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Christianization without economic development: Evidence from missions in Ghana

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ABSTRACT

One of the most powerful cultural transformations of the 20th century has been the dramatic expansion of Christianity outside of Europe. This unique historical process was facilitated by vast Christian missionary efforts. In this paper, we study the economic effects of Christian missions in Ghana. We rely on six distinct identification strategies that exploit exogenous variations in Christian missionary expansion from 1828 to 1932. We find no association between Christian missions, whether Protestant, Catholic, Presbyterian or Methodist, and local economic development, whether during contemporary or colonial times. However, some results suggest that Christian missions might have had a positive effect on human capital formation. There might thus be contexts in which missions promoted human capital accumulation without this necessarily translating into local economic development.

One of the most enduring questions in the social sciences concerns the role of religion in economic development. Religion has shaped institutions and people's beliefs, thereby possibly affecting choices in such variables as education, health, savings, entrepreneurship, social trust, redistribution, and public good provision. These in turn may fuel or hamper development.[2]

The Protestant Reformation in 16th century Europe has been regarded as a pivotal event with far-reaching economic effects (Becker and Woessmann, 2009; Inglehart and Baker, 2000; Landes, 1998; Woodberry, 2012). The most significant re-

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[2] See Iyer (2016), Barro and McCleary (2019), Carvalho et al. (2019) and Becker et al. (2021) for surveys.

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ligious transformation of the 19th and 20th centuries has been the dramatic expansion of Christianity *outside* of Europe, facilitated by vast missionary efforts. A recent, yet vibrant, literature has shown positive long-term effects of Christian missions established during colonial times on religion, human capital and health in Africa (Alesina et al., 2021; Baten et al.; Cagé and Rueda, 2016, 2020; Cogneau and Moradi, 2014; Jedwab et al., 2019; Nunn, 2010, 2014; Okoye and Pongou, 2019; Wantchekon et al., 2015), Asia (Bai and Kung, 2015; Calvi et al.; Calvi and Mantovanelli, 2018; Castelló-Climent et al., 2018; Menon and McQueeney, 2020), the Americas (Feir et al., 2019; Valencia Caicedo, 2019; Waldinger, 2017) and globally (Woodberry, 2012; Acemoglu et al., 2014).[3] The question is whether Christian missionary efforts also affected economic development. For Asia and Latin America, Bai and Kung, 2015, Valencia Caicedo (2019b), and Calvi et al. find a positive relationship between missionary presence and measures of present-day economic development. Within Africa, Wietzke (2015) reports a negative association for Madagascar, whereas Boateng et al., 2019 find a positive correlation for Ghana. However, these last two studies do not rely on identification strategies.

In this paper we investigate the diffusion of Christianity in colonial Ghana and its repercussions on economic development at the local level. We develop a series of identification strategies, based on exogenous variation in missionary expansion, to examine the development effects of Christianity in general, and certain denominations in particular. We focus on Ghana, for which we created a novel dataset on the locations of Christian missions over one century, contemporary religion, and economic development at a fine spatial level: 2091 grid cells of 0.1×0.1 degrees (11×11 km). Today, the vast majority (ca. 80%) of Ghanaians are Christians divided into Protestant and Catholic faiths (ICF), making Ghana an ideal testing ground. The availability of detailed data on the spread of Christian missions from 1751 to 1932 in Ghana, as well as contemporary *and* historical data on religious affiliation and local economic development, enables us to examine both colonial and contemporary effects of missions from various Christian denominations.

An extensive literature has associated Protestantism with favorable long-term outcomes. Compared to the Catholic practice of reading out the scriptures in Latin, Lutherans' emphasis of worshipers' reading of the gospel generated the necessary human capital (literacy) for Protestant economies in Europe to prosper (Becker and Woessmann, 2009, 2010). Also, Rubin (2014, 2017) finds that the diffusion of the printing press that spread Protestantism helped to undermine the legitimacy of religious authorities that ultimately spurred parliamentarism. Protestant missionaries have been associated with better educational outcomes today in China, Africa and India (Alesina et al., 2021; Bai and Kung, 2015; Cagé and Rueda, 2016; Calvi et al.; Chen et al., 2014; Gallego and Woodberry, 2010; Nunn, 2014). Thus, the first hypothesis we test is that Protestant missions positively affected economic development at the local level in Ghana.

H1: Protestant missions induced more economic development

In addition, many studies emphasized differences between Christian denominations. Most famously, Weber (1905) argued that the Calvinist doctrine of predestination encouraged individuals to work hard and accumulate wealth (Weber 1905, p. 67, Barro and McCleary, 2019, pp. 49–51). Hornung (2014) documents substantial positive effects of the settlement of (higher skilled) French Huguenots in 18th century Prussia on long-run manufacturing productivity. Waldinger (2017), Valencia Caicedo (2019b) and Valencia Caicedo and Voth (2018) find differences between Catholic denominations adhering to different values in Latin America.

In our context, there were two Protestant mission societies: Presbyterians and Methodists. Their teachings and values differed in ways that the literature found influencing culture, beliefs and preferences and thereby ultimately economic outcomes (e.g. Guiso et al., 2006; Waldinger, 2017; Valencia Caicedo, 2019b). According to Wiltgen (1956, p. 137), the Presbyterians in Ghana "were by far the stronger and were the more energetic [...]. Each church and school of theirs had its accompanying workshop in which the missionaries tried to instill habits of industry." Moreover, each of their main mission stations had its own trading post exporting cash crops, which according to Sundkler and Steed (2000, p. 206) "[...] allowed the mission to play a dominant role in raising the standard of agriculture and in introducing new crops." Overall, Presbyterians were more Calvinist and pro-economic development (Miller 2003, p. 13).[4] Hence, we investigate the hypothesis that Presbyterian dominated regions are economically more advanced than Methodist ones.

H2: Presbyterian missions were more conducive to economic development as compared to Methodist ones

Catholicism is typically regarded as less aligned with capitalist culture as compared to Protestantism (Basten and Betz, 2013). However, in Africa, Catholicism absorbed followers of traditional religions. Hence, the effect of Catholicism may depend on the context studied and the comparison group selected. In fact, previous works have shown that Catholic missionary activities in colonial Africa positively affected present-day education (Gallego and Woodberry, 2010; Nunn, 2014; Wantchekon et al., 2015). Hence, we examine the effect of Catholic missions.

[3] See Meier zu Selhausen (2019) and Valencia Caicedo (2019a) for concise surveys of the literature on missionary legacies.

[4] In the U.S., Presbyterians are among the wealthiest and most educated denominations (Sander, 1992; Pew Research Center, 2014). Methodists are lower ranked but still ranked in the top third of religious denominations.

H3: Catholic missions were also conducive to economic development

Thus far, few works have examined the missionary impact *during* colonial times.[5] One may expect historical effects to fade away over time. For example, during colonial times mission schools were the primary providers of schooling (Frankema, 2012), but this changed after independence, when many African countries dramatically expanded government schooling. It is also conceivable that development effects gained momentum. By studying the effects of missionary expansion at different points in time, we can shed light on potential channels. Hence, we also investigate missions' developmental effects in the past.

H4: Christian missions influenced economic development during colonial times

Studying the impact of Christianization (Protestantism, Presbyterianism, and Catholicism) on development outcomes today, we propose *six* identification strategies. Five strategies exploit possibly exogenous variations in 19th and early 20th century missionary expansion. First, the (Protestant) Methodists and Presbyterians divided Ghana into spheres of influence in 1847. At the shared boundary, this created more competition and more Protestant missions in general. Second, the partition into spheres also geographically concentrated Methodists and Presbyterian missionary activities within their respective spheres of influence. This led to a discontinuity along the agreed boundary. Third, the spheres prompted Methodists and Presbyterians to direct their activities respectively west and east of the boundary and its continuation up to the border with Ivory Coast, thus constraining their expansion paths. Fourth, the Catholics were late-but-fast comers. Under prevailing Protestant and Muslim competition, their strategy was to expand further away from Protestant and Muslim core areas. Fifth, we exploit an extraordinary miracle: rain falling during missionary mass ending the 1932 drought and famine in northwestern Ghana, which caused Catholic mass-conversion and a different local trajectory. Finally, unlike most studies, we have panel data on the location of missions and local economic development during the colonial period itself. This enables us to study the effects of mission openings in an panel-event study framework.

Our analyses all point to the same result. Unlike previous studies, we find little support for an effect of Christian missions on economic development in Ghana - neither today nor in the past, nor when analyzing missions of various Christian denominations separately. However, two out of the five strategies show a positive association between Christian missions and human capital today. This suggests that there are contexts in which missions may have promoted human capital accumulation without this necessarily stimulating local economic development.

We differ from the literature in that we focus on local economic effects at the more macroeconomic level rather than effects at the individual level. Individual-level studies are problematic because they may capture distributional effects. For example, there may be many Christians found among the local elite. As such, this would not make the local society as a whole richer. In addition, unlike many studies that use one identification strategy (or none), our six identification strategies allow us to examine the effects of the same Christian denominations in different contexts. The broadly consistent results reinforce our main takeaways and address external validity concerns. Furthermore, we use exhaustive census data on the location of mission stations in Ghana. Previous studies instead have relied on mission atlases as their main source of mission data (e.g., Nunn, 2010; Cagé and Rueda, 2016). In Jedwab et al., 2019, we showed that mission atlases report centrally located, European residence missions in historically more developed areas. Relying on atlases leads to upward biased estimates of the effects of mission stations, a problem that this paper addresses. Next, unlike studies that examine the effects of missions for a whole continent, looking at spatial discontinuities within one country means that we compare groups that are subject to similar national institutions. Finally, to our knowledge, this paper is the first paper finding no long-term economic effect of colonial missions in a developing country.

Section 1 presents our data. Section 2 describes the religious development in Ghana and assesses religious persistence. Section 3 presents baseline OLS estimations. Section 4 describes our *five* strategies and presents their results. Section 5 sheds light on the impact of mission stations during colonial times. After presenting robustness tests in Section 6, Section 7 concludes.

1. Data

To study the role of Christianity in economic development, we partition Ghana into 2091 grid cells of 0.1 × 0.1 degrees (11 × 11 km), and regress measures of local economic development in 2000 on the population shares of various Christian denominations in 2000. However, the causal identification of this relationship poses a fundamental challenge. The placement of missions may have been affected by local economic conditions in the past, which raises endogeneity concerns insofar as those economic conditions persist into the present (Jedwab et al., 2019). We thus develop various identification strategies based on exogenous variations in Christian missionary expansion in colonial Ghana. We collect spatial data on contemporary and historical Christianity (and its determinants) and contemporary and historical economic development. Web Data Appendix Section A provides more details on sources and data construction. Descriptive statistics of the key variables used in the main tables are shown in Web Appendix Table B1.

[5] Cogneau and Moradi (2014), Wantchekon et al. (2015) and Dupraz (2019) are exceptions.

Christianity - Contemporary Period. We obtain the spatial distribution of Protestants and Catholics from a 10% sample of the 2000 Population Census (Ghana Statistical Service, 2000), whose enumeration areas we georeferenced.[6] The 2000 census did not, however, break down the Protestant denominations. Hence, to obtain the population shares of Presbyterians and Methodists we use survey data on both female and male adults (from age 15) from the Demographic and Health Surveys (DHS) (ICF, various). We use all DHS rounds for which there are GPS readings available, i.e. 1993, 1998, 2003, 2008, 2014, 2016, and 2017.[7] For each survey year, we compute the religious share within a cell, disregarding cells with less than 10 observations. We then obtain the share for 1993–2017 by averaging the shares across all available cells and years.

One issue when relying on the DHS could be that our measures of economic development refer to the year 2000, whereas some of the DHS survey the distribution of Christian denominations at a later point. One may be concerned about reverse causality. However, using data from the pre-2000 DHS surveys only would leave us with a smaller sample and noisier data, which would tilt results in favor of *not* finding a relationship between Christianity and economic development.[8] Given the persistence in religious dominance, 10 years should not make a major difference. In fact, spatial patterns in religion strongly agree between the DHS (1993–2017) and the census (2000). For example, the coefficient of correlation for the Protestant share is 0.81. Therefore, we treat the 1993–2017 DHS as a cross-section of Christian shares ca. 2000.

Christianity - Historical Period. From the ecclesiastical returns of the *Blue Books of the Gold Coast* 1844–1932 and numerous mission society reports 1751–1843 we created an annual, georeferenced and *exhaustive census* data set of all Christian mission stations in Ghana 1751–1932 (Jedwab et al., 2019). We count a total of 2144 mission stations. The Catholic, Presbyterian and Methodist denominations accounted altogether for 92.2% of all mission-years.

Contemporary Development Outcomes. (i) *Night light intensity:* We use satellite data on night lights in 2000 as a proxy for local economic development (NOAA, 2015).[9] To avoid issues related to top-coding, we use the radiance calibrated version of this data, which records levels of luminosity beyond the normal digital number upper bound of 63. (ii) *Urban population:* Census data on urbanization comes from Ghana Statistical Service (2000). We obtain for each cell the population share of all towns with more than 1000 inhabitants. (iii) *Other development outcomes:* Census data on skilled occupations, literacy, and child mortality in 2000 are taken from Ghana Statistical Service (2000). Variables are explained in more detail in Section 3

Colonial Development Outcomes. (i) *Urbanization:* The *Gold Coast Population Censuses* of 1891, 1901, 1911, 1921, and 1931 list most localities. Defining as a town any locality with more than 1000 inhabitants, we obtain a geospatialized panel of 633 towns that existed at any point in 1891–1931. We then obtain for each cell the total sum of their urban population in each year. (ii) *Education & health:* From the 1931 census, we obtained for each locality the number of individuals with education in or over standard 4. This is equivalent to four years of schooling and amounts to basic literacy (Kuczynski, 1948; Graham, 1971). Furthermore, the 1931 Census reported for each locality the number of infirmities diagnosed as leprosy, blindness, deafness and "mentally deranged".[10]

Finally, we use a vast number of control variables that measure economic and non-economic conditions in or before 1932. More precisely, these characteristics proxy for geography (coastal proximity, malaria), political conditions (important pre-colonial towns, early colonial boundary, colonial administrative cities), transportation (ports, rivers, trade routes, railroads, roads), population (rural and urban populations) and economic activities (slavery, cash crops, mines) in or before 1932. These come from Jedwab et al., 2019 and are described in detail in Section 3.

2. Background

2.1. The Christianization of Ghana 1828–2020

Around 1800, the vast majority of Ghanaians followed African traditional religions, apart from a Muslim stronghold in the northern part of the country, brought about by Muslim traders in the 18th century (Weiss, 2008, pp. 44–49). Today, Christianity is Ghana's most common religion.

Christianization started with two Protestant mission societies. The Presbyterians arrived in 1828 at Accra in the east, whereas the Methodists arrived in 1835 at Elmina in the west (Fig. 1(a) shows their respective locations).[11] Both mission societies then expanded along the coast and into the hinterland. Confronted with Protestant competition in the south, Catholic

[6] Since we only have data for 10% of the population census, the most rural cells of our sample do not have enough observations to correctly estimate these shares. Data is available for 1895 cells only (= 2091 - 196 missing cells).

[7] To ensure respondent confidentiality, the DHS displaced the GPS coordinates of residents by up to 2 km (urban) and 5 km (rural). Using 11 × 11 km cells mitigates this measurement error.

[8] The 1993 and 1998 DHS surveys consist of 11,245 women and 2846 men in 384 grid cells only. In contrast, using all 1993–2017 DHS surveys we obtain data for 74,709 women and 16,817 men in 982 grid cells.

[9] Night lights have become a standard measure in the stream of literature that studies development at the local level in the absence of localized income data (Henderson et al., 2012; Michalopoulos and Papaioannou, 2013).

[10] We georeferenced the 1931 localities using a matching approach based on place names (Web Appx. A.6).

[11] The history of Presbyterianism in Ghana is more complex than summarized here. At the very beginning, there were two mission societies, one from Basel in Switzerland ("Basel Mission"), the other one from Bremen in Germany ("North German Missionary Society"). Around 1900, the British and German governments confined their activities to the Gold Coast Colony and German Togoland, respectively. During World War I, the British government expelled Swiss and German missionaries (Miller, 2003, p. 15). Instantly, Scottish Presbyterians took over their mission stations (Jones, 1922, p. 134). Because there was a clear continuation, strong cooperation and similarities between the different Presbyterian mission societies, our study abstracts from these details and calls all of them "Presbyterians".

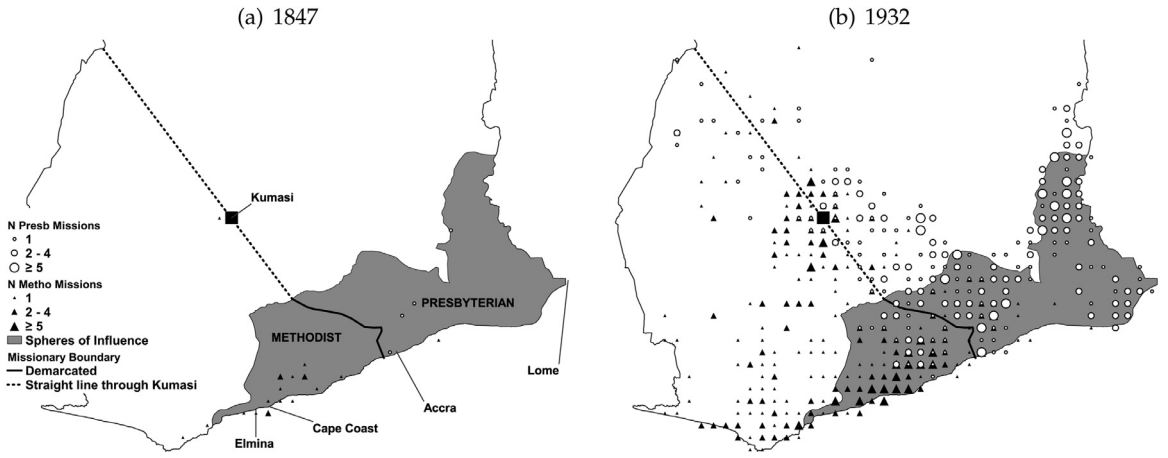

Fig. 1. Spheres of Influence and Location of Mission Stations of Presbyterians and Methodists. *Notes:* Fig. 1(a) shows the boundary (black line) between the "spheres of influence" (grey area) of the Methodists (left) and the Presbyterians (right) and the respective location and number of their mission stations in 1847, the year the mission societies agreed on an alliance (N Methodist / Presbyterian stations = 21 / 4). The demarcation line was retrieved from a 1:1,500,000 map of the Presbyterian mission society showing their mission field (Perthes, 1873). The dashed line labeled "Straight line through Kumasi" indicates the spheres that would have followed if, conditional on the spheres as of 1847, the societies had expanded towards the Ashanti capital Kumasi and beyond up to the border to the Ivory Coast, respectively. Fig. 1(b) shows the spheres and the location and number of missions for each group in 1932 (N Methodist / Presbyterian stations = 532 / 388). See Web Data Appendix for data sources.

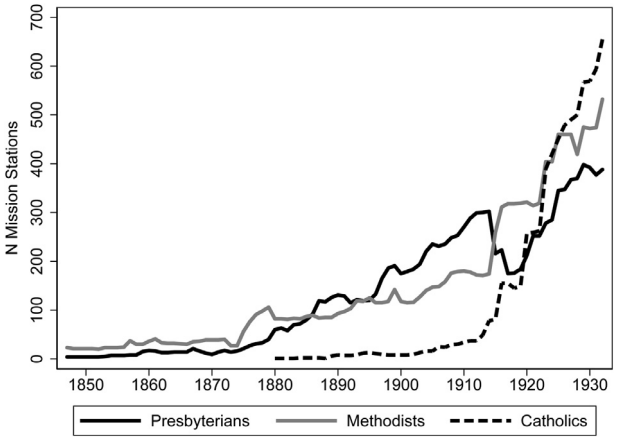

Fig. 2. Evolution of the Number of Mission Stations in Ghana, 1847–1932. *Notes:* Fig. 2 shows the respective evolution of the number of mission stations for the three main Christian denominations in Ghana annually from 1847 to 1932. See Web Data Appendix for details on the data.

missionaries arrived later at Elmina, in 1880. Initially, their progress was slow, but they caught up with the other denominations between 1910 and 1920, expanding northwards, and also entering from neighboring countries (Togo, Ivory Coast, Burkina Faso). Fig. 2 shows the number of mission stations of the three denominations over time. The top panel of Fig. 3 maps their geographic spread by 1932.

Figure 4 illustrates Ghana's religious transformation over the 20th century. Figure 4(a) shows that Ghana's Christian population share has increased from 2% in 1891 to 80% today, while the percentage of Muslims remained relatively stable at 15%. Christian conversions thus largely came from followers of traditional religions. Next, Fig. 4(b) shows the Christian denominations among Ghana's population. Until the 1970s, the two mainline Protestant groups (Presbyterians and Methodists) and the Catholics shared the Christian market roughly equally. After the 1970s, Pentecostal, charismatic and other African churches gained momentum.

The bottom panel of Fig. 3 maps the geographic distribution of Methodists, Presbyterians and Catholics in 2000. Methodists and Presbyterians continue to make up important shares of religious beliefs in southern Ghana. As discussed in the next subsection, their religious shares in 2000 strongly mirror their geographical concentration before 1932, the last year of our mission data. In contrast, Catholics' southern concentration pre-1932 noticeably shifted north, showing a strong presence in the center, along the western and eastern borders, and in the north-west.

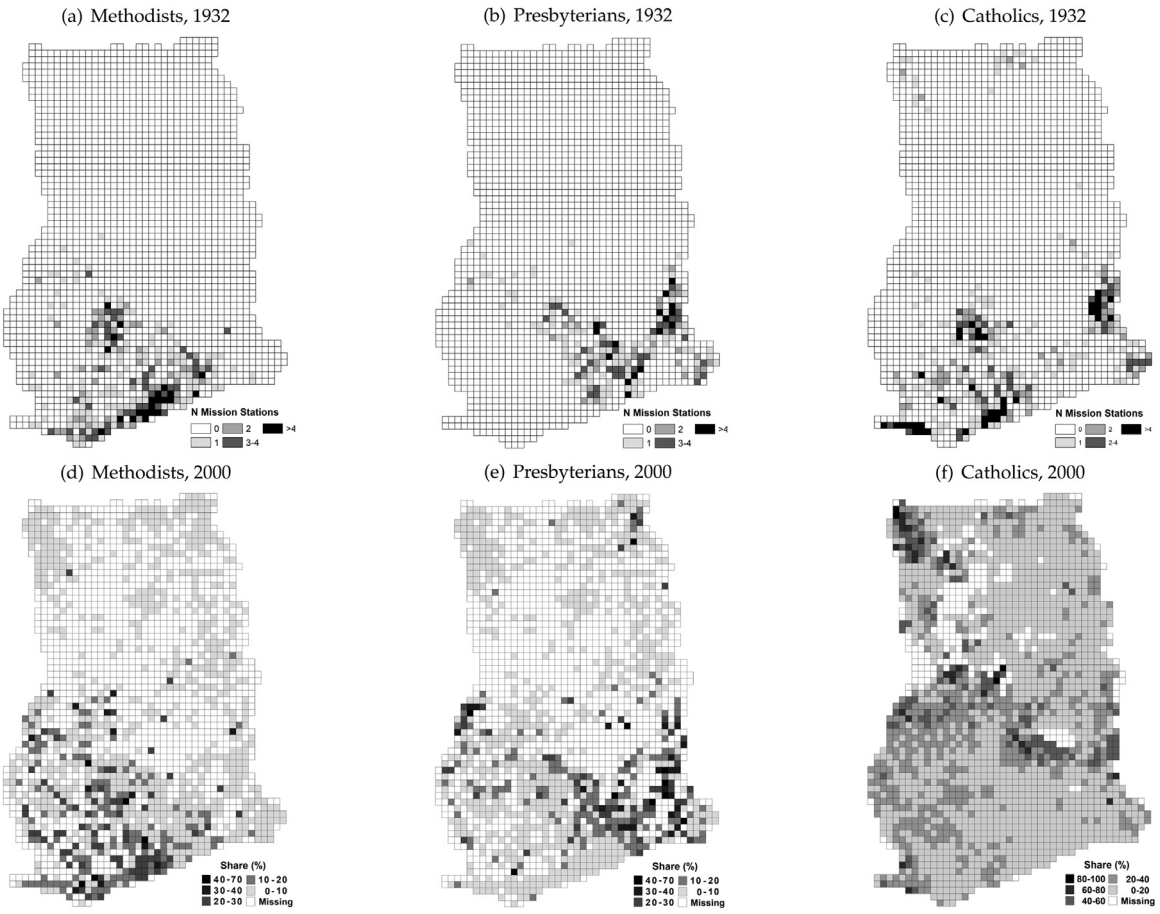

Fig. 3. Location and Number of Mission Stations 1932 and Spatial Distribution of Christianity today. *Notes:* Figs. 3(a)–(c) show the number of mission stations of the three main missionising denominations in 1932. Figure 3(d)–(f) show religious shares of the Christian denominations in 2000. The percentage of Catholics in Fig. 3(f) is based on the 2000 Population Census (N cells=1895). The percentage of Methodists and Presbyterians in Fig. 3(d) and (e) was estimated by averaging over the various available DHS in 1993–2017. As a result, the number of populated cells is smaller (N=982). The color shade indicating the Catholic shares differs from the one used for the two Protestant groups, because distributions are not the same.

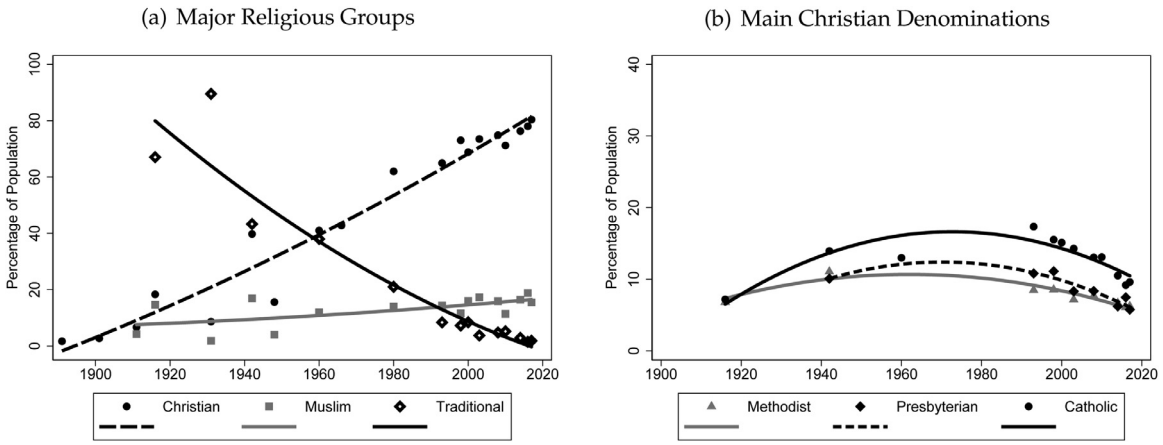

Fig. 4. Aggregate Evolution of Religious Shares in Ghana, 1891–2017. *Notes:* Fig. 4 shows estimates of religious shares from the following sources: Population censuses (1891, 1901, 1911, 1931, 1948, 1960, 2000, 2010); DHS (1993, 1998, 2003, 2008, 2014, 2016, 2017); GCR (1916, 1942); Christian Council Christian Council (1978) (1966, 1978) and Ghana Statistical Service (1980). See Web Data Appendix. Fig. 4(a) distinguishes between Christians, Muslims and adherents of African traditional religions. Fig. 4(b) distinguishes between Catholics and mainline Protestant groups, the Presbyterians and the Methodists. The respective evolution of each group is illustrated by a quadratic fit.

Table 1
Spatial Path Dependence in Christianity, 19th–21st Centuries, OLS.

	Dependent Variable: Share of ... circa 2000							
	Protestants		Catholics		Presbyterians		Methodists	
Pre-1932 Mission Variables:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Dist. 1st Presb. Mission	−0.10***	−0.13***	0.07***	0.04	−0.02	0.00	0.03***	0.01
	[0.03]	[0.03]	[0.02]	[0.03]	[0.02]	[0.02]	[0.01]	[0.01]
Log Dist. 1st Metho. Mission	−0.13***	−0.06	−0.09***	−0.04	0.02	0.04**	−0.05***	−0.05**
	[0.04]	[0.05]	[0.03]	[0.04]	[0.01]	[0.02]	[0.01]	[0.02]
Log Dist. 1st Catho. Mission	0.05*	0.01	0.10***	0.03	0.01*	−0.00	0.01	0.00
	[0.03]	[0.04]	[0.03]	[0.04]	[0.01]	[0.01]	[0.01]	[0.01]
Log Dist. Any Prot. Mission	−0.05**	−0.05***	0.04**	0.02				
	[0.02]	[0.02]	[0.02]	[0.02]				
Log Dist. Any Catho. Mission	−0.05***	−0.02	−0.04***	−0.04**	−0.01*	−0.01*	−0.01	−0.00
	[0.02]	[0.02]	[0.02]	[0.02]	[0.01]	[0.01]	[0.00]	[0.00]
Log Dist. Any Presb. Mission					−0.03***	−0.02***	0.01	0.00
					[0.01]	[0.01]	[0.00]	[0.00]
Log Dist. Any Metho. Mission					0.01	0.00	−0.02***	−0.02***
					[0.01]	[0.01]	[0.01]	[0.01]
Observations	1895	1895	1895	1895	982	982	982	982
R-squared	0.71	0.77	0.16	0.23	0.21	0.29	0.35	0.38
Full Controls ≤ 1932	N	Y	N	Y	N	Y	N	Y

Notes: This table shows for 1895 grid cells of 0.1×0.1 ° ($\approx 11 \times 11$ km) the effects of colonial missionary activity (pre-1932) on the contemporary shares of various Christian denominations (cols. (1-4): 2000; cols. (5-8): mean in 1993–2017). Log Dist. Any Prot. Mission, Log Dist. Any Catho. Mission, Log Dist. Any Presb. Mission and Log Dist. Any Metho. Mission is the log of the Euclidean distance to cells with a Protestant mission, a Catholic mission, a Presbyterian mission and a Methodist mission at any point in 1751–1932, respectively. Log Dist. 1st Presb. Mission, Log Dist. 1st Metho. Mission, and Log Dist. 1st Catho. Mission is the log of the Euclidean distance to the first Presbyterian mission (1828), the first Methodist mission (1835), and the first important Catholic missions (1880 for the south, 1906 for the North), respectively. Conley SEs (40 km): * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

2.2. The persistence of Christianity 1932–2000

Persistence of religious patterns is interesting in its own right but it is also a necessary condition for applying identification strategies that rely on "historical accidents". We now more formally test for persistence, i.e. whether Christianity today reflects the presence of Christian missions in the past (pre-1932). We use the following specification:

$$\text{Christianity}_{c,2000} = \alpha + \text{Mission Variables}'_{c,\leq 1932}\beta + X'_{c,\leq 1932}\xi + \mu_c \quad (1)$$

where $\text{Christianity}_{c,2000}$ denotes the population share of the selected Christian denomination in cell c around year 2000: Protestant, Catholic, Presbyterian or Methodist. $\text{Mission Variables}_{c,\leq 1932}$ is a vector of measures of pre-1932 mission expansion at the cell level that includes the log distance in km to any pre-1932 mission, the log distance to the first mission of each of the three major missionizing denominations. $X_{c,\leq 1932}$ is a vector of controls that measure development in and before 1932 and may account for the endogeneity of mission placement at the cell level (Jedwab et al., 2019). Standard errors are corrected for spatial correlation using the estimator proposed by Colella et al. (2019). We apply a distance cut-off of 40 km, thereby allowing for spatial dependence across four neighboring cells. In Section 3, we motivate this choice in detail.

Table 1 shows that there is strong spatial path dependence in the concentration of Christian denominations. Cells with a high contemporary population share of Protestants (cols. 1-2), Catholics (cols. 3-4), Presbyterians (cols. 5-6), and Methodists (cols. 7-8) are cells that experienced greater missionary presence of the same denomination before 1932. In particular, columns (1)-(2) show that the contemporary Protestant share is explained by the log distance to any Protestant mission pre-1932 and Presbyterian missionaries' initial point of diffusion. The high R^2 (0.71) points to strong path dependence. Both long-term effects and R^2 remain similar when we include mission location controls (col. (2)). Persistence is much weaker for Catholic missions (cols. 3-4) because Catholic expansion gained momentum comparatively late and intensified post-1932.[12] In fact, and contrary to Protestants, Catholics drifted away from their original mission field (also compare Fig. 3(a) and (f)). But they also expanded farther away from Presbyterian missionaries' initial point of diffusion.[13] Columns (5)-(8) report the effects for the two mainline Protestant denominations. Both Presbyterian and Methodist population shares are predicted by the log distance to their respective pre-1932 missions and the distances to their ports of entry. The R^2 is lower because many Presbyterian and Methodist followers (and their offspring) appear to have switched to other Protestant denominations since 1932.[14]

[12] The first Catholic mission was founded at Elmina (1880) on the coast. The first one in the north was established at Navrongo (1906). Fig. 2 shows how the number of Catholic mission stations started to grow in the 1910s.

[13] See Web Appx. Figure B1 for the distributions of Protestantism as a whole, Islam, and traditional religions in 2000.

[14] If we use the same population shares but for 40+ year-olds only, and control for mission locations, the R^2 increases slightly. Overall, the few variables we used for $\text{Mission Variables}_{c,\leq 1932}$ already contain a lot of information. Adding more mission variables, such as the log number of years the cell has had

Table 2
Christian Denominations and Economic Development, 2000, OLS.

	Dependent Variable: Log Mean Night Light Intensity in 2000 (Mean: 0.26)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Protestant Share 2000	0.90***	0.57***	0.43***	0.30*				
	[0.17]	[0.17]	[0.14]	[0.16]				
Catholic Share 2000	−0.08	0.16	0.15	0.16	−0.25	0.09	0.04	−0.06
	[0.13]	[0.14]	[0.12]	[0.10]	[0.20]	[0.12]	[0.10]	[0.09]
Presbyterian Share 2000					1.24***	0.10	0.51**	0.37
					[0.40]	[0.28]	[0.26]	[0.23]
Methodist Share 2000					2.15***	1.01***	0.27	0.15
					[0.44]	[0.27]	[0.20]	[0.17]
Observations	1895	1895	1895	1895	982	982	982	982
R-squared	0.16	0.25	0.52	0.60	0.09	0.37	0.51	0.59
"Standard" Controls	N	Y	Y	Y	N	Y	Y	Y
Full Controls ≤ 1901	N	N	Y	Y	N	N	Y	Y
Full Controls ≤ 1932	N	N	N	Y	N	N	N	Y

Notes: This table shows for 1895 grid cells of 0.1 x 0.1 degree (≈ 11 × 11 km) the effects of the pop. shares of various Christian denominations ca. 2000 on local economic development in 2000. "Standard ctrls" are the controls commonly used in the literature on the long-term effects of colonial missions in Africa. "Full controls" are the variables we use to better control for the endogenous placement of missions (≤ 1901: We include variables defined ca. 1901 or before; ≤ 1932: We include all variables). Conley SEs (40 km).

In sum, we find strong spatial persistence of Christian missionary activities pre-1932 on contemporary Christian affiliation in Ghana. With these results now established, natural experiments of history that provide possibly exogenous variation in Christian missions in 1932 can be used to investigate the long-term local economic effects of Christianization.

3. Baseline OLS results

Could Christianization have been conducive to local economic development? Our departure point is a naive OLS estimation of the following form:

$$\text{EconDvt}_{c,2000} = \alpha + \text{Christianity}'_{c,2000}\beta + X'_c\epsilon + \mu_{c,2000} \quad (2)$$

where $\text{EconDvt}_{c,2000}$ stands for local economic development in cell c ca. 2000. Our preferred measure for $\text{EconDvt}_{c,2000}$ is the log of night light intensity calculated as the average pixel value in cell c. The data comes from satellite images with no sensor saturation, so as to avoid censoring of the dependent variable in bright urban localities. $\text{Christianity}_{c,2000}$, the percentage share of Christians in a cell, is the variable of interest. We distinguish between $\text{Protestants}_{c,2000}$ and $\text{Catholics}_{c,2000}$ (data from the census). We further distinguish between the Protestant mainline denominations $\text{Methodists}_{c,2000}$ and $\text{Presbyterians}_{c,2000}$ (data from the DHS). Omitted groups include Muslims, adherents of traditional religions, and atheists.

We run the regression with four sets of control variables X_c. First, we use an empty set, to inform about the simple correlation between Christianity and economic development. Second, we include controls commonly used in the literature on the long-term effects of colonial missions in Africa.[15] We label these the "standard controls". The estimated effect thus represents the one from a "standard" OLS regression in the mission legacy literature. Third and fourth, we include a "full set of controls". We divide this set into (i) variables $X_{c,\leq 1901}$ that measure conditions in or before 1901 and (ii) those $X_{c,\leq 1932}$ that measure development in or before 1932.

The rationale is twofold. First, Jedwab et al. (2019) have shown that in Africa missionaries took local conditions into account when they opened new stations. Protestant mission societies preferred richer and more populated places. Therefore, finding that more Christian areas are currently more developed may reflect the fact that these areas were more developed to start with. One way to reduce this endogeneity is to add to the standard set of controls an exhaustive number of control variables that better capture historical development.[16] Second, we divide our full set of controls in order to explore whether

a mission (+1, to handle zeros), the log number of mission-years (+1; we add the number of missions in the cell in each year across all years) and the square of the log distance to a mission, and this for all denominations, does not increase the R^2 much more (not shown).

[15] In his study on religious conversion in Africa Nunn (2010) used: (i) European explorer routes before colonization. His data shows no explorers before Ghana's official colonization, so there is no variation across cells; (ii) 19th century railroads. The first Ghanaian railroad was opened in 1901, so there is no variation across cells; (iii) soil quality; (iv) access to a water source (we add a dummy if the cell is within 10 km from a navigable river); and (v) slave export intensity. Cagé and Rueda (2016) use the controls from Nunn (2010) plus: (vi) rainfall; (vii) distance to the coast, (viii) malaria ecology; (ix) population density in 1800; and (x) a dummy if there was a large city in 1800.

[16] We used these variables previously in Jedwab et al. (2019), Table 1. In addition to the "standard controls" they include *geography:* historical malaria intensity (and we use log distance to the coast instead of distance to the coast); (ii) *political conditions:* headchief towns in 1901, the boundary of the Gold Coast Colony established by the British c. 1850, administrative capitals in 1901; (iii) *transportation:* ports c. 1850, rivers, trade routes ca. 1850, railroads in 1932, and roads in 1930; (iv) *population:* log urban population in 1891, 1901 and 1931 and log rural population in 1901 and 1931. In 1901, we only have georeferenced rural population data for southern Ghana. We thus include a dummy if any locality in the cell was surveyed by the 1901 census; (v)

Table 3
Christian Denominations and Other Outcomes, ca. 2000, OLS.

Dep. Var. (2000):	Urban Share		Skilled Occup. Sh.		Literacy Rate		Child Mortality	
Share circa 2000:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1. Protestant Share	36.91***	13.22*	7.06***	3.26***	63.44***	40.73***	−6.55***	−4.57***
	[6.27]	[7.75]	[0.84]	[1.07]	[2.54]	[4.84]	[1.03]	[1.47]
Catholic Share	4.94	7.01	2.47***	3.32***	27.37***	26.38***	−4.53**	−3.03*
	[10.34]	[8.83]	[0.82]	[0.70]	[5.77]	[4.89]	[2.09]	[1.68]
Observations	1895	1895	1895	1895	1895	1895	1895	1895
2. Presb. Share	44.27***	21.88*	11.95***	4.48***	93.97***	39.82***	−10.38***	−5.14**
	[13.56]	[12.52]	[2.37]	[1.67]	[12.28]	[6.86]	[2.65]	[2.07]
Metho. Share	72.70***	14.92	12.38***	0.12	96.17***	10.54	−5.96**	0.22
	[13.66]	[14.40]	[2.07]	[1.29]	[12.49]	[7.81]	[2.71]	[1.92]
Catholic Share	−2.86	−8.83	0.65	1.39**	12.11	12.55***	2.67*	1.98**
	[7.91]	[7.66]	[1.23]	[0.56]	[10.25]	[4.22]	[1.59]	[0.95]
Observations	982	982	975	975	975	975	975	975
Mean in the Data:	30.01	30.01	4.41	4.41	34.69	34.69	18.91	18.91
Full Controls $\leq$ 1932	N	Y	N	Y	N	Y	N	Y

Notes: This table shows for 1895 grid cells of 0.1×0.1 ° ($\approx 11 \times 11$ km) the effects of the population shares of various Christian denominations circa 2000 on economic outcomes other than night light intensity in 2000. Conley SEs (40 km).

any effect of $\text{Christianity}_{c,2000}$ on $\text{EconDvt}_{c,2000}$ is related to (i) contemporary patterns of $\text{Christianity}_{c,2000}$ or (ii) historical patterns in $\text{EconDvt}_{c,1932}$, both of which may have been influenced by $\text{Christianity}_{c,1932}$. When we add the controls defined after 1901 ($X_{c,\leq 1932}$), we better control for $\text{EconDvt}_{c,1932}$ and better isolate a contemporary effect. Without these, the estimated long-run effect may reflect to a larger extent developments in the past that persist until today. We use 1901 as the cut-off, because the expansion in mission stations accelerated post-1875, especially post-1900 (Fig. 2).

Kelly (2019) showed that spatial dependence of errors can lead to strongly downward biased standard errors. We therefore estimate heteroskedastic and autocorrelation consistent (HAC) standard errors, as proposed by Colella et al. (2019). We choose a 40 km distance cut-off, based on the extent of spatial autocorrelation of residuals observed in the data.[17]

Table 2 reports the results. In columns (1)-(4), we find Christian areas, particularly the Protestant areas, to be relatively more developed today. Without controls (col. (1)), a one standard deviation in the population share of Protestants and Catholics is associated with a 0.40 and −0.02 standard deviation in log night lights, respectively. A Beta coefficient of 0.40 is large as a 0.40 standard deviation in log night lights (0.58) is almost equal to the mean in log night lights (0.26).[18] However, the coefficient of Protestantism decreases when adding more controls, pointing towards an upward bias if variables proxying for historical development are omitted. With the full controls (col. (4)), the Beta coefficient decreases to 0.13 ($\approx$ one third of the mean in log night lights) and 0.04 (one tenth) for Protestants and Catholics, respectively. For Protestants, the standardized correlation is thus reduced by a factor of 3.1.

In cols. (5–8), we distinguish between the two mainline Protestant denominations, the Presbyterians and Methodists. Sample size decreases because we rely on DHS survey data. Previous results are confirmed. Without controls (col. (5)), Protestant areas appear more developed today. Estimated denomination coefficients decrease markedly after including the standard set of controls (col. (6)). In col. (7), where we use the full set of controls for economic conditions in or before 1901, Presbyterian areas show a lead over Methodist areas, whereas the share of Catholics is not significantly associated with night lights today. After controlling for economic conditions in or before 1932 in col. (8), there is no significant difference across Christian denominations and the correlations are small and insignificant (the Beta coefficients are low, at −0.01, 0.05 and 0.02 for the Catholic, Presbyterian and Methodist share, respectively). The reduction in the coefficients from cols. (3) to (4) and (7) to (8) suggests that there might have been a historical effect of Protestantism on historical economic development. We will examine this later.

In Table 3, we study four other development outcomes showing the specification without controls in odd columns and the specification with the full controls in even columns (akin to cols. (1) and (4) of Table 2 respectively). First, in columns (1)-(2), we use the percentage of urban population within a cell in 2000 (mean of 30.01%). The urban share captures to what extent urban localities have grown but also to what extent rural localities became urban. Second, in columns (3)-(4), we investigate the occupational composition of the workforce in 2000. We define (i) professional, technical and related, (ii) administrative and managerial, and (iii) clerical and related as high-skilled occupations and use their

economic activities: dummies for slave markets, cash crop producing areas (cocoa, kola, palm and rubber; post-1901), and mines (1931); and (vi) *other:* land area, altitude, and ruggedness.

[17] We use a spatial correlogram of the residuals as a diagnostic tool, which displays Moran's I by distance bands. In other words, we examine up to which distance residuals are spatially correlated. We do this for each estimation. In general, spatial autocorrelation is quite high up to the second neighboring grid. Spatial autocorrelation decreases when adding our control variables and becomes insignificant after the fourth neighboring grid at ca. 44 km (see Web Appendix Figure B2 for a spatial correlogram of residuals from Table 2). Our 40 km cut-off may be at the lower end. However, setting a higher cut-off would push results in favor of *not* finding an impact of Christianity.

[18] Summary statistics are provided in Web Appx. Table B1.

share within a cell as outcome variable (mean of 4.41%). Third, we consider two measures of human capital in 2000. In columns (5)-(6), we use the adult literacy rate (mean of 34.69%). In columns (7)-(8), we use the child mortality rate (mean of 18.91%), the only directly observable health variable in the census.[19]

The correlation between Protestantism and urbanization (as shown in Table 3, Panel 1, cols. (1) and (2)) resembles the correlation between Protestantism and night lights in terms of Beta coefficients (0.28 and 0.10 vs. 0.40 and 0.13). The Beta coefficients correspond to about one third and one tenth of the mean in the urban share, respectively. This is exactly the same as we found for log night lights. The Beta coefficient is then divided by a similar magnitude when including the full controls defined in or before 1932 (by 2.8 vs. 3.1 for night lights).

In contrast, for the skilled occupations share, the Beta coefficients are higher overall – e.g., 0.46 and 0.21 for Protestants (cols. (3) and (4)) – and the correlation is reduced by less when we add the full controls (by 2.2 for Protestants). These Beta coefficients then correspond to about 40% and 20% of the mean in the skilled occupations share, respectively. Thus, Christianity seems to better explain local skill composition than local economic development, implying that the presence of skilled occupations might not always translate into economic development.

Our results for literacy point in the same direction (cols. 5-6). The correlations are high, with Beta coefficients of 0.82 and 0.53 for Protestants. Adding the full controls reduces the estimate by only 1.5 (vs. 2.2 for jobs, 2.8 for urbanization and 3.1 for lights). The Beta coefficients then correspond to 50% and 30% of the mean in literacy, respectively. Religion might explain differences in education, but these seem to weakly translate into skilled jobs and economic development.

Finally, for child mortality we find lower correlations than for education (Beta of −0.29 and −0.20 for Protestants), possibly because child mortality is more influenced by access to public health infrastructure and environmental conditions. Indeed, the Beta coefficients then correspond to about 10% and 5% of the mean in the child mortality rate, respectively. However, like for education, the magnitude of the correlation decreases by a factor of 1.5 with the full controls.

Overall, the more economic the outcome, the more our controls appear to absorb some of the possible effects of religion today. Moreover, similar to Table 2, there is no statistical difference between Catholics and Protestants once we add the full set of controls.

Panel 2 of Table 3 then shows the associations for Presbyterians, Methodists and Catholics. In general, Presbyterianism seems to be more strongly correlated with the outcomes than Methodism. However, the Beta coefficients for the Presbyterian share remain low, around 0.05–0.10, for the more economic outcomes once our full controls defined in or before 1932 are included.

These estimates are not causal. Therefore, we implement six identification strategies in the next section. As a preview of the results, the better identified correlations between Christianization and local economic development are generally low and almost always insignificant.

4. Identification strategies

We now use several identification strategies to investigate the impact of Christianization on developmental outcomes in Ghana. More precisely, we propose a set of variables Z that capture presumably exogenous expansion patterns of Christian missions during the colonial period. The analysis consists of two steps. First, we examine whether these variables Z explain the spatial concentration of Christian denominations today. For cells c, the model is:

$$\text{Christianity}_{c,2000} = \alpha + Z'_{c,\leq 1932}\beta + X'_c\gamma + \epsilon_{c,2000} \tag{3}$$

Second, we study the reduced-form (RF) effects of the same variables Z on economic development today, as proxied by log night light intensity in 2000:[20]

$$\text{EconDvt}_{c,2000} = \widetilde{\alpha} + Z'_{c,\leq 1932}\widetilde{\beta} + X'_c\widetilde{\gamma} + \widetilde{\epsilon}_{c,2000} \tag{4}$$

Below, we find that those possibly exogenous determinants of missionary expansion Z are strongly correlated with Christian population shares today but *not* with our measures of long-run economic development. This might imply that Christianization is not significantly associated with economic development today.

We prefer reduced form estimates and refrain from using Z as instruments in a 2SLS framework. One major issue with instrumenting Christianity today is that Z may not satisfy the exclusion restriction depending on how we interpret Christianity: Our variables Z explain the establishment of Christian missions during the colonial period and prevalence of Christianity in 2000. Yet, missions may have had long-term effects on dimensions other than religion, including on education and health.[21]

[19] More precisely, for women aged 15–49 who have given birth, we calculated the proportion of their children who have died. We restrict the analysis to women aged 15–49 years, because above that age adult mortality rates start to increase significantly in developing countries, and we want to avoid any selection effect from that.

[20] In both cases, standard errors are corrected for spatial correlation using a cut-off of 40km (Colella et al., 2019).

[21] We may interpret Christianity as being a "package" including not just religion *per se* but also various other aspects of human capital. However, if the goal of the analysis is to capture the causal effect of Christianity *net* of its effects on human capital, omitting human capital would violate the exclusion restriction. Estimating a conditional IV controlling for human capital in 2000 may not be a solution, because human capital controls are possibly "bad controls".

Table 4
Local Economic Effects of Protestant Missions, RF1 (Log Distance to Protestant Boundary).

	RF1		RF1: Drop Spheres		RF1: Straight Line	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	Dependent Variable: Population Share of Protestants in 2000 (Mean = 0.37)					
Log Dist. to Protestant Boundary	−0.03***	−0.02**	−0.04***	−0.02**	−0.05***	−0.05***
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.02]
Panel B:	Dependent Variable: Log Mean Night Light Intensity in 2000 (Mean = 0.26)					
Log Dist. to Protestant Boundary	−0.01	−0.01	−0.04	−0.03	−0.06	−0.06
	[0.05]	[0.05]	[0.06]	[0.05]	[0.04]	[0.04]
Full Controls ≤ 1901	Y	Y	Y	Y	Y	Y
Full Controls ≤ 1932	N	Y	N	Y	N	Y
Observations	1895	1895	1661	1661	1895	1895

Notes: This table shows for 1895 grid cells of 0.1×0.1 ° ($\approx 11 \times 11$ km) the reduced-form (RF) effects of the log distance to the Protestant boundary (i.e. the common boundary between the Presbyterian and Methodist spheres of influence and its straight continuation through Kumasi up to the border with Ivory Coast). Cols. (3-4): We drop the cells corresponding to the Presbyterian and Methodist spheres of influence. Cols. (5-6): We use as the main variable of interest the log distance to the constructed straight line starting at the intersection of the coast and the demarcated boundary and passing through Kumasi. In cols. (1-6), we add a fourth order polynomial in longitude, i.e. longitude, its square, its cube and its fourth power. Conley SEs (40 km).

Table 5
Summary of Identification Strategies RF1-RF5.

	Possibly Exogenous Z	Denomination of Interest	Hypothesis Tested
RF1: Dist. to Protestant Boundary	Logged distance to the full (demarcated + straight) Protestant boundary	Protestant share in 2000	H1
RF1, No Spheres	Logged distance to the full (demarcated + straight) Protestant boundary (excluding cells belonging to the spheres of influence)	Protestant share in 2000	H1
RF1, Straight Line	Logged distance to the straight line starting at the intersection of the coast and the Prot. boundary and passing through Kumasi	Protestant share in 2000	H1
RF2: Spheres of Influence	Two dummies for whether a cell belonged to the Presbyterian sphere of influence or Methodist sphere of influence.	Presbyterian sh. - Methodist sh. circa 2000	H2
RF3: East of Boundary	A dummy if the cell is East of the full Protestant boundary while controlling for the log distance to it	Presbyterian sh. - Methodist sh. circa 2000	H2
RF3, No Spheres	A dummy if the cell is East of the full Prot. boundary while controlling for the log distance to it (excl. cells in the spheres of influence)	Presbyterian sh. - Methodist sh. circa 2000	H2
R3, Straight Line	A dummy if the cell is East of the straight Protestant boundary while controlling for the log distance to it	Presbyterian sh. - Methodist sh. circa 2000	H2
RF4: Buffer Strategy	Product of logged distance to the Protestant spheres of influence and logged distance to the Muslim sphere of influence	Catholic share in 2000	H3
RF5: Rain Miracle	Logged distance to Jirapa where the rain miracle took place	Catholic share in 2000	H3

Notes: This table summarizes the various identification strategies used and hypotheses tested. H1: Protestant missions induced more economic development; H2: Presbyterian missions were more conducive to economic development as compared to Methodist ones; H3: Catholic missions were also conducive to economic development. In addition, we impose sample restrictions. In RF3 (no spheres) we drop cells that are located within the two Protestant spheres of 1847, i.e. we drop cells presumably most concerned by a possibly endogenous drawing of the Protestant boundary. In RF4, we drop cells within the Protestant and Muslim Spheres.

In the following section, we present the background that motivates the choice of the variables Z. We then present the results of models (3) and (4). A summary of all identification strategies, required sample restrictions, and hypotheses tested by each strategy is shown in Table 5.

4.1. *A Methodist and a Presbyterian* sphere of influence, *Southern Ghana*

The Presbyterians and the Methodists were the first mission societies that maintained permanent mission stations in Ghana (since 1828 and 1835, respectively). In 1847, the two churches, while they still had established very few missions, almost all of them on the coast, agreed on an alliance. They divided up the future religious market into spheres of influence, shown in Fig. 1 (Debrunner, 1967, p. 11, Samwini, 2003, p. 22).[22] Methodists took on the Fante areas in the west and the Presbyterians concentrated on the Ga-Adangme/Akyem areas in the east. The partition represented the hinterlands of their

[22] Such cartel-like arrangements were common then (e.g., for the U.S., see Finke and Stark (2005)).

respective first missions but the demarcation line also followed what mission societies believed was an ethno-linguistic line, so that each society could specialize in one language in their evangelization efforts.[23]

The Ga-Adangme/Akyem and Fante shared similarities in many important respects.[24] Both groups were coastal and agrarian; both were long engaged in trade with the hinterland; both became a British protectorate at roughly the same time; both practiced polygyny; slavery was present; and their traditional religions included a belief in a supreme creator. But there were also differences. More slaves were passed through the western (i.e., Methodist) Fante territory. Facing the threat of an Ashanti invasion, the Fante chieftaincies also became more hierarchically organized as a confederation; and the Fante had a matrilineal kinship system.

After the British defeated the Ashanti Kingdom in 1896, missionaries could safely advance toward its capital Kumasi. There was no territorial agreement this time, but expanding towards Kumasi was conditioned by the spheres agreed in the past and the already occupied locations closest to Kumasi. The "race" to Kumasi went through homogeneous Ashanti territory. Figure 1(a) shows the boundary demarcating the spheres of influence of the two Protestant societies. It also shows the closest way to reach Kumasi and an extension of this line up to the border. Based on visual inspection, the partition of the territory into spheres of influence strongly affected the placement of Methodist and Presbyterian mission stations by 1932 (Fig. 1(b)). They are predominantly based in their own sphere. However, given the race from the coast all the way to the border, each mission society had an incentive to disproportionately establish missions along the full boundary (Fig. 1(b)). We use this context to develop three reduced-form (RF) strategies.

H1: Protestants vs. Other Religions (RF1): The localities just along the full boundary had a high strategic value for both Protestant mission societies. Occupying those cells represented one way to block intrusions by the other mission society. In line with Gallego and Woodberry (2010), we would thus expect competition to be most intense where the two mission societies actually met. We should observe more Protestant missions *in general* along the boundary between the two Protestant mission societies in 1932. Because of persistence (see Section 2.2), we would also expect that those past missionary investments were carried over into today's religious shares.

Based on this reasoning, in model (3) Z is the log of the Euclidean distance to the full (demarcated + straight) boundary predicting the concentration of Protestant missions and the dependent variable is the share of Protestants in 2000. To avoid capturing a west (Methodist) versus east (Presbyterian) effect or an effect of being close to the border with another country, we add a fourth-order polynomial in longitude to our set of controls. To account for simple geographic diffusion, we also control for the log distances to the first Presbyterian mission and the first Methodist mission. As before, we add controls for the endogenous placement of missions. If we only add the "1901 and before" controls, we allow missions to have a more historical effect that includes (economic) channels from ca. 1900 to present-day Christianity and economic development. When we add the 1932 controls, we capture more contemporary (post-1932) effects.

Table 4 shows the results with the controls in or before 1901 in odd-numbered columns and with the controls in or before 1932 in even-numbered columns. As expected, cells further away from the historical boundary of the two Protestant mission societies have a smaller Protestant share today (cols. 1-2) of Panel A). One potential endogeneity concern about the boundary is that the first demarcated segment followed ethno-linguistic lines and thus separated two population groups that were not "similar" enough before the partition. In columns (3) and (4) of Panel A, we drop cells from the regression that are located in the two Protestant spheres of 1847, i.e. we drop cells presumably most concerned by a possibly endogenous drawing of the boundary. If anything, the estimated effect increases.

Alternatively, we remove the possibly endogenous segment by constructing a straight line from where the two spheres intersect on the coast *and* passing through Kumasi. In columns (5) and (6) of Panel A, we use the log distance to this straight line as variable Z. The estimated effect remains similar. Overall, while our variables that measure presumably exogenous missionary expansion are strongly correlated with the Protestant share today (Panel A), they are not significantly correlated with local economic development today (Panel B). This might imply that Protestant missions were not particularly conducive to economic development.

H2: Presbyterians vs. Methodists (RF2 & RF3): The next identification strategies echo the work of Waldinger (2017) and Valencia Caicedo (2019b). Waldinger (2017) studied the case of Mexico, comparing various Catholic orders with different traditions and values. She constructed an instrumental variable based on the observation that missionary diffusion started in Mexico City, and that the initial direction - largely random - determined the final geographical distribution of mission stations. Valencia Caicedo (2019b) contrasted Jesuits with Franciscans, who settled in different areas in Latin America. Our context is similar to Waldinger (2017). The expansion path of the two Protestant mission societies was constrained by the initial demarcation of the spheres and both targeted the city of Kumasi. Their investments in mission stations were heavily concentrated within their spheres (see Fig. 3(a) and (b)) and we still observe today a marked discontinuity in the proportion of Methodists and Presbyterians along the old demarcation line and expansion path (see Fig. 3(d) and (e)). Hence, we can exploit this context to investigate the effect of Presbyterian missions vs. Methodist missions.

When we compare the two denominations, in model (3) we express the dependent variable as the difference between the Presbyterian share and the Methodist share in the gridcell ca. 2000. We assume that the demarcation of the spheres

[23] There was no preference for one language over the other, because at the beginning no European missionary spoke any vernacular upon their arrival (Smith, 1966, p. 29, Sundkler and Steed, 2000, p. 203, Debrunner, 1967, p. 99).

[24] The qualitative comparison is based on several readings (Danquah, 1968; Kilson, 1971; Manoukian, 1964; Murdock, 1959; Shumway, 2011). See Web Appendix section A7. for a more detailed discussion.

Table 6
Local Economic Effects of Protestant Missions, RF2-RF3 (Spheres of Influence).

	Dependent Variable: Log Mean Night Light Intensity in 2000 (Mean: 0.26)							
	RF2: Spheres		RF3: East		RF3: East No Spheres		RF3: East Straight Line	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A:	Dependent Variable: (Presbyterian Share - Methodist Share) in 2000 (Mean = 0.01)							
Presbyterian Sphere Dummy	0.04	0.04						
	[0.03]	[0.03]						
Methodist Sphere Dummy	−0.06**	−0.07**						
	[0.03]	[0.03]						
East of Prot. Boundary Dummy			0.06***	0.07***	0.05**	0.05**	0.09***	0.09***
			[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]
Panel B:	Dependent Variable: Log Mean Night Light Intensity in 2000 (Mean = 0.26)							
Presbyterian Sphere Dummy	0.28	0.15						
	[0.18]	[0.21]						
Methodist Sphere Dummy	−0.13	−0.12						
	[0.12]	[0.12]						
East of Prot. Boundary Dummy			0.11	0.03	−0.05	−0.15**	0.20*	0.11
			[0.11]	[0.10]	[0.07]	[0.06]	[0.12]	[0.11]
Full Controls ≤ 1901	Y	Y	Y	Y	Y	Y	Y	Y
Full Controls ≤ 1932	N	Y	N	Y	N	Y	N	Y
Observations	963	963	963	963	786	786	963	963

Notes: This table shows for 1895 grid cells of 0.1×0.1 ° ($\approx 11 \times 11$ km) the reduced-form (RF) effects of two dummies for whether the cell belongs to the Presbyterian or Methodist sphere of influence (RF2; cols. 1-2) or a dummy if the cell is East of the Protestant boundary consisting of the demarcated boundary separating the Presbyterian and Methodist spheres of influence and its straight continuation through Kumasi up to the border with Ivory Coast (RF3; cols. (3-8)). For the regressions in columns (1-8), we add a fourth order polynomial in longitude, i.e. longitude, its square, its cube and its fourth power. For the regressions in columns (1-2), we also add a fourth order polynomial in latitude, i.e. latitude, its square, its cube and its fourth power. For the regressions in columns (3-8), we instead add the log distance to the Protestant boundary. Conley SEs (40 km).

anticipates the concentration of Presbyterian and Methodist missions. The variable Z consists of two dummies, whether a cell belonged to the Presbyterian or Methodist sphere of influence defined in 1847 (RF2). Note that we exclude cells that already had a Presbyterian or Methodist mission in 1847. Again, we want to avoid capturing a west vs. east effect. We therefore include a fourth-order polynomial in longitude.

Another possibly exogenous determinant of the differential share between Presbyterians and Methodists can then be constructed based on the fact that Presbyterians' and Methodists' expansion paths were respectively located east and west of the full (demarcated + straight) boundary separating the two mission societies. In (3), we can thus instead use a dummy if the cell is east of the full boundary while simultaneously controlling for the log distance to it (RF3).

Implicitly, the "compliers" with this analysis are individuals who adopted a particular Protestant denomination, because they lived in the respective territory and therefore were exposed to that denomination. The validity of the analysis rests on the fact that the choice and extent of spheres was exogenous to future local economic conditions. We argued that this is plausible. The two mission societies arrived more or less at the same time (1828 and 1835) at the landing points of Osu and Elmina, which were both fishing villages in the proximity of what were then small towns with a British trading fort (Accra and Cape Coast, respectively).[25] It is conceivable that the Methodists would have landed in Accra if it had not already been taken by the Presbyterians. The spheres were decided in 1847 based on little information beyond the coast itself. A stronger assumption is that the two spheres are exactly the same except for the assignment to the respective sphere of denomination. We already hinted at differences, e.g. in ethno-linguistic groups.

We can more formally test for observed pre-partition differences between the two spheres. In Web Appx. Table B2, we regress *Presbyterian sphere dummy* minus *Methodist sphere dummy* (col. (1); RF2), a dummy for cells located east of the full boundary (col. (2); RF3), or a dummy for whether the grid cell is occupied by the ethnic groups taken on by the Presbyterians instead of the Methodists (col. (4)), on observable geographical and economic characteristics of the grid cells. While we find no differences in terms of economic geography (ports, cities, trade routes and slave markets), we find lower precipitation levels and higher altitude in the Presbyterian sphere/groups (soils, navigable rivers and historical malaria are not consistently different).

Table 6 shows the results with the controls in or before 1901 in odd-numbered columns and with the controls in or before 1932 in even-numbered columns. As expected, cells in the Presbyterian (Methodist) sphere have higher shares of Presbyterians (Methodists) today (cols. 1-2) of Panel A; RF2). Likewise, cells east of the boundary have relatively higher shares of Presbyterians (vs. Methodists) today (cols. 3-4) of Panel A; RF3). This last result holds if (i) we drop the cells located within the spheres, so that variation comes from cells outside the spheres (cols. (5) and (6) of Panel A) or (ii)

[25] In fact, Cape Coast later became the capital of the colony. In 1877 the capital was moved to Accra.

we use as the boundary the straight line from where the two spheres intersect on the coast *and* passing through Kumasi (cols. (7) and (8) of Panel A).

Next, while expansion patterns of Christian missions are strongly correlated with the relative share of Presbyterians (vs. Methodists) today (Panel A), they are not particularly correlated with local economic development today (Panel B). The only exception is when we use the straight line as boundary *and* the 1901 controls in column (7). However, the estimated correlation is halved and loses significance after including the 1932 controls (col. (8)). This might imply that Presbyterian missions were not more conducive to development than Methodist ones.

4.2. Catholics as latecomers

The Catholics entered the stage relatively late. Their network of mission stations only started to grow significantly in the late 1910s (see Fig. 2). The cartel-like structure and dominant position of the Protestants on the coast deterred the Catholics' entry (Agbeti 1986, p. 102, Bouron 2019, p. 146). Religious markets in other West African colonies were more promising. Therefore, Catholic mission societies entered the Gold Coast via its neighboring countries.

First, the Society of African Missions (SMA), already firmly established in the Ivory Coast (Sundkler and Steed 2000, p. 197), diffused into Ghana's western areas. The first SMA missionaries arrived at Elmina in 1880 (at the western fringe but within the Methodist's sphere). Second, the "White Fathers" entered Ghana's north from Burkina Faso in 1906. Initially, their presence was limited (see Section 4.3 below). Moreover, they faced Muslim-dominated areas in the north-east where conversions were difficult. Third, the Society of the Divine Word (SVD) was based in German Togoland where they opened their first mission at Lomé in 1892 (Debrunner 1967, p. 209). After Germany's defeat in World War I, the western part of Togoland became a British mandate and was integrated into Ghana, including those SVD mission stations (Fig. 1(a) shows Lomé's location). Competition with the Presbyterians only intensified from the late 1930s (Adoboli, 2018).[26] Overall, fragmentation into three mission societies allowed Catholic missionaries to circumpass both Protestant and Muslim areas and establish themselves in their backyards.

H3: Catholics vs. Other Religions (IV4): In Jedwab et al. (2019) we argued that the Catholics, facing Protestant competition in southern Ghana, were forced to direct their conversion efforts towards poorer localities. Gill (1998, p. 71) traced a related dynamic in Latin America, whereby the influx of Protestant competition caused the Catholic Church to shift its resources and rhetoric toward the needs of the non-elite. Indeed, Catholic mission societies had the financial backing of the Vatican. As such, they could "afford" to focus their missionization efforts on poorer areas. Hence, the placement of Catholic mission stations *within* the Protestant spheres is highly endogenous. For our identification strategy, we drop those cells. For the same reason, we drop cells within the Muslim sphere in the north (Weiss, 2008), which leaves us with 1273 cells.

The Catholics could have followed three strategies in the territories outside the spheres.[27] First, they could have opted to contain the Protestant and Muslim spheres by intensifying missionary activities at their fringes. Second, they could have avoided competition and gone as far away from the spheres as possible. Third, they could have placed their mission stations randomly into those "leftover" cells. We construct a variable that measures those strategies without presuming which strategy was followed. More precisely, we use the product of the cell's log distance to the Protestant sphere and the cell's log distance to the Muslim sphere. The variable is illustrated in Fig. 5(a) which shows the Protestant and Muslim spheres as well as the product of the two distance measures for the 1273 cells in this analysis. In model (3), the dependent variable is the Catholic share and our measure of possibly exogeneous Catholic missionary expansion is the product of the log distance to the Muslim and Protestant spheres. We then also control for the log distances to the points of entry in the south (Elmina in 1880), in the north (Navrongo in 1906), and in the east (Lomé after World War I). Columns (1)-(2) of Panel A in Table 7 report the results. We find a strong positive relationship. Thus, Catholic mission societies expanded "away" from the Protestant and Muslim spheres. Indeed, comparing the concentration of Catholics in 2000, shown in Fig. 5(b), with our product variable, mapped in Fig. 5(a), confirms the strong geographical correlation. However, while the product variable is strongly correlated with the share of Catholics today (Panel A), it does not correlate with local economic development today (Panel B). This might suggest that Catholic missions were not particularly conducive to economic development.

4.3. A rain miracle during the 1932 famine in Jirapa, Northern Ghana

The Catholic "White Fathers" opened the first station at Navrongo, a rural locality in northern Ghana in 1906 (see Fig. 6). They did not face competition from other Christian denominations in the north.[28] The Christian faith, however, was not very attractive to Africans. Until 1930, the Catholic mission opened only three other mission stations. A rain miracle in another northern locality, Jirapa, in 1932 changed this trajectory. Der (1974, p. 52) describes the miracle as follows:

> "In 1932 the north-west region was hit by a severe drought that threatened the livelihood of farmers. Sacrifices offered to the local gods produced no rain. This shook the confidence of the people in the power of their gods and their

[26] There is indeed a striking lack of Catholic mission stations in the Presbyterian sphere in 1932. See Fig. 3(c).

[27] The identifying assumption here is that the exogenous late entry of Catholics into Ghana made adherents to the traditional religions that lived at the fringe of the Protestant and Muslim spheres easier to convert to Catholicism.

[28] The colonial government prohibited Protestant missionary societies from entering that region until 1909 (Weiss, 2008). Protestants then stayed away from the north until the 1950s (Samwini, 2003).

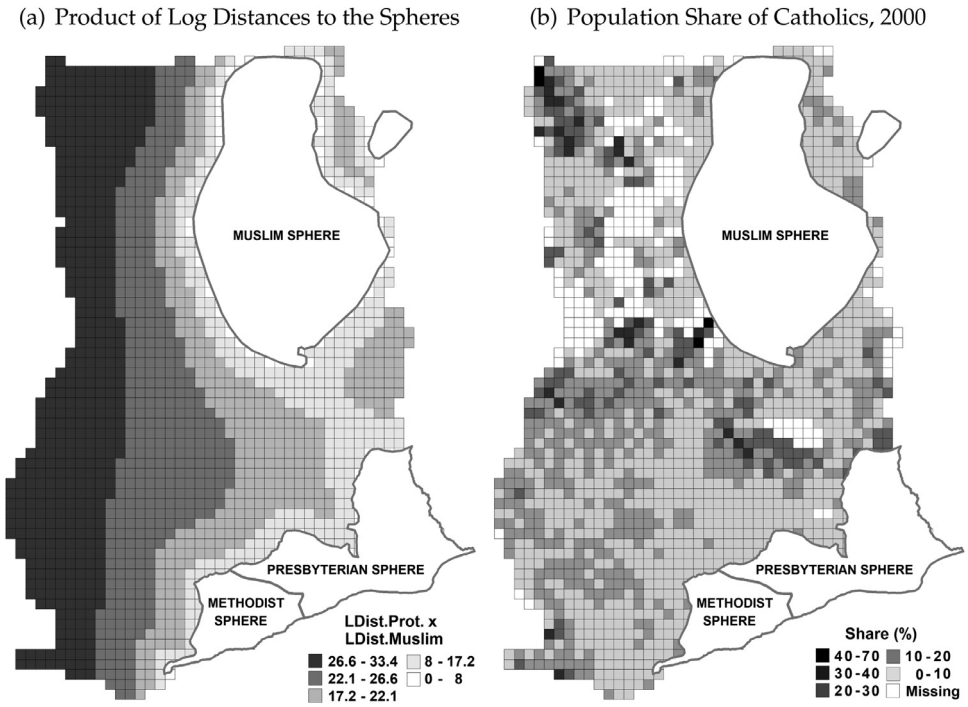

Fig. 5. Expansion Pattern of the Catholic Missions. *Notes:* Fig. 5(a) shows the product of the logged distance to the Protestant spheres of influence and the logged distance to the Muslim sphere of influence. After excluding cells within the Protestant and Muslim spheres, we use this variable (RF4) as a possibly exogenous determinant of the Catholic share in 2000. Fig. 5(b) shows the Catholic share in 2000, based on the 2000 Population Census. The Muslim sphere of influence is drawn from Weiss (2008, p. 176) and is based on detailed investigations by the Presbyterians in 1910. See Web Data Appendix for data sources.

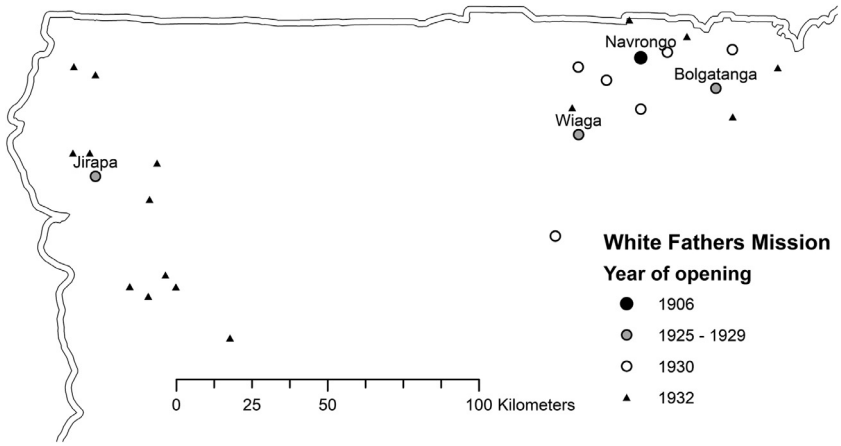

Fig. 6. Place and Year of Opening of Catholic Mission Stations, Northern Ghana. *Notes:* These missions correspond to the White Fathers. See text and Web Data Appendix for details on data sources.

> ancestors. In their distress converts and non-converts alike turned to the missionaries for assistance. In July, 1932, the Superior of the mission at Jirapa, Remigius McCoy, led a delegation of the Chief, his sub-chiefs and elders in prayer in the church to ask for rain. The result was a heavy rainfall in Jirapa a few minutes afterward."

Mass-conversion to Catholicism around Jirapa followed immediately. By the end of 1932, the number of converts of the White Fathers' mission had grown from 4800 in 1931 to 24,500 (Gold Coast, 1932). This differed markedly from the trajectory of the other Catholic societies in Ghana. For the same year, the SVD reported an increase from 22,000 to 27,000 church members, whereas the SMA reported a decrease from 75,000 to 70,200. Fig. 6 shows the location and opening years of the mission stations in the North. The number of mission stations in the Jirapa area grew from one in 1931 to 11 stations one year later. By 1947, that number had increased to 27. Hawkins (1997, p. 51) in particular wrote that: "[Q] within fifteen

Table 7
Local Economic Effects of Catholic Missions, RF4 (Buffer) and RF5 (1932 Miracle).

	RF4: Buffer		RF5: Miracle 1932	
	(1)	(2)	(3)	(4)
Panel A:	Dep. Var.: Catholic Share in 2000 (Mean = 0.21)			
Log Dist. Prot. Area * Log Dist. Muslim Area	0.01***	0.01***		
	[0.00]	[0.00]		
Log Dist. to 1932 Jirapa Miracle			−0.08***	−0.10***
			[0.02]	[0.02]
Panel B:	Dep. Var.: Log Mean Night Light Intensity in 2000 (Mean = 0.26)			
Log Dist. Prot. Area * Log Dist. Muslim Area	0.00	0.00		
	[0.00]	[0.00]		
Log Dist. to 1932 Jirapa Miracle			−0.01	−0.03
			[0.03]	[0.04]
Full Controls ≤ 1901	Y	Y	Y	Y
Full Controls ≤ 1932	N	Y	Y	Y
Province (4) FE	N	N	N	Y
Observations	1273	1273	1895	1895

Notes: This table shows for 1895 grid cells of 0.1×0.1 ° (≈ 11×11 km) the reduced-form (RF) effects of the product of the logged distance to the Protestant spheres of influence and the logged distance to the Muslim-dominated territory (RF4; cols. (1-2); for 1273 cells outside these spheres of influence) or the logged distance to Jirapa (RF5; cols. (3-4)), the locality where the rain miracle took place in 1932. In cols. (1-2), we also control for the logged distances to the first Catholic mission in the south (1880) and the first Catholic mission in the North (1906). In cols. (3-4), we instead control for a dummy whether there is a Catholic mission in the cell in 1931, the logged distance to cells with a Catholic mission at any point before 1931, and the logged distance to the Northern border with Burkina-Faso. In col. (4), we also add four province fixed effects (based on 1931 boundaries). Conley SEs (40 km).

years of the Jirapa incident, the White Fathers had laid claim to almost a quarter of all LoDagaa <ddq>“souls”</ddq> in the immediate vicinity of their stations [around Jirapa][Q]”.

The 1932 rain miracle represents an unlikely, exogenous event that changed the religious composition in that region. First, it is worth noting that the Catholic Church was fiercely opposing African beliefs in the power of rainmaking. Hence, endogenously “producing” miracles as a strategy of the Church in missionary work as explained in Barro and McCleary (2016) is not a concern in this context. Second, there is a clear discontinuity after the event. The number of converts expanded massively.[29] Third, anthropologists, cited in Hawkins (1997), argued that similarities between the Christian doctrine and traditional religious beliefs made conversion easier in that region. However, these beliefs were *generally* shared among adherents of traditional religions in that region. The Jirapa station was not different from other northern stations. Other stations thus serve as a plausible counterfactual of what would have happened to Jirapa absent the miracle.

The context of Ghana’s north is fascinating. First, the White Fathers provided schooling and medical care. This allows for the usual channels stressed in the literature to work. Second, Ghana’s northern region was a poor, rural backwater. To our knowledge, the literature has not investigated the heterogeneous effects of missions, depending on the context in which they have been established. In this context, it would then be very convincing if we were to find a positive effect of religion on economic development. In sum, we use the Jirapa miracle as a natural experiment that increased the percentage of Catholics around Jirapa, particularly when compared to mission stations of the same mission society elsewhere in northern Ghana. The “compliers” are thus descendants of individuals who adopted Catholicism as a result of the miracle.

H3: Catholics vs. Other Religions (RF5). For model (3), we consider the Catholic share in 2000 as dependent variable and use as a possibly exogenous historical driver of Catholic missionary expansion the logged distance to Jirapa, where the miracle took place. Since the shock happened in 1932, we only show the specification with the full set of controls measuring conditions in 1932 (or before). We then add three more controls. First, to focus on cells without Catholics in 1931, we include a dummy if there was a Catholic mission in the cell in 1931. Second, to account for post-1932 diffusion in Catholicism, we add the log distance to the nearest Catholic station in 1931. Third, because the shock took place in the north, we include the logged distance to the northern border. Alternatively, we include province fixed effects (1931; N = 4), one of them being the “Northern Territories” so as to only compare places in the same area, and the North in particular.

Columns (3)-(4) of Panel A in Table 7 show that the population share of Catholics in 2000 strongly decreases with the log of the distance to Jirapa (col. (4) includes province fixed effects). In contrast, distance to Jirapa does not correlate with economic development today (Panel B). Thus, it does not appear that Catholic missions were conducive to economic development.

[29] For the full sample of 2091 cells and using a simple difference-in-difference framework, we find a strong negative effect of the log distance to Jirapa on the opening of Catholic missions between 1931 an 1932 (not shown, but available upon request). We then find no effect of the log distance to Jirapa in 1929–1931 when many Catholic missions were also opened in the north (see Fig. 6), thus implying parallel trends (not shown, but available upon request).

Table 8
Effects of Historical Christian Intensity on Long-Term Development, IV1-IV4.

Instrumented Variable:	Dependent Variable: Log Mean Night Light Intensity in 2000 (Mean: 0.26)			
	Pre-1932 Mission Dummy		Log Dist. to Pre-1932 Mission	
	(1)	(2)	(3)	(4)
Panel A:	**IV1 = Log Distance to the Protestant Boundary**			
Protestant Mission Pre1932	0.30	−0.02		
	[0.69]	[1.15]		
Log Dist. Prot. Mis. Pre1932			−0.05	0.00
			[0.11]	[0.12]
IV F-Stat.	14.90	5.81	21.63	17.93
Observations	2091	2091	2091	2091
Panel B:	**IV2 = Presbyterian & Methodist Sphere of Influence Dummies**			
(Presb.-Metho.) Mission Pre1932	0.57**	0.41		
	[0.28]	[0.31]		
(Presb-Metho) Log Dist Mis. Pre32			−0.01	−0.04
			[0.20]	[0.18]
IV F-Stat.	7.26	6.974	6.348	5.77
Observations	2070	2070	2070	2070
Panel C:	**IV3 = East of Protestant Boundary**			
(Presb.-Metho.) Mission Pre1932	0.37	0.11		
	[0.54]	[0.41]		
(Presb-Metho) Log Dist Mis. Pre32			1.54	0.43
			[6.58]	[2.08]
IV F-Stat.	6.307	6.614	0.054	0.0753
Observations	2070	2070	2070	2070
Panel D:	**IV4 = Buffer Strategy for Catholics**			
Catholic Mission Pre1932	0.15	0.18		
	[0.45]	[0.47]		
Log Dist. Cath. Mis. Pre1932			−0.02	−0.02
			[0.05]	[0.05]
IV F-Stat.	3.303	4.761	7.423	9.133
Observations	1438	1438	1438	1438
Full Controls ≤ 1901	Y	Y	Y	Y
Full Controls ≤ 1932	N	Y	N	Y

Notes: This table shows the effects of historical Christian intensity – as measured by missionary activity before 1932 – on long-term economic development in 2000. We report the results for four IV strategies described in the text: distance to the Protestant boundary, Protestant spheres of influence, East of the Protestant boundary, buffer strategy for Catholics, and distance to the 1932 miracle. See the text for a description of the controls used. Conley SEs (40 km): * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5. Historical mission stations and economic development

In this section, we more directly examine whether past missions contributed to economic development today. Furthermore, we study whether mission stations influenced economic development during colonial times. If no short-term effects are found, long-term effects are unlikely, which would strengthen our results that Christianization has not necessarily promoted economic development.

5.1. Mission stations in the past and economic development today

We now use the possibly exogenous historical (pre-1932) determinants of missionary expansion as *instruments* for measures of the exposure to mission stations during colonial times (in 1932): (i) a dummy if there was a mission in the cell at any point before 1932; (ii) the log of the distance to cells with a mission at any point in time before 1932. We estimate five IV models corresponding to our five RF regressions (IV1 for RF1, IV2 for RF2, IV3 for RF3, IV4 for RF4, and IV5 for RF5).[30]

Panel A of Table 8 shows that when using IV1 (log distance to the Protestant boundary) the effect of historical Protestant missions on economic development in 2000 is always insignificant. In Panel B and C, we use IV2 (sphere of influence dummies) and IV3 (east of Protestant boundary dummy) to instrument measures of colonial era diffusion of Presbyterianism as compared to Methodism: (i) the difference between two dummies if there was a Presbyterian mission and a Methodist mission at any point in 1932 (cols. 1-2); (ii) the difference between the log distances to cells with a Presbyterian or Methodist mission at any point in 1932 (cols. 3-4). Presbyterian missions show no significant effects with the full controls. In Panel D,

[30] For example, using IV1 based on RF1, the first-stage specification is: Protestant $\text{Mission}_{c,1932} = \delta_1 + \delta_2 \text{Log Dist. to Prot. Boundary} + X_c\delta_k + v_c$. The second-stage specification is: $\text{EconDvt}_{c,2000} = \beta_1 + \text{Protestant Mission}_{c,1932} + X_c\beta_k + u_c$. Throughout, we estimate HAC standard errors with a 40 km cut-off.

Table 9
Reduced-Form Effects of RF1-RF4, 1931 Census.

Dependent Variable:	Urban		Num.Education		Num.Infirmities	
	Share		÷ Pop. 15–45		÷ Pop. 15–45	
	in 1931		in 1931		in 1931	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A:	**RF1: Log Distance to the Protestant Boundary**					
Log Dist. Boundary	−0.02*	−0.01	−0.00	−0.00	0.00***	0.00**
	[0.01]	[0.01]	[0.00]	[0.00]	[0.00]	[0.00]
Observations	1368	1368	1512	1512	1512	1512
Panel B:	**RF2: Presbyterian & Methodist Sphere of Influence Dummies**					
Presb. Sphere	0.07	0.03	0.01**	0.01	0.01**	0.01**
	[0.06]	[0.05]	[0.00]	[0.00]	[0.01]	[0.00]
Metho. Sphere	0.03	0.00	0.01	0.00	0.00	0.00
	[0.06]	[0.04]	[0.01]	[0.01]	[0.00]	[0.00]
Observations	1347	1347	1492	1492	1492	1492
Panel C:	**RF3: East of Protestant Boundary**					
East of Boundary	0.03	0.02	0.01**	0.00	0.01***	0.01***
	[0.02]	[0.02]	[0.00]	[0.00]	[0.00]	[0.00]
Observations	1347	1347	1492	1492	1492	1492
Panel D:	**RF4: Buffer Strategy for Catholics**					
Log Dist. Prot. x	−0.00	−0.00	0.00	0.00	0.00	0.00
Log Dist. Muslim	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Observations	854	854	969	969	969	969
Mean in the Data	0.14	0.14	0.01	0.01	0.02	0.02
Full Controls ≤ 1901	Y	Y	Y	Y	Y	Y
Full Controls ≤ 1932	N	Y	N	Y	N	Y

Notes: This table shows the reduced-form effects of the four instruments used (RF1, RF2, RF3, RF4) on historical economic outcomes. Cols. (1-6): We use for the year 1931 the cell urban share (defined as the population share of localities above 1000 inh.), the proportion of the number of "educated" individuals to the population of 15–45 year-olds, and the proportion of the number of "infirmities" ("leprosy", "blindness", "deaf", "mentally deranged") to the population of 15–45 year-olds (source: 1931 Census). See the text for a description of the variables and the controls (note that we do not include log urban population and log rural population in 1931 to avoid over-controlling for local economic development circa 1932). Conley SEs (40 km): * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

we use IV4 (buffer strategy) to instrument Catholic missions prior to 1932, finding no effect on economic development in 2000.

5.2. Mission stations and development during colonial times

Cross-Sectional Analysis 1931/32. We now study the impact of Christianization during colonial times (hypothesis H4) by investigating the reduced-form effects RF1-RF4 on economic and human capital outcomes in 1931/32.[31]

As seen in Panel A of Table 9, we do neither find urbanization (col. (2)), nor the proportion of individuals with primary school attainment (4 years) in 1931 (col. (4)), to significantly decrease with distance to the Protestant boundary (RF1). However, being further away from the Protestant boundary increases the proportion of infirmities (leprosy, blindness, deafness, mental illnesses) in 1931 (col. (6)).[32] Furthermore, as seen in Panels B and C, once we include more controls, we do not find that cells and individuals within the Presbyterian sphere (RF2) or east of the full boundary (RF3) are significantly more urbanized, educated and healthy in 1931. If anything, more infirmities are observed in Presbyterian areas (col. (6) of Panels B-C). Finally, Panel D shows that RF4 (buffer strategy for Catholic missions) does not correlate with development outcomes in 1931.

Panel Analysis 1891–1931. We also exploit the panel dimension of our annual mission data and the fact that we know each cell's total urban population – defined as the total population of localities above 1000 inhabitants in 1891, 1901, 1911, 1921 and 1931.[33] If missions spurred local economic development before 1932, we should observe villages becoming towns

[31] For RF1, the specification is $\text{EconDvt}_{c,1932} = \alpha + \beta \text{Log Dist. to Segment}_{c,1932} + X_c\gamma_k + \epsilon_c$. We do not report results for RF5, because the rain miracle and expansion of Catholicism in Northern Ghana happened after 1931.

[32] For these regressions, the specification with the controls defined in 1932 or before does not include log urban population and log rural population in 1931, since we do not want to over-control for economic development then.

[33] Total population is not available at the cell level. We thus cannot compute urban shares.

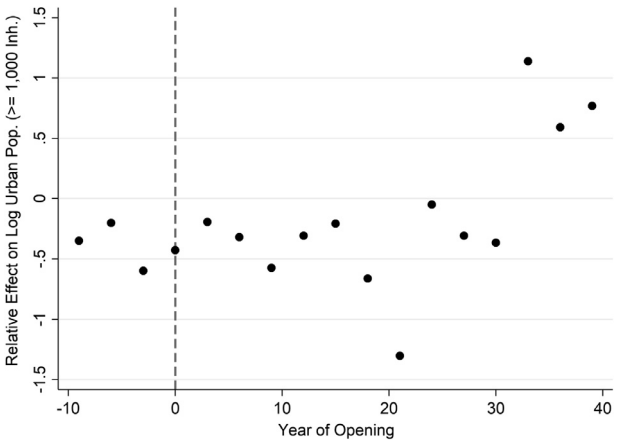

Fig. 7. Urban Growth Effects Before and After Opening of Mission Stations, 1891–1931. *Notes:* Coefficients estimated an event study framework. More precisely, we restrict the sample to those 387 cells without any mission in 1891 but where a mission was established between 1901 and 1931 (N = 387 × 5 = 1935). Since we use variables of interest defined between t-10 and t, we lose one round of data (N = 1548). We then use the panel specification in col. (1) of Table 10 but instead of using the mission dummy in $t - 10$ we include 4 dummies for whether year t is 7–9 ("−9"), 4–6 ("−6"), 1–3 ("−3") or 0 ("0") years before a mission was opened and 13 dummies for whether year t is 1–3 ("3") ... 36–39 ("39"). The figure plots the coefficients of each pre-opening and post-opening dummy.

and towns growing, i.e. urban population growth. Indeed, while there were 144 towns above 1000 in 1891, their total number tripled to 437 by 1931.[34]

For cells c and years t, we regress urban population growth between $t - 10$ and t on a dummy if cell c had a mission station in $t - 10$.[35] We only exploit the timing of mission openings, by restricting our sample to those 387 cells without any mission in 1891 but with a mission between 1901 and 1931 (N = 387 × 5 = 1935). Since the variable of interest is defined in $t - 10$, we lose one round of data (N = 1548). We add cell and year fixed effects. Given cell fixed effects, we do not include the time-invariant controls used in the other tables. Because we do not have an instrument for mission openings, we need to control for time-varying factors to the best extent possible. By adding (29) district (as of 1931)-decade fixed effects, we absorb common shocks within the same district and year. Because there are on average only 13 cells per district, we compare similar cells over time. Lastly, we include initial log population in $t - 10$ and initial log population in 1897 interacted with year fixed effects, thus capturing mean reversion in urban growth.[36]

Table 10 shows the results. In the baseline estimation in column (1) we find no statistically significant effect of missions in $t - 10$ on urban growth between $t - 10$ and t. Because 1931 district boundaries might have been formed endogenously to local economic development before 1931 we use ethnic group-decade instead of district-decade fixed effects, but find no effect (col. (2)). Adding a second lag of the mission dummy (in t-20), to allow a missionary stimulus more time, also yields no effect (col. (3)). We then distinguish between the extensive and intensive margins. Column (4) shows the estimate for the extensive margin. The dependent variable is the change between $t - 10$ and t in a dummy equal to one if the cell contains a town of at least 1000 inhabitants. We find no relationship. In column (5), we focus on the intensive margin, studying urban growth for cells with a town of at least 1000 inhabitants in both $t - 10$ and t. We lose a large share of the sample as few towns consistently had more than 1000 inhabitants in multiple years.[37] Next, we test for denomination effects. We find no significant effect when adding a dummy if a Protestant mission existed in $t - 10$ (col. (6)) nor if a Presbyterian mission existed in $t - 10$ (col. (7)). Overall, across all panel specifications, we do not find a link between Christian missions and urban growth.

We push this analysis further by examining the effect of mission openings in an event study framework. We use the same panel regression as before. However, instead of using the mission dummy in $t - 10$ we include four dummies for whether year t is 7–9 ("−9"), 4–6 ("−6"), 1–3 ("−3") or 0 ("0") years before a mission was opened and thirteen dummies for whether year t is 1–3 ("3") ... 36–39 ("39"). We then plot in Fig. 7 the coefficients of each pre-opening dummy and post-opening dummy. We do not find an effect before a mission is opened. No urban growth effect is visible for 30 years either. Effects appearing after 30 years are small and not significant (p-val. ≈ 0.30–0.56).[38] Overall, missions do not appear to have affected short- and medium-term economic development.

[34] The largest town population was 19,999 in 1891 and 60,726 in 1931.

[35] Since all cells have more or less the same area, population levels also measure population densities.

[36] For cells c, districts d and years t, the specification is (HAC standard errors, with a 40 km distance cut-off errors): Log $\text{Pop}_{c,d,t}$ - Log $\text{Pop}_{c,d,t-10}$ = a + b*$\text{Mission}_{c,d,t-10}$ + ρ*Log $\text{Pop}_{c,d,t-10}$ + γ_t*Log $\text{Pop}_{c,d,1897}$ + θ_t + λ_c + $\kappa_{d,t}$ + $\mu_{c,d,t}$.

[37] This is only for the restricted sample of 387 cells with no missions in 1891 and a mission at one point in 1901–1931.

[38] We find similar results for Protestant and Presbyterian missions in the event study framework (not shown).

Table 10
Local Economic Effects of Christian Missions, Panel Regressions, 1891–1931.

Dependent Variable:	△ Log Urban Pop. (Loc. ≥ 1000) btw t-10 and t (Col.(4): Dummy if Pop. ≥ 1000)						
Specification:	Baseline	Ethnic-Decade FE	Second Lag	Extensive Margin	Intensive Margin	Protestant	Protestant & Presb-Metho
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dummy Mission$_{t-10}$	0.33	0.28	0.17	0.01	−0.57***	−0.01	−0.02
	[0.27]	[0.26]	[0.32]	[0.03]	[0.10]	[0.69]	[0.70]
Dummy Mission$_{t-20}$			0.27				
			[0.29]				
Dummy Prot. Mission$_{t-10}$						0.38	0.39
						[0.60]	[0.61]
Dummy Presb. Mis.$_{t-10}$-Dummy Metho. Mis.$_{t-10}$							0.03
							[0.18]
Observations	1548	1548	1161	1548	156	1548	1548
Cell FE	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y
District$_{1931}$-Decade FE	Y	Y	Y	Y	Y	Y	Y
Extra Controls	Y	Y	Y	Y	Y	Y	Y

Notes: This table shows for 387 cells during the period 1891–1931 the medium-run effects of Christian missions on urban population growth. We restrict the full sample of 2091 cells to 387 cells where no mission existed initially in 1891 and where a mission was established at one point in 1901–1931. To avoid dropping cells with 0 population, we use log(urban pop. + 1). We always control for the log of the initial urban pop. level (in t-10) and the log of the urban pop. in 1897 interacted with year FE. Col. (4): The dep. var. is the change in a dummy equal to one if the cell has a city of at least 1000 inh. Col. (5): We further restrict the sample to cells with a city of at least 1000 inh. in both t-10 and t, in order to focus on the intensive margin of urban growth only. Conley SEs (40 km).

6. Extensions

Region Fixed Effects. We addressed spatial autocorrelation using HAC standard errors. Kelly (2019) also argues that spatial correlation tends to fall when including spatial fixed effects. We can thus include region (as of 1931) fixed effects (N = 4). Doing so may also account for (i) the Northern region having always been poorer and being more Muslim, (ii) precolonial state centralization in the Ashanti region, (iii) the long history of contact with European trade in the Gold Coast Colony proper, and iv) a history of German rule in Togoland. We can also include region fixed effects based on today's boundaries (N = 10). The reduced-form effects of RF1-RF5 on log night light intensity in 2000 remain small and not significant (see Web Appx. Table B3).[39]

Sampling. When studying the effect of Presbyterian (vs. Methodist) missions (RF2-RF3), we relied on the DHS 1993–2017 to obtain the shares of Methodists and Presbyterians ca. 2000. One concern when doing so could be that night light intensity is measured in 2000, hence preceding the year of some of the DHS surveys. To address reverse causality concerns we adjust the dependent variable so that it is defined later on. Web Appx. Table B4 shows that results hold if we study the reduced-form effects of RF1-RF5 on night lights in 2011 instead of 2000.

Combining the RFs. One limitation of our analysis is that we cannot use all the RFs in the same regression. RF4 (buffer strategy for Catholics) imposes that we exclude core Protestant areas. Thus, we cannot combine RF4 and RF1-RF3 (which focus on Protestant denominations). Also, RF5 (1932 miracle) imposes that we control for Catholic presence in 1931, which would mechanically make RF4 ineffective. However, in Web Appx. Table B6, we simultaneously use RF1 (distance to the Protestant boundary) *and* RF2 (spheres of influence) or RF3 (east of the boundary) in models (3) and (4). We find a strong correlation of RF1 (being closer to the Protestant demarcation line) with Protestantism (cols. 3-4) and RF2-RF3 with Presbyterianism vs. Methodism (cols. 5-6) in year 2000. However, we find no correlation with economic development in 2000 (cols. 1-2).

Other Economic Outcomes. We tend to find no significant reduced-form effects (RF1-RF5) on other economic development outcomes in 2000. For both, the urban share (Panel A of Web Appx. Table B5) and the share of skilled occupations (Panel B), we find a positive significant link with Christianization for only one out of nine regressions (col. (3)). For the share of skilled occupations, we then find significant negative, *not* positive, correlations with Methodist areas (col. (4)) and Presbyterian areas (col. (6)).

Human Capital Outcomes. Various studies focus on the effects of missions on human capital. In Table 11, we study the reduced-form effects (RF1-RF5) on the literacy rate of individuals aged 15 and above in 2000 (Panel A) and the child mortality rate in 2000 (Panel B). For literacy, three of nine RF regressions point to a significant positive association (cols. (2), (3) and (8)) and three regressions reveal a significant *negative* correlation (cols. (4), (6) and (9)). For child mortality, one regres-

[39] The only significant effect is for "East of the Boundary" (RF3) when excluding cells that are located within the two Protestant spheres. However, the negative effect implies that Presbyterian areas are *less*, not more, developed.

Table 11
Local Economic Effects of Christianization, Reduced-Form Effects, Human Capital Outcomes.

Strategy:	RF1: Distance to Prot. Boundary			RF2: Spheres	RF3: East	RF3: East	RF3: East	RF4: Buffer	RF5: Miracle
		No Spheres	Straight Line			No Spheres	Straight Line		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dependent Variable: Literacy Rate in 2000 (Mean: 34.69)								
1. Reduced Form									
L. Dist. Prot Bound.	−1.61*	−1.81**	−4.92***						
	[0.85]	[0.80]	[1.08]						
Presb. Sphere				1.62					
				[5.44]					
Metho. Sphere				−5.93*					
				[3.23]					
East of Bound.					−3.88	−9.08***	−1.76		
					[3.49]	[3.41]	[2.95]		
L.Dist.Prot*L.Dist.Islam								0.63***	
								[0.21]	
L.Dist.Miracle									2.76**
									[1.19]
Obs.	1895	1661	1895	956	956	781	956	1273	1895
Full Ctrls ≤ 1932	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Dependent Variable: Child Mortality in 2000 (Mean: 18.91)								
1. Reduced Form									
L. Dist. Prot Bound.	0.13	0.15	0.82**						
	[0.29]	[0.32]	[0.36]						
Presb. Sphere				0.00					
				[1.12]					
Metho. Sphere				0.46					
				[1.15]					
East of Bound.					1.88**	3.34***	0.92		
					[0.74]	[0.81]	[0.73]		
L.Dist.Prot*L.Dist.Islam								−0.03	
								[0.11]	
L.Dist.Miracle									−2.14***
									[0.62]
Obs.	1895	1661	1895	956	956	781	956	1273	1895
Full Ctrls ≤ 1932	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: Conley SEs (40 km).

sion (col. (3)) shows a positive impact and three regressions (cols. (5), (6) and (9)) show a *negative* impact. The evidence regarding the effects of Christianization on human capital is thus inconclusive.

Agricultural Development. Christian missions might have fostered *agricultural* development through their vocational training, the introduction of new crops, and their trading companies. Since localized data on agricultural productivity does not exist, we follow two strategies. First, using log night light intensity in 2000 as the dependent variable, we weight cells by (100 - the urban share), thereby giving more weight to rural observations while preserving sample size. Second, we proxy rural wealth by the share of rural residents with access to improved water sources and sanitation facilities in 2000. Panel A of Web Appx. Table B7 shows that the reduced-form effects on rural night lights are insignificant in eight out of the nine regressions.[40] The association with water/sanitation (Panel B) is insignificant in six out of the nine regressions.[41] Moreover, the significant effects are of the wrong sign. Finally, Web Appx. Table B8 shows the same non-effects for the literacy rate of farmers or the child mortality rate of rural residents in 2000. Thus, Christianization was not particularly associated with agricultural development.[42]

Gender-Related Outcomes. Nunn (2014) has shown for sub-Saharan Africa that Protestant (residence) missions had relatively stronger long-term effects on women's education than Catholic missions. We investigate this for Ghana using two gender-related human capital outcomes as dependent variables: (i) the ratio of the female-to-male literacy rate (for adults)

[40] The only significant effect is for "RF3: East No Spheres", implying that Presbyterians (who went east of the boundary) might have had negative, *not* positive, effects on rural economic development.

[41] The only significant estimates are for: (i) two of the RF3 analyses, implying that Presbyterians (who went east of the boundary) might have had more negative, not positive, effects on rural infrastructure; and (ii) the RF5 analysis, implying that (less Catholic) rural residents farther away from the Jirapa miracle were richer, *not* poorer.

[42] For farmers' literacy rate, we find significant positive effects of Christianization in three cases (RF1: No Spheres, RF1: Straight Lines and RF4: Buffer) and significant negative effects in two cases (RF2 Spheres and RF3: No Spheres). For rural child mortality, we only find one significant positive effect and four effects are negative and significant.

in 2000; and (ii) the ratio of the female-to-male child mortality rate in 2000. The reduced-form effects RF1-RF5, shown in Web Appendix Table B9, suggest that there is no heterogeneous effect across the sexes. If anything, we find a *higher*, not lower, female-to-male mortality ratio in more Catholic grid cells located further away from the Protestant and Muslim dominated areas (RF4).

7. Concluding remarks

One century of Christianization has transformed Ghana's religious landscape. In 2017, about 80% of the Ghanaian population were Christians. Conversion came at the expense of traditional religious beliefs. In this paper, we established that spatial historical patterns of Christianity persist to the present-day. We then found a positive correlation between Christianity today and measures of economic development today, even after controlling for an extensive set of factors that might help account for endogeneity in mission placement.

Using six distinct identification strategies that exploit possibly exogenous variations (natural experiments) in Christian missionary expansion, we then did not find much evidence for a positive effect of Christianity on economic development in Ghana. These results are broadly consistent across Christian denominations (i.e. Protestantism, Catholicism, Presbyterianism, Methodism), which reinforces our main takeaways and addresses external validity concerns.

It could well be that Christians in Africa are among the most skilled and wealthiest members of society when compared to other individuals within their communities (Alesina et al., 2020; Meier zu Selhausen et al., 2018; Wantchekon et al., 2015). But the fact that Christianization might have increased social mobility does not automatically generate economic activity. The private returns of being a Christian – which may include increased human capital – might have been larger than its actual social returns. Indeed, in a seminal study, Pritchett (2001) pointed out that rapidly rising educational attainment rates in post-independence Africa have failed to translate into learning and sustained economic growth at the macro level. Some aspects of Christianization might have also hampered economic development, for example by promoting social upheaval, and thus lowering interpersonal trust, in missionized communities (Okoye, 2021). Likewise, religiosity can increase religious participation at the expense of labor supply and economic production (Barro and McCleary, 2003; Campante and Yanagizawa-Drott, 2015).

Sub-Saharan Africa is becoming the new global center of Christianity (Pew Research Center, 2015). Our analysis for Ghana suggests that continued Christian conversion might not necessarily promote economic development on the continent.

Declaration of Competing Interest

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Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jebo.2021.07.015.

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