6.59%	9.07%	0.31%		
2022	396	626	113491	5811	400	688	1673	1733	275	678	346	8572	3032	0	5540	119031	4.88%	5.73%	0.24%		

Notes: The data table shows yearly statistics for the Central Malawi Conference from 1995 to 2022. The Central Malawi Conference corresponds to a *locality* in our sample and is part of the Malawi Union Conference. The Malawi Union Conference was called Malawi Union Mission before 2015, denoting a higher level of support from a supervisory body, as explained in A.1.2. The Central Malawi Conference was denoted Central Malawi Field before 2005 for the same reasons. Website accessed: «https://www.adventiststatistics.org/stats_y_stats.asp?FieldID=C10071&view=y_stats&StartYear=1900&EndYear=2022&submit=Build+Table» on September 2, 2024

A.1.1. Variable Definitions

- Year: Year in which the statistical values were reported.
- Churches: Total number of registered churches for the specified year and field.¹⁶
- Companies: Total number of registered companies for the specified year and field.¹⁷
- Beginning Membership: Membership at the beginning of the year.
- Baptisms: Number of additions by baptism reported for the given year.

¹⁶A local church is a mature congregation that has representation in conference sessions.

¹⁷A company is a congregation that has not yet achieved maturity and has not formally been organized as a local church.

- Former Member Baptisms: Number of additions by baptisms of former members (previously removed by dropped or missing).
- Professions of Faith: Number of additions by profession of faith¹⁸ reported for the given year.
- Transfers In: Number of additions by transfer of membership into this conference during the year.
- Transfers Out: Number of losses by transfer of membership out of this conference during the year.
- Deaths: Number of losses by death.
- Dropped: Number of memberships dropped by individual request.
- Missing: Number of members reported missing.
- Total Gains: Total number of members added by all methods. Total Gains = Baptisms + Former Member Baptism + Profession of Faith + Transfers In.
- Total Losses: Total number of members removed by all methods. Total Losses = Dropped + Missing + Death + Transfers Out.
- Adjust: Used historically to note adjustments needed to ensure consistency because of reporting errors or subsequent corrections. 'Adjustments' can also be used by fields to report membership corrections that do not necessarily fit in other columns.
- Net Growth: Shows the net growth during the year. Formula: Net Growth = Ending Membership - Beginning Membership.
- Ending Membership: Membership reported at the end of the given year.
- Ordained Ministers: Number of ordained ministers.¹⁹
- Licensed Ministers: Number of licensed ministers.²⁰

For our analyses, we define *Total Gains* (or simply *Gains*) as the sum of Baptisms, Former Member Baptisms, and Professions of Faith and exclude transfers in. Likewise, we define *Total Losses* (or *Losses*) as the sum of Dropped and Missing, and again exclude transfers out (as transfers are likely more due to reorganizations in SDA structures).

¹⁸A profession of faith is an alternative to baptism for individuals to become members. It is reserved for people who previously belonged to another church and had already been baptized by immersion.

¹⁹An ordained minister is a licensed minister with years of experience that has proved themselves in pastoral ministry.

²⁰A licensed minister is a minister that has received a license, which means one that has started out their pastoral track but is still inexperienced.

A.1.2. SDA Organizational Structure

We conduct our analyses at the lowest geographical level of organization of the SDA Church. This corresponds to the public data available from the SDA's Office of Archives, Statistics, and Research (ASTR).

The organizational structure of the Seventh-day Adventist Church (North American Division of Seventh-day Adventists, 2024) consists of four main elements that operate within a global framework.

- **Local Church:** The foundational unit of the Church, composed of individual members. A Local Church is officially recognized by the constituency session of a local Conference or Mission, which grants it status as a Seventh-day Adventist Church. (The SDA's ASTR does not provide data at the level of "local churches", but only at the next level above the local church level.)
- **Local Conference/Mission:** A group of Local Churches within a defined geographic area. A Local Conference is granted official status by the constituency session of a Union Conference or Mission. The term "Conference" indicates a high level of self-governance, whereas "Mission" denotes an organization that receives direct support from a supervisory body.
- **Union Conference/Mission:** This is a grouping of local Conferences and/or Missions within a specific geographic territory. A Union Conference/Mission is granted official status by the General Conference's constituency session. The Union's membership consists of local Conferences and Missions.
- **General Conference:** The highest organizational level, encompassing all Union Missions, Union Conferences, and other directly attached fields globally. The General Conference provides supervision and assistance to the Church's operations worldwide.

The General Conference (the SDA's highest organizational level) is divided into "divisions" or regional offices. The SDA divisions are the following: East-Central Africa Division (ECD), Euro-Asia Division (ESD), Inter-American Division (IAD), Inter-European Division (EUD), North American Division (NAD), Northern Asia-Pacific Division (NSD), South American Division (SAD), South Pacific Division (SPD), Southern Africa-Indian Ocean Division (SID), Southern Asia Division (SUD), Southern Asia-Pacific Division (SSD), Trans-European Division (TED), and West-Central Africa Division (WAD).

The countries in our sample come from WAD, ECD, SID, as well as the Middle East and North Africa Union Mission.

Administratively speaking, many Missions and Conferences are further subdivided into Fields (Seventh-Day Adventist Church, Monrovia Central, 2018; Adventist Statistics, 2024). As such, the lowest administrative level in each geographical can be a Mission, a Conference, or a Field. Our analyses always take the lowest administrative level available as our unit of analysis, because this is the lowest level at which the data are made available to the public.

A.2. Localities

To construct our unit of analysis, which we refer to as the *locality*, we gathered information from several sources. First, using the ASTR’s website structure, we identified all the units at the lowest level of the organizational structure of the Seventh-Day Adventist Church and scraped their membership tables for each one of them. Then, we compared the units available with the ones listed in the SDA Yearbooks, identifying the *geographical territory* of each locality. Figure A2 provides examples of territorial definitions in the 2015 SDA Yearbook.

Figure A2: 2015 SDA Yearbook

<p>EAST ASSOCIATION MISSION Organized 1985</p> <p>Territory: The provinces of Lunda Norte, Lunda Sul, and Moxico.</p>	<p>NORTH BOTSWANA CONFERENCE Established 1921; organized 1951; reorganized 1984, 2008</p> <p>Territory: Central, Chobe, Ngamiland, and North-East Districts.</p>
<p>CENTRAL MALAWI CONFERENCE Organized 1964; reorganized 2008</p> <p>Territory: Central region of Malawi.</p>	<p>SOUTH KENYA CONFERENCE Organized 1912; reorganized 1953, 1981</p> <p>Territory: Central and South Kisii, Trans-Mara, Narok, Gucha, and Masaba Districts.</p>

Notes: The figure presents the territories of four *localities*, as described in the 2015 SDA Yearbook: the East Association Mission of Angola, the North Botswana Conference, the Central Malawi Conference, and the South Kenya Conference.

Given the expansion of the SDA church, *localities* go through slight changes over the years, adapting to their growing membership by splitting Missions, Conferences, or Fields into smaller units over time. Instead of trying to modify these units to match across the entire sample period, we decided to respect their structure by identifying as a locality a Mission, Conference, or Field that has the exact same boundaries over time, for as many years as the locality’s geographical territory remains constant. This yields an unbalanced panel, with a varying number of localities across years (ranging from 93 in 1991 to 195 in 2020).

For most of these *localities*, the sub-national units described in the *territory* description in the corresponding SDA Yearbook are straightforward, as seen in Figure A2, describing the exact districts, states, or regions encompassed by the Mission, Conference, or Field. In a minority of cases, Yearbook territorial definitions were ambiguous, requiring us to make informed judgments about exact locality boundaries.

A.3. GAEZ

GAEZ is a seven-stage model that combines soil and climate data to produce estimates of potential yields under different assumptions. The calculated yield of each crop/land utilization type (LUT) is affected by water sources (e.g., rain-fed vs. irrigated) and by the assumed intensity of inputs and management (e.g., low vs. high).

For this study, we selected the rain-fed, low-level option of inputs for each crop to reduce potential concerns that the choice of (high) agricultural inputs or irrigation reflects endogenous decisions that could be potentially correlated with religious adherence.²¹

A.4. Concordance of GAEZ crops with Crops in FAO Production Data

Appendix Table A1 shows the concordance we use to match crops found in the GAEZ data with crops found in the FAO production database.

²¹According to the GAEZ documentation, under a low level of inputs, the farming system is largely subsistence-based. The production relies on traditional cultivars, labor-intensive techniques, no application of plant nutrients, no use of chemicals for pest and disease control, and minimum conservation measures (FAO and IIASA, 2022).

Table A1: Mapping between GAEZ crops and FAO Production names

Crop Name	GAEZ Abbreviation	FAO Specification List
banana	bana	Bananas
barley (best type)	barl	Barley
buckwheat	bckw	Buckwheat
phaseolous bean	bean	Beans, dry
cabbage	cabb	Cabbages
carrot	carr	Carrots and turnips
cassava	casv	Cassava, dry
chickpea	chck	Chick peas, dry
coconut	cocn	Coconuts, in shell
cacao (best type)	coco	Cocoa beans
coffee (best type)	coff	Coffee, green
cotton	cott	Cotton linters
cowpea	cowp	Cow peas, dry
dry peas	dpea	Peas, dry
flax fibre	flax	Flax, raw or retted
gram	gram	Chick peas, dry
groundnut	grnd	Groundnuts, excluding shelled
maize (best type)	maiz	Maize (corn)
millet (best type)	mllt	Millet
oat	oats	Oats
oil palm	oilp	Palm oil
olive	oliv	Olive oil
onion	onio	Onions and shallots, dry (excluding dehydrated)
pigeonpea	pigp	Pigeon peas, dry
rapeseed	rape	Rape or colza seed
dryland rice	ricd	Rice
rye (best type)	ryes	Rye
sorghum (best type)	sorg	Sorghum
soybean	soyb	Soya beans
sweet potato	spot	Sweet potatoes
sugar beet	sugb	Sugar beet
sugar cane	sugc	Sugar cane
sunflower	sunf	Sunflower seed
tea	teas	Tea leaves
tobacco	toba	Unmanufactured tobacco
tomato	toma	Tomatoes
wheat (best type)	whea	Wheat
yam (best type)	yams	Yams

A.5. FAO Export Prices

The Food and Agricultural Trade Dataset is collected, processed, and disseminated by FAO according to the standard International Merchandise Trade Statistics (IMTS) Methodology. The data is mainly provided by the United Nations Statistics Division, Eurostat, and other national authorities as needed. This source data is checked for outliers, trade partner data is used for non-reporting countries or missing cells, and data on food aid is added to take into account total cross-border trade flows (Food and Agriculture Organization of the United Nations (FAO), 2024). The data contains information on import and export quantities and values at a country-year level starting in 1961. Quantities are reported in thousands of animals or tonnes, (only the latter being relevant for our analyses). Values are adjusted using US prices and reported in thousands of real 2010 US dollars. With this information, we construct a panel of time-varying trade prices at the country level, focusing on Sub-Saharan Africa (SSA). The dataset is first filtered to retain only observations corresponding to crops matching the FAO GAEZ crops as listed in Annex A.4, for which land suitability is measured. Export prices are calculated by dividing export value by export quantity, when both values are different from zero, and assigning a missing value otherwise. Thus, prices correspond to thousands of US dollars per ton. To adjust for inflation – since the export values are reported in US dollars – prices are further deflated using the U.S. Consumer Price Index (CPI) from the The World Bank (2024). The data is filtered to include only SSA countries. Finally, missing country-crop-year combinations are filled in with the average of available prices for countries in the region for each crop-year combination, weighted by the export volume of each country.

A.6. Seventh-Day Adventist Global Church Member Survey (GCMS)

The General Conference of the SDA church commissioned the Global Church Member Survey (GCMS) over three rounds: 2013, 2017, and 2022. The GCMS was fielded in each of these years in the church's global membership, at the individual level. The Meta-Analysis Research Team at Andrews University worked with the ASTR and the research teams from each Division during the development of the surveys. Each research team chooses the data collection format that fits their needs. The vast majority of them are collected in-person, with mail, electronic surveys in asynchronous mode, and synchronous group settings being the second, third, and fourth most common (66%, 12%, 11%, and 11% respectively for the third GCMS round).²² Participation is voluntary. The survey is administered at the individual level. There is no intentional individual-level

²²For a small portion of the data, they do not have registries of the collection method.

panel dimension; while some individuals may be present in the panel for multiple years, no individually-identifying data is collected to connect these individuals over time. We use the country-level geographic identifiers in the dataset to create a panel of cross-sections over time.

The survey first asks for demographic characteristics such as gender, age, marital status, and education. Of greatest interest to us are questions on religious behavior and beliefs. To maintain comparable questions for our analysis, and due to lower sample sizes and more aggregation of units, we exclude the first round for our estimations. In both the 2017 and 2022 rounds, members are asked whether they agree or disagree with statements aiming at measuring their *spiritual struggle*:

- In some ways I think I am spiritually lost.
- My faith has been shaken and I am not sure what I believe.
- I feel I have lost some important spiritual meaning that I had before.

All responses to these questions are on a five-point scale that ranges from one (strongly disagree) to five (strongly agree). We define a “spiritual struggle” index as the average of these three questions (on feeling “spiritually lost”, that their “faith has been shaken”, and that they have “lost some important spiritual meaning”).

Additionally, the GCMS includes questions regarding the consumption of alcohol and tobacco. (There are no questions on the consumption of coffee or tea, and no questions on the production of any of these goods.) The 2017 round asks a yes or no question on whether the members have consumed tobacco or alcohol in the past 12 months. The 2022 round asks how often members have consumed alcohol or tobacco in the past 12 months, with the options being: never, once or twice, 3-10 times, or more than 10 times. To make the questions comparable, for the 2022 round we group all answers for which the members have consumed any amount of alcohol or tobacco as a yes. We then construct indicator variables for the 2017 and 2022 rounds indicating whether the individual has consumed these prohibited goods in the last 12 months (separately for alcohol and tobacco).

See Table B2 for summary statistics of the GCMS data. The final sample once we restrict to the countries included in our sample is around 35,000 across the two GCMS rounds. The average alcohol usage across the two survey rounds is 7%, and the average tobacco usage is 3%. The mean of “Spiritual Struggle” is 2.88 and its standard deviation is 1.07.

A.7. Nighttime Lights

The harmonized global nighttime light dataset from Li et al. (2020) consistently integrates records of nightscape from the Defense Meteorological Satellite Program (DMSP) and the Visible Infrared Imaging Radiometer Suite (VIIRS). From their dataset, we use the DMSP data, which reports nighttime light information at a 30 arc-seconds resolution (approximately one kilometer) in digital numbers (DN). DN values range from 0 to 63, where higher values indicate more intense light emissions (Li et al., 2020). To use a consistent measurement for a proxy of economic development previous to our sample, we use the 1992 data, taking the population-weighted average across each locality to build our nighttime lights (NL) variable.

A.8. Droughts

The Global SPEI Database 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 multi-scalar drought index – the standardized precipitation evapotranspiration index (SPEI).²³ This measure 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), we 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. The SPEI standardized scale defines the following categories of drought: Slight $(0, -0.9)$, Moderate $[-0.9, -1.5)$, Severe $[-1.5, -2)$, and Extreme $[-2, -\infty)$.

We combine the shapefiles for the SDA localities with the drought data to build yearly measurements of droughts for each locality. We take the highest level of drought in the 12-month period for each pixel in the SPEI data, and then take averages across pixels within each SDA locality. We do this separately in each year of analysis. This yields a measure of droughts at the locality-year level: the within-locality average of the pixel-level max drought across months (in a particular year). Lastly, we flip the sign of the variable to obtain a more intuitive interpretation, with higher values representing higher levels of drought.

²³Based on the Palmer drought severity index (UCAR-PDSI, 2.5°).

Appendix B. Additional Tables & Figures

B.1. Summary Statistics

Table B1: Summary Statistics: SDA Membership Data

	Mean	SD	p10	p25	p50	p75	p90	Min	Max	N
Costs:										
SDA Cost _t	14.36	56.14	0.00	0.00	0.00	0.46	24.30	0.00	652.93	4,238
SDA Cost _{t-1}	14.03	55.97	0.00	0.00	0.00	0.21	21.89	0.00	677.20	4,238
SDA Cost _{t-2}	14.80	58.57	0.00	0.00	0.00	0.21	23.30	0.00	677.20	4,238
SDA Cost _{t-3}	14.91	59.09	0.00	0.00	0.00	0.15	23.09	0.00	677.20	4,238
Average Costs:										
SDA Cost _{t,t-1}	14.20	45.13	0.00	0.00	0.00	4.37	36.91	0.00	645.51	4,238
SDA Cost _{t,t-2}	14.40	41.69	0.00	0.00	0.00	7.33	41.27	0.00	593.24	4,238
SDA Cost _{t,t-3}	14.53	39.71	0.00	0.00	0.01	9.73	44.07	0.00	457.48	4,238
Dependent Variables:										
Gains	3022.61	4253.70	100.00	379.00	1255.00	4162.00	8133.00	0.00	47397.00	4,238
Net Gains	2533.25	3804.67	50.00	287.00	1016.50	3323.00	6997.00	0.00	44651.00	4,238
Losses	628.00	2803.45	0.00	5.00	94.00	513.00	1501.00	0.00	1.3e+05	4,238
Supply-Side Variables:										
Churches	319.13	366.58	23.00	69.00	189.50	442.00	776.00	0.00	2735.00	4,238
Institutions	2.38	3.28	0.00	0.00	1.00	3.00	7.00	0.00	19.00	4,238

Notes: Data are at the locality-year level, for sub-national localities of the Seventh-Day Adventist church. $SDACost_t$ and other opportunity cost variables calculated as described in Section 3.2. Data are an unbalanced panel from 1991 to 2022, for up to XX localities per year. Data on membership and churches are from the SDA Office of Archives, Statistics, and Research (ASTR). Data on institutions are counts of health and education facilities which we digitized from SDA Yearbooks (General Conference of Seventh-day Adventists, Archives, Statistics, and Research, 2023), extracting SDA institutions using listed addresses to geo-reference institutions and assign them to localities. Gains are defined as the total number of members added by all methods, including baptisms, former member baptisms, or professions of faith. Losses are defined as the total number of members removed from membership rolls, either by dropping membership or by being recorded as missing. Net gains are gains minus losses.

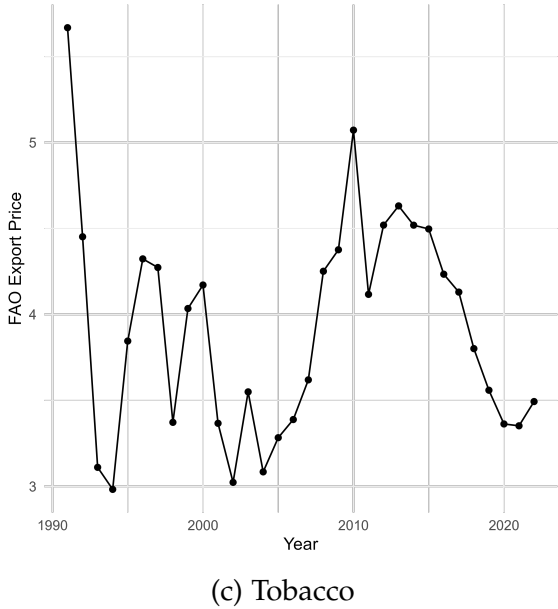
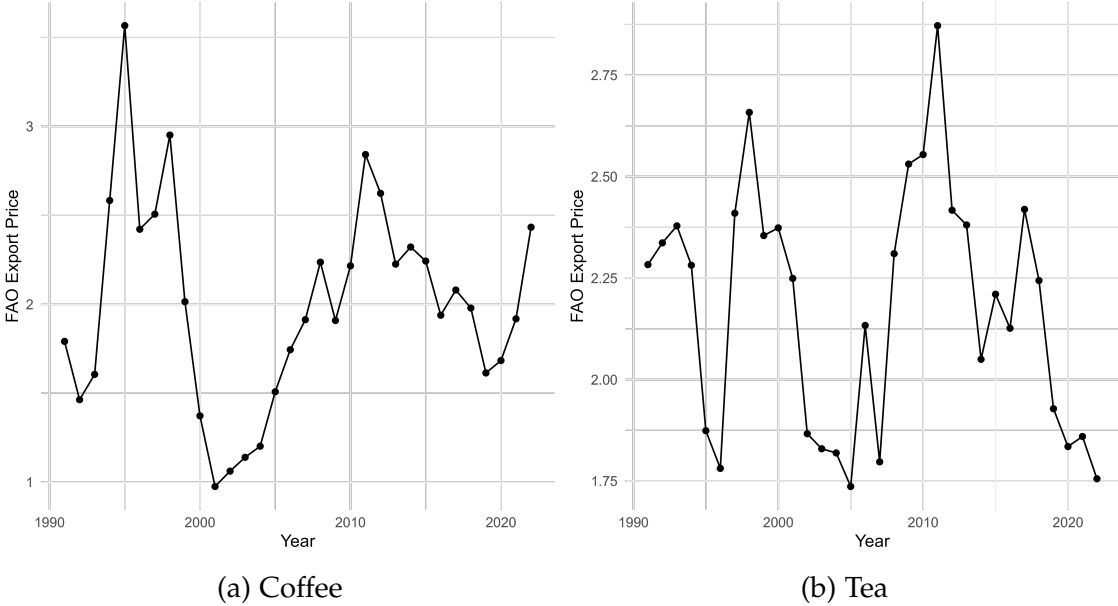
Table B2: Summary Statistics: SDA Member Surveys

	Mean	SD	Min	p10	p25	p50	p75	p90	Max	N
Prices:										
SDA Cost _t	3.14	5.84	0.00	0.00	0.00	0.11	1.46	10.28	80.85	35,127
SDA Cost _{t-1}	19.62	53.49	0.00	0.00	0.00	0.42	4.59	51.27	320.70	35,127
SDA Cost _{t-2}	4.24	13.67	0.00	0.00	0.00	0.54	3.42	3.43	168.50	35,127
SDA Cost _{t-3}	22.03	56.13	0.00	0.00	0.00	2.08	14.33	39.94	353.45	35,127
Dependent Variables:										
Sermons frequently mention Holistic Living	0.74	0.44	0.00	0.00	0.00	1.00	1.00	1.00	1.00	30,645
Commitment to SDA Church	0.95	0.21	0.00	1.00	1.00	1.00	1.00	1.00	1.00	32,739
Satisfied with SDA Church	0.81	0.39	0.00	0.00	1.00	1.00	1.00	1.00	1.00	32,690
Alcohol Usage	0.07	0.26	0.00	0.00	0.00	0.00	0.00	0.00	1.00	32,513
Tobacco Usage	0.03	0.16	0.00	0.00	0.00	0.00	0.00	0.00	1.00	32,286
Controls:										
Age	38.62	13.80	12.00	22.00	28.00	37.00	48.00	58.00	96.00	33,627
Female	0.39	0.49	0.00	0.00	0.00	0.00	1.00	1.00	1.00	34,345
Education Level	4.05	1.37	0.00	2.00	3.00	4.00	5.00	5.00	6.00	33,625

Notes: Data are at the country-year level, for Sub-Saharan Africa. Data are a two-period panel of countries in 2017 and 2022. Opportunity cost variables calculated as described in Section 3.2. Dependent variables are from the Global Church Member Survey (GCMS) (2017 and 2022).

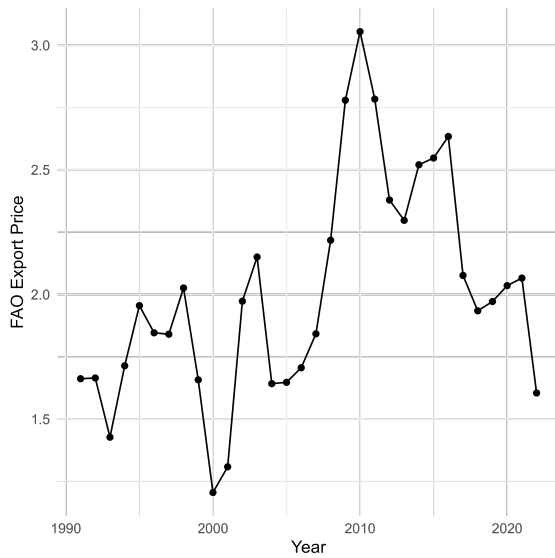
B.2. Price Time Series

Figure B3: Average FAO Export Prices: Prohibited Crops

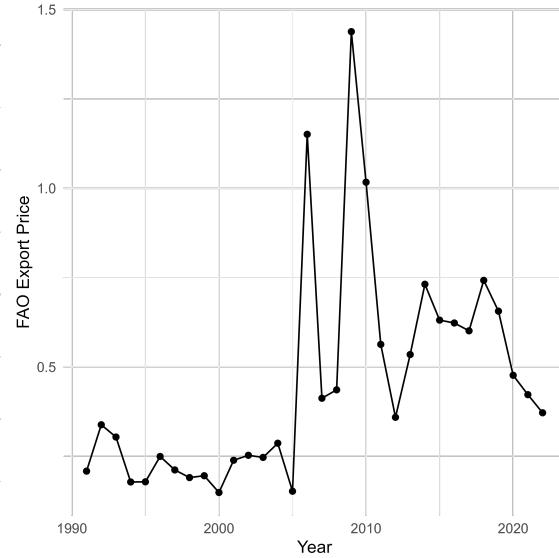


Notes: The figures present the regional (Sub-Saharan Africa) average FAO Export prices over time for crops prohibited or discouraged by the SDA (Food and Agriculture Organization of the United Nations (FAO), 2024).

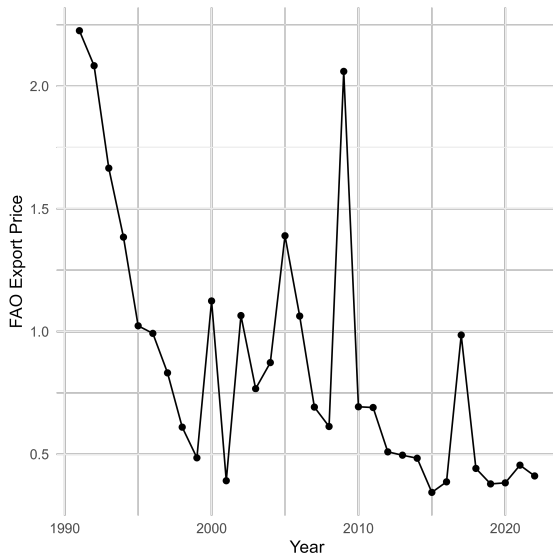
Figure B4: Average FAO Export Prices: Non-Prohibited Crops (Examples)



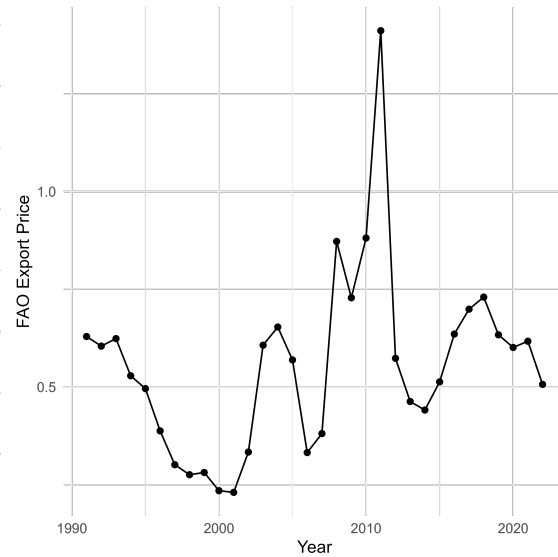
(a) Cacao



(b) Maize



(c) Carrot



(d) Sweet Potato

Notes: The figures present the regional (Sub-Saharan Africa) average FAO Export prices over time for a subset of crops that are neither prohibited nor discouraged by the SDA (Food and Agriculture Organization of the United Nations (FAO), 2024).

B.3. Production

Table B3: Impact of the Opportunity Cost of Religious Membership on Agricultural Production

	Dependent Variable: Log Area Harvested							
	Prohibited Crops				Non-Prohibited Crops			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SDA Cost _t ^t	0.002*** (0.001)				-0.000 (0.000)			
SDA Cost _{t,t-1} ^t		0.003*** (0.001)				-0.001 (0.000)		
SDA Cost _{t,t-2} ^t			0.003*** (0.001)				-0.001** (0.001)	
SDA Cost _{t,t-3} ^t				0.004*** (0.001)				-0.001** (0.001)
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Country Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1,073	1,073	1,073	1,073	1,337	1,337	1,337	1,337
Num Countries	35	35	35	35	44	44	44	44
Adjusted R2	0.906	0.907	0.908	0.908	0.987	0.987	0.988	0.988
Outcome Mean	100,752	100,752	100,752	100,752	3,632,479	3,632,479	3,632,479	3,632,479
Outcome SD	178,327	178,327	178,327	178,327	6,123,439	6,123,439	6,123,439	6,123,439

Notes: Observations are countries in Sub-Saharan Africa between 1994 and 2022. Standard errors clustered at the country level are presented in parentheses. *Area Harvested* is the total area harvested in each country-year for the given crops, measured in hectares. *Amount Produced* is the total production in each country-year for the given crops, measured in kilograms of dry weight. *Prohibited Crops* are coffee, tobacco, and tea. *Non-Prohibited Crops* are banana, barley, buckwheat, phaseolous bean, cabbage, cacao, carrot, cassava, chickpea, coconut, cotton, cow pea, dry peas, flax fiber, groundnuts, maize, millet, oat, palm oil, olive oil, onion, pigeon pea, rape seed, rice, rye, sorghum, soybean, sweet potato, sugar beet, sugar cane, sunflower, tomato, wheat, yam. *SDA Cost_{t,t-k}^t* measures the average opportunity cost of abiding by the SDA crop prohibitions—the revenue per hectare agricultural revenue given up per hectare due to abiding by SDA crop restrictions on coffee, tea, and tobacco—between years t and $t - k$. Estimated using Poisson regressions via pseudo-maximum likelihood; regressions exclude observations that are either singletons or separated by a fixed effect (Correia et al., 2020). Regressions control for country population in 1980 interacted with year fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.4. Alternative Specifications

Table B4: Impact of the Opportunity Cost of Religious Membership on Member Decisions: Placebo Test using Leads of the Opportunity Cost Measure

	Dependent Variable:					
	Net Gains		Gains		Losses	
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{SDA Cost_{t+1,t+2} > 0\}$	-0.018 (0.056)		0.001 (0.038)		-0.057 (0.180)	
$Q_1^+ \{SDA Cost_{t+1,t+2}\}$		-0.043 (0.078)		0.008 (0.052)		0.212 (0.250)
$Q_2^+ \{SDA Cost_{t+1,t+2}\}$		-0.032 (0.041)		-0.009 (0.033)		-0.070 (0.168)
$Q_3^+ \{SDA Cost_{t+1,t+2}\}$		-0.000 (0.079)		-0.019 (0.056)		-0.292 (0.222)
$Q_4^+ \{SDA Cost_{t+1,t+2}\}$		0.038 (0.076)		0.028 (0.045)		-0.370 (0.328)
Locality Fixed Effects	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	4,020	4,020	4,020	4,020	3,960	3,960
Num SDA Localities	407	407	407	407	394	394
Num Countries	44	44	44	44	44	44
Pseudo R^2	0.856	0.856	0.905	0.905	0.662	0.666
Outcome Mean	2523.512	2523.512	3013.940	3013.940	625.610	625.610
Outcome SD	3796.311	3796.311	4259.246	4259.246	2753.488	2753.488

Notes: Observations are SDA localities in Sub-Saharan Africa between 1991 and 2022. Standard errors clustered at the country level are presented in parentheses. *Gains* is the number of reported baptisms, professions of faith, and former member baptisms in the SDA locality in a given year. *Losses* is the number of reported dropped and missing members in the SDA locality in a given year. *Net Gains* is reported gains minus losses. $SDA Cost_{t,t+k}$ measures the average opportunity cost of abiding by the SDA crop prohibitions: the agricultural revenue per hectare given up per hectare if *constrained* by SDA crop restrictions on coffee, tea, and tobacco—between years $t+1$ and $t+k$. $\mathbb{1}(x > 0)$ represents the indicator function that equals 1 when x is greater than zero and 0 otherwise. $Q^+(x)$ represent indicator variables equal to 1 if x is in k th quartile of non-zero values of x and 0 otherwise. Estimated using Poisson regressions via pseudo-maximum likelihood; regressions exclude observations that are either singletons or separated by a fixed effect (Correia et al., 2020). Regressions control for population in each locality in 1980 interacted with year fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.5. Accounting for Maximum Unconstrained Revenue

Table B5: Impact of the Opportunity Cost of Religious Membership on Member Decisions: Controlling for Maximum Potential Revenue

	Dependent Variable:					
	Net Gains		Gains		Losses	
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}\{SDA Cost_{t,t-2} > 0\}$	-0.104** (0.048)		-0.080** (0.034)		0.282* (0.164)	
$Q_1^+ \{SDA Cost_{t,t-2}\}$		-0.060 (0.040)		-0.037 (0.028)		0.484* (0.283)
$Q_2^+ \{SDA Cost_{t,t-2}\}$		-0.099 (0.094)		-0.081 (0.069)		0.040 (0.188)
$Q_3^+ \{SDA Cost_{t,t-2}\}$		-0.158*** (0.044)		-0.121*** (0.036)		0.294* (0.161)
$Q_4^+ \{SDA Cost_{t,t-2}\}$		-0.194*** (0.052)		-0.171*** (0.050)		-0.097 (0.191)
$\ln(R_{t,t-2}^{max,t})$	-0.004 (0.115)	-0.021 (0.116)	0.055 (0.110)	0.035 (0.110)	1.024** (0.502)	0.942* (0.500)
Locality Fixed Effects	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y
Observations	4,238	4,238	4,238	4,238	4,175	4,175
Num SDA Localities	424	424	424	424	412	412
Num Countries	44	44	44	44	44	44
Pseudo R^2	0.856	0.856	0.905	0.905	0.666	0.670
Outcome Mean	2533.254	2533.254	3022.607	3022.607	637.481	637.481
Outcome SD	3804.671	3804.671	4253.701	4253.701	2823.458	2823.458

Notes: Observations are SDA localities in Sub-Saharan Africa between 1991 and 2022. Standard errors clustered at the country level are presented in parentheses. *Gains* is the number of reported baptisms, professions of faith, and former member baptisms in the SDA locality in a given year. *Losses* is the number of reported dropped and missing members in the SDA locality in a given year. *Net Gains* is reported gains minus losses. $SDA Cost_{t,t-k}$ measures the average opportunity cost of abiding by the SDA crop prohibitions: the agricultural revenue per hectare given up per hectare if *constrained* by SDA crop restrictions on coffee, tea, and tobacco—between years t and $t-k$. $R_{t,t-k}^{max,t}$ measures the average maximum potential *unconstrained* agricultural revenue—the agricultural revenue per hectare for producing the maximum potential revenue crop regardless of prohibitions—between years t and $t-k$ in a SDA locality. $\mathbb{1}(x > 0)$ represents the indicator function that equals 1 when x is greater than zero and 0 otherwise. $Q^+(x)$ represent indicator variables equal to 1 if x is in k th quartile of non-zero values of x and 0 otherwise. Estimated using Poisson regressions via pseudo-maximum likelihood; regressions exclude observations that are either singletons or separated by a fixed effect (Correia et al., 2020). Regressions control for population in each locality in 1980 interacted with year fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B6: Impact of the Opportunity Cost on Church Responses:
Controlling for Maximum Potential Revenue

	Dependent Variable:			
	Churches		Institutions	
	(1)	(2)	(3)	(4)
$\mathbb{1}\{SDAcost_{t,t-2}^l\}=1$	-0.011 (0.021)		0.081*** (0.028)	
$Q_1\{SDAcost_{t,t-2}^l\}$		-0.007 (0.027)		0.090*** (0.031)
$Q_2\{SDAcost_{t,t-2}^l\}$		-0.035 (0.022)		0.076** (0.035)
$Q_3\{SDAcost_{t,t-2}^l\}$		0.023 (0.018)		0.066* (0.034)
$Q_4\{SDAcost_{t,t-2}^l\}$		0.017 (0.016)		0.057 (0.041)
$\ln(R_{t,t-2}^{max,l})$	0.015 (0.038)	0.020 (0.041)	-0.008 (0.098)	-0.015 (0.096)
Locality Fixed Effects	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y
Observations	4,238	4,238	2,700	2,700
Num SDA Localities	424	424	266	266
Num Countries	44	44	32	32
Pseudo R^2	0.945	0.946	0.465	0.466
Outcome Mean	319.130	319.130	3.725	3.725
Outcome SD	366.580	366.580	3.440	3.440

Notes: Observations are SDA localities in Sub-Saharan Africa between 1994 and 2022. Standard errors clustered at the country level are presented in parentheses. *Churches* is the number of reported churches and companies in the SDA locality in a given year. *Institutions* the total number of education and health institutions in the SDA locality in a given year. $SDA Cost_{t,t-k}$ measures the average opportunity cost of abiding by the SDA crop prohibitions—the agricultural revenue per hectare given up per hectare if *constrained* by SDA crop restrictions on coffee, tea, and tobacco—between years t and $t-k$ (see Appendix A). $R_{t,t-k}^{max}$ measures the average maximum potential *unconstrained* agricultural revenue—the agricultural revenue per hectare for producing the maximum potential revenue crop regardless of prohibitions—between years t and $t-k$ in a SDA locality. $\mathbb{1}(x > 0)$ represents the indicator function that equals 1 when x is greater than zero and 0 otherwise. $Q^+(x)$ represent indicator variables equal to 1 if x is in k th quartile of non-zero values of x and 0 otherwise. Estimated using Poisson regressions via pseudo-maximum likelihood; regressions exclude observations that are either singletons or separated by a fixed effect (Correia et al., 2020). Regressions control for population in each locality in 1980 interacted with year fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.6. Heterogeneity

Table B7: Impact of the Opportunity Cost of Religious Membership on Membership Decisions: Heterogeneity by Share of Population that is an SDA Member in a Locality

	Dependent Variable:		
	Net Gains	Gains	Losses
	(1)	(2)	(3)
$\mathbb{1}\{SDA Cost_{t,t-2} > 0\}$	-0.185*** (0.034)	-0.128*** (0.029)	0.452** (0.204)
$\mathbb{1}\{SDA Cost_{t,t-2} > 0\} * SDA_{rSDA}$	0.013*** (0.005)	0.007*** (0.002)	-0.037*** (0.012)
Locality Fixed Effects	Y	Y	Y
Year Fixed Effects	Y	Y	Y
Observations	4,238	4,238	4,175
Num SDA Localities	424	424	412
Num Countries	44	44	44
Pseudo R^2	0.857	0.905	0.665
Outcome Mean	2533.254	3022.607	637.481
Outcome SD	3804.671	4253.701	2823.458

Notes: Observations are SDA localities in Sub-Saharan Africa between 1991 and 2022. Standard errors clustered at the country level are presented in parentheses. *Gains* is the number of reported baptisms, professions of faith, and former member baptisms in the SDA locality in a given year. *Losses* is the number of reported dropped and missing members in the SDA locality in a given year. *Net Gains* is reported gains minus losses. SDA_{rSDA} is the share of the population that are SDA members in a locality in the first year a locality appears in the SDA records. The denominator is estimated population in 1980 per locality based on Klein Goldewijk et al. (2017). $SDA Cost_{t,t-k}$ measures the average opportunity cost of abiding by the SDA crop prohibitions—the agricultural revenue per hectare given up per hectare if *constrained* by SDA crop restrictions on coffee, tea, and tobacco—between years t and $t - k$. $\mathbb{1}(x > 0)$ represents the indicator function that equals 1 when x is greater than zero and 0 otherwise. $Q^+(x)$ represent indicator variables equal to 1 if x is in k th quartile of non-zero values of x and 0 otherwise. Estimated using Poisson regressions via pseudo-maximum likelihood; regressions exclude observations that are either singletons or separated by a fixed effect (Correia et al., 2020). Regressions control for population in each locality in 1980 interacted with year fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table B8: Impact of the Opportunity Cost of Religious Membership on Membership Decisions: Heterogeneity by Drought Experience

	Dependent Variable:		
	Net Gains	Gains	Losses
	(1)	(2)	(3)
$\mathbb{1}\{SDA Cost_{t,t-2} > 0\}$	-0.141*** (0.051)	-0.118*** (0.039)	0.056 (0.103)
$\mathbb{1}\{SDA Cost_{t,t-2} > 0\} * Drought$	0.064* (0.038)	0.060** (0.026)	0.239 (0.146)
Locality Fixed Effects	Y	Y	Y
Year Fixed Effects	Y	Y	Y
Observations	4,238	4,238	4,175
Num SDA Localities	424	424	412
Num Countries	44	44	44
Pseudo R^2	0.856	0.905	0.672
Outcome Mean	2533.254	3022.607	637.481
Outcome SD	3804.671	4253.701	2823.458

Notes: Observations are SDA localities in Sub-Saharan Africa between 1991 and 2022. Standard errors clustered at the country level are presented in parentheses. *Gains* is the number of reported baptisms, professions of faith, and former member baptisms in the SDA locality in a given year. *Losses* is the number of reported dropped and missing members in the SDA locality in a given year. *Net Gains* is reported gains minus losses. *Drought* is the average value for each year of the highest drought point during the year of each pixel for each locality. $SDA Cost_{t,t-k}$ measures the average opportunity cost of abiding by the SDA crop prohibitions—the agricultural revenue per hectare given up per hectare if *constrained* by SDA crop restrictions on coffee, tea, and tobacco—between years t and $t - k$. $\mathbb{1}(x > 0)$ represents the indicator function that equals 1 when x is greater than zero and 0 otherwise. $Q^+(x)$ represent indicator variables equal to 1 if x is in k th quartile of non-zero values of x and 0 otherwise. Estimated using Poisson regressions via pseudo-maximum likelihood; regressions exclude observations that are either singletons or separated by a fixed effect (Correia et al., 2020). Regressions control for population in each locality in 1980 interacted with year fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.