EXPORTING CHRISTIANITY: GOVERNANCE AND DOCTRINE IN THE GLOBALIZATION OF US DENOMINATIONS

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Abstract

In this paper we build a model of market competition among religious denominations, using a framework that involves incomplete contracts and the production of club goods. We treat denominations akin to multinational enterprises, which decide which countries to enter based on local market conditions and their own "productivity." The model guides us in estimating how a denomination's religious doctrine and governance structure affect its ability to attract adherents. Using data on the foreign operations of US Protestant denominations in 2005 from the World Christian Database, we find that (1) denominations with stricter religious doctrine attract more adherents in countries in which the risk of natural disaster or disease outbreak is greater and in which government provision of health services is weaker, and (2) denominations with a decentralized governance structure attract more adherents in countries in which the pastor cost of connecting with congregants is lower. These findings illuminate factors shaping the composition of religion within countries, helping account for the rise of new Protestant groups. They also provide empirical evidence for the recent theoretical developments in organization and trade.

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1. INTRODUCTION

Rivalry between religions is a constant feature of human society. Historically, competition was often resolved by military conflict (Iyigun, 2008), with victors imposing their religious beliefs on the vanquished. Today, it is common for religious groups to compete for adherents through the market. Over the last 50 years, options for religious practice have expanded globally, as the end of colonialism, the demise of communist regimes, and the spread of democracy have weakened the control of state-sponsored churches and reduced the prevalence of governments based on anti-clericalism (Mickelthwait and Wooldridge, 2009). Religious groups, be they Christian, Jewish, or Muslim, are increasingly international in outlook, with the goal to build global bodies of believers, rather than simply national ones (Thomas, 2010).

Christian groups have a long tradition of market-based competition, dating back to the Protestant Reformation (Ekelund, Hebert and Tollison, 2006). Over time, Protestant denominations have grown at the expense of Catholics and the Orthodox.[1] Within Protestantism, there is competition between mainline denominations, which trace their origins to the Reformation, and groups arising in the last two centuries, including Pentecostals, Mormons, Jehovah's Witnesses, and Seventh Day Adventists. In 2010, Pentecostalism and related groups claimed 400-600 million adherents worldwide, accounting for a quarter of all Christians. While competition within Christianity has attracted considerable interest from other social sciences (Meyer, 2004, and Robbins, 2004), it has received little attention from economists.

In this paper, we build a model of competition among religious groups and apply it to the foreign operations of Protestant denominations headquartered in the US. We treat a denomination akin to a multinational enterprise, which differentiates its own "brand" along the dimensions of religious doctrine and organizational structure. A denomination's organization and doctrine are typically established early in its history and thereafter stable over time (Melton, 1989; Chaves, 1993b). We can therefore examine how organization and doctrine affect denomination performance, distinct from the usual context in which multinational organizational structure is endogenous (e.g., Nunn, 2007; Rajan and Wulf, 2006; Marin and Verdier, 2008).

In our theoretical model, each country consists of many local religious markets. A denomination chooses which markets to enter based on the combined objectives of attracting

[1] Between 1970 and 2005, the share of Protestants among Christians rose from 26% to 35%, while the share of Christians in the global population remained stable at 33%.

members and generating revenues.[2] It enters a market by choosing to recognize a local congregation as a member of its global organization, which is analogous to international licensing or franchising, and by agreeing to have a local pastor manage the congregation. We assume denominations vary in their attractiveness to believers, which we treat as a fixed characteristic similar to firm productivity (Melitz, 2003). Entry into a local market is subject to a fixed cost, which keeps low productivity groups from entering unattractive locations.

Organizational structure takes one of two broad forms. Centralized denominations place authority over pastors and doctrine in the hands of international bodies, whereas decentralized denominations give individual congregations control (Chaves, 1993a). We assume that transactions between a pastor (manager) and a denomination (headquarters) are subject to incomplete contracts (Grossman and Hart, 1986).[3] In decentralized denominations, the pastor has greater authority, which increases his incentive to invest in serving his congregation; in centralized denominations, the denominational headquarters has greater authority, which gives it more control over how its member congregations operate.

Following Iannaccone (1992), we assume that the doctrinal strictness of a denomination affects free riding among its members. The functions of a congregation include organizing worship, educational activities, charitable undertakings, and other social services, in which congregants are both consumers and producers. These services have the quality of club goods, giving congregants an incentive to free ride on the efforts of others. Having a stricter religious doctrine limits the access of church members to secular goods, thereby increasing their incentive to participate in church life. When the cost of secular goods increases, participation intensity (and the attendant production of club goods) increases more among strict groups than among less strict ones, raising the marginal utility in the former group relative to the latter.

Our model has two predictions. First, in countries where the cost of relevant secular goods is higher, stricter denominations will have larger membership, due to their being more efficient in producing club goods. Second, in countries where the cost to pastors of serving congregants is lower, decentralized denominations will have larger membership, due to their pastors' stronger investment incentives. These predictions guide our empirical estimation, in which we use the World Christian Database to examine the number of adherents that US-

[2] See Iannaccone (1998a) for a discussion of literature on treating churches as payoff maximizing firms.
[3] See Allen (1995) for an incomplete contracts view of church organization.

headquartered denominations attract in foreign markets in 2005.

To empirically implement our first prediction on how the cost of secular goods affects religious adherence, we draw on recent literature testing Iannaccone (1992). Hungerman (2005) and Gruber and Hungerman (2007) show that government social services are substitutes for the club goods that churches provide. Historically, when the US government has expanded (contracted) social spending, donations to and participation in Christian churches has decreased (increased). Berman (2000) and Chen (2010) obtain related findings when examining ultra-orthodox Judaism in Israel and Islamic worship in Indonesia, respectively.[4]

The *supply* of social services that we can measure reliably across countries at all income levels relate to health care. We also observe variation in the *demand* for health services associated with incidence of natural disasters and disease outbreaks. Weaker supply of public health services or stronger demand for health services drives up the cost of obtaining these services – either by increasing queuing for government-provided health care or the price of privately supplied health care – which according to our model means stronger demand for strict denominations over non-strict ones. For instance, prior to the 2010 earthquake in Haiti, the most active Protestant groups in the country were US denominations with strict religious doctrine (including Adventist and Pentecostal churches). In the aftermath of the earthquake, these groups saw sharp increases in church activity.[5] In the estimation, we find that, controlling for denomination and country fixed effects, stricter denominations attract more members in countries with a weaker provision of health services and with higher incidence of disasters or disease. Placebo tests show no such interaction effect between these country characteristics and theoretically irrelevant features of religious doctrine, such as the frequency of communion. Our contribution to the literature is to show how demand for and supply of public services affect the relative success of strict religious groups across a large number of countries.[6]

To implement our second prediction, we need measures of costs that pastors face in serving their congregants. Beyond the worship service, pastors connect with congregants through

[4] See also Dehejia, DeLeirec, and Luttmer (2007) and Scheve and Stasavage (2006).

[5] See Tom Phillips, "Religion Fills Void Left by Aid Agencies," *The Guardian*, Jan. 25, 2010; Anne Barnard, "Suffering, Haitians Turn to Charismatic Prayer", *New York Times*, November 24, 2010; Kwame Dawes, "Amid Disasters, A Preacher Holds Fast to His Faith in Haiti," *USA Today*, Jan. 5, 2011; and Christophe Wargny, "Haiti in the Hands of the NGOs," *Counterpunch*, Jan. 7, 2011.

[6] Recent literature examines religiosity across countries (Barro and McCleary, 2005; McCleary and Barro, 2006; Barro and Hwang, 2007), but does not consider within-country competition among religious groups.

home visits, participating in community events, and other forms of outreach. The ease of outreach is likely to depend on local communication and transportation costs. Existing literature documents that expanding transportation networks is associated with increased local trade (Donaldson, 2010) and more frequent transactions between buyers and suppliers (Datta, 2012), with these effects being stronger in service industries (Chandra and Thompson, 2000). Improvements in land transportation may thus benefit activities requiring face-to-face interaction, such as religion. Similarly, improved communication services are associated with stronger connections between local buyers and sellers, particularly in developing-country markets (Jensen, 2007; Aker, 2010; Aker and Mbiti, 2010). Consistent with our model, we find that decentralized denominations attract more members in countries with better communications and *land* transportation.[7] Placebo tests show that no such interaction effect exists for *air* transportation, which is unlikely to affect pastor costs of connecting with members.

Our findings on denominational organizational structure are relevant for recent literature on organizations in international trade (Antràs and Rossi-Hansberg, 2009). Antràs and Helpman (2004) examine theoretically the entrepreneurs' choice between a centralized structure of vertically integrating with suppliers versus a decentralized structure of contracting with suppliers. Bloom, Sadun, and Van Reenen (2009) examine empirically what makes multinational firms more decentralized in their internal organization. We complement this work by showing where decentralized organizations are more likely to succeed.

In section 2, we present our data on the size, religious doctrine, and governance structure of denominations. In section 3, we present a model of entry and competition among religious groups. In section 4, we derive the empirical specification and discuss estimation issues. In section 5, we present our estimation results. And in section 6, we offer final discussion.

2. DATA AND EMPIRICAL SETTING

2.1 Christian denominations

The data for our analysis are from the World Christian Database (WCD). The WCD tracks religious affiliation for Christian denominations across countries, giving numbers of

[7] This finding is consistent with recent literature in public finance and macroeconomics (e.g., Fernald, 1999; Roller and Waverman, 2001) that links labor productivity and infrastructure.

affiliated members and congregations in 1970 and 2005.[8] Each denomination is identified by its name, religious tradition (e.g., Baptist, Holiness-Pentecostal, Reformed-Presbyterian), and megabloc, and is accompanied by information on its international affiliation. Megablocs include Roman Catholics, Orthodox, and Anglicans, which constitute the historic or traditional church; conventional Protestants; Independents, which includes churches that have split from Protestant denominations or that are unaffiliated with international church bodies; and Marginals, which are groups considered outside the Christian mainstream, the largest of which are the Mormons and the Jehovah's Witnesses. With some abuse of terminology, we use the term Protestant to refer to four WCD blocs: Anglicans, traditional Protestants, Independents, and Marginals.

In the raw WCD, there are over 6,300 individual denominations, which represent a much smaller number of denominational aggregates that share an international governing body, internal organizational structure, and religious doctrine. We form denominational aggregates by combining sub-denominations that have a common megabloc, religious tradition, and name or association with an international governing organization.[9]

We focus on Protestant denominations headquartered in the US, the country for which we have by far the most complete data. Between 1970 and 2005, the share of Protestants belonging either to the UK-headquartered Anglican Church or to other non-US-headquartered denominations each fell, the former from 14% to 10% and the latter from 17% to 15%. Denominations headquartered in the United States saw their market share rise from 13% to 23%. Sources beyond the WCD, including *The Handbook of Denominations in the United States*, (Mead, Hill, and Atwood, 2001), help us link US religious groups across countries, permitting us to identify the global operations of US denominations. The absence of comparable data makes similar matching problematic for non-US based groups. Our sample consists of 130 US

[8] The WCD is maintained by Gordon-Conwell Theological Seminary and builds on material originally published in the *World Christian Encyclopedia* (WCE) by Barret, Kurian, and Johnson (2001). The WCE compiled periodic censuses that individual Christian denominations conduct of their membership and produced initial estimates of the number of adherents by denomination in 1970. These estimates were cross-checked against information obtained from national censuses, national church bodies, and interviews of church leaders. The WCD further updates denomination counts in the WCE to 2005, based on cross-correlated information from 5,000 questionnaires of national church bodies, field surveys in 200 countries, a large body of published and unpublished contemporary material provided by individual churches, and interviews of bishops, church leaders, and theologians.

[9] In some countries, owing to government regulation of religion, the WCD groups denominations into "union of bodies of different traditions." We drop a country from the sample if more than 20% of its affiliated Christians fall into this category. These include six large nations (Australia, Canada, China, Congo, Germany, and Pakistan) and 10 small ones, which in 2005 represented 13% of Christians in the WCD.

denominations that have adherents abroad.[10]

The denominations in our sample have distinct origins. Mainline traditions include movements brought from Europe to the United States in the 17th and 18th centuries (e.g., Congregationalists, Lutherans, Methodists, Presbyterians, and Quakers). In 2005, they accounted for 12% of adherents outside of the United States that belong to US denominations, down from 23% in 1970. Evangelical and fundamentalist denominations, such as Southern Baptists, include groups that split off from mainline denominations in the 19th and early 20th centuries, typically over doctrinal disputes. From 1970 to 2005, their share of foreign adherents in US denominations fell somewhat, from 29% to 25%.[11] Pentecostalism,[12] now a century old, espouses speaking in tongues and other ecstatic practices including healing and prophesying. Between 1970 and 2005, the share of foreign adherents in US denominations belonging to Pentecostal or other so-called "renewalist" groups rose from 22% to 37%. Mormons and Jehovah's Witnesses are considered outside the Christian mainstream because they accept religious texts other than the Christian Bible. Between 1970 and 2005, these two groups, plus Seventh Day Adventists, saw their share of foreign adherents belonging to US denominations rise from 16% to 21%.[13]

Table 1 lists the 35 largest Protestant denominations worldwide (based on their adherents outside the US), of which 24 are headquartered in the United States. The size of denominations varies immensely, with the largest US denomination (Assemblies of God) having 42.4 million adherents outside of the United States in 2005, the 10th largest (United Methodist Church USA) having 3.7 million, the 30th largest (Pentecostal Church of God) having 0.6 million, and all denominations below the 80th rank having fewer than 0.1 million. Figure 1a plots for US denominations the number of adherents abroad against the number of adherents in the United States. The strong positive relationship indicates that denominations successful in the United

[10] We begin with 204 Protestant denominations headquartered in the United States. Of these, 16 are not found in the WCD (including some older groups that have been subsumed into newer denominations and some very small groups not captured by the WCD), 42 have no congregations in the WCD outside of the US (including old denominations in the process of dying out and a few recently created entities with minimal foreign presence), 8 have congregations outside the US but only in countries excluded from the sample owing to aggregation problems (see note 9), and 8 are very small denominations on which we could find no information on their organization or doctrine.

[11] Another schismatic tradition, the Holiness Movement, split off from mainline Methodists in the late 19th century. It emphasizes the restrictive doctrine of sanctification, in which believers purify themselves of sin (and are then to sin no more). Between 1970 and 2005, their share of foreign adherents of US denominations fell from 12% to 6%.

[12] A related group, the Charismatic Movement, emerged in the United States in the 1960s and includes individuals who left mainline denominations and embrace speaking in tongues.

[13] Additionally, Mormons maintain a strict dietary regimen, rigid guidelines on charitable giving, and a requirement that young men provide two years of missionary service; Jehovah's Witnesses have an elaborate theology surrounding the end of the world and are required to go door-to-door to convert non-believers.

States are also successful globally, consistent with a Melitz (2003) style framework.

There is also variation in the number of countries in which denominations operate. Most denominations are present in fewer than a dozen countries. Table 2 shows the number of countries in the sample in which US denominations have a presence in 1970 and in 2005. In 1970, only 10.9% of country-denomination cells have positive entries; by 2005, the share rises to 13.5%. As seen in Figure 1b, US denominations that attract more adherents in the United States (and presumably are more "productive") are present in more countries abroad. In the empirical analysis, we address the entry of denominations into countries in order to control for possible selection bias in estimating determinants of denomination size.

2.2 Denominational doctrine and governance

In the production of religious services, one can think of the church as the factory, the pastor as the manager, and, given that worship is a collective activity, the congregants as both workers and consumers (Iannaccone, 1998a). The denomination provides the intellectual property used in production, which includes religious doctrine and a system of governance (Chaves, 1993a). Denominations range in form from loose membership associations to rigidly hierarchical bodies. We code denominations according to the their governance structure and the strictness of their religious doctrine, using information from Melton (1989), Barrett, Kurian, and Johnson (2001), the World Christian Database, and denomination websites. In many cases, the core elements of a denomination's doctrine and governance were established by a religious entrepreneur who founded the organization.[14] In the early years of a movement, some elements of doctrine and structure are malleable but once codified tend to change only slowly over time (Melton, 1989; Chaves and Sutton, 2004; Finke and Stark, 2008).

Congregations that belong to a denomination share a defined religious doctrine, given in the denomination's statement of faith. The doctrine is a system of belief that is in part what attracts adherents to church. Christianity is organized around the life and teachings of Jesus Christ, as described in the New Testament of the Christian Bible. Previous literature has attempted to define doctrinal strictness of Christian groups in order to apply the Iannaccone (1992) model. Following Hoge (1979), Iannaccone (1998b), and Ekelund, et al. (2006), we

[14] For example, Aimee Semple McPherson founded the Foursquare Church, Joseph Smith founded the Mormons, and Charles Taze Russell founded the Jehovah's Witnesses. See Allen (1995) for case studies of church founding.

define strict religious doctrine to include the beliefs listed in Table 3, which also gives the share of US denominations that abide by these beliefs: (a) the Bible is the infallible word of God, (b) to become a Christian one must openly repent and convert (be "born again"), (c) one should try actively to convert others to Christianity, (d) Christ's return to earth (second coming) is imminent, (e) non-believers are damned to eternal suffering, (f) one should live by a strict moral code (modest dress, no smoking or drinking, no sexual activity outside marriage, etc.), (g) believers should be "sanctified" (see note 11), (h) speaking in tongues is evidence of one's religiosity, and (i) divine healing is possible.

Some beliefs – evangelism, repentance and conversion, infallibility of the Bible, and damnation of non-believers – are common to most groups, with at least 70% of US denominations adopting one of these. Others – the imminence of Christ's second coming, sanctification, speaking in tongues, behavioral restrictions, and divine healing – are less common. The second set of beliefs includes the dimensions along which strict groups differentiate themselves. For instance, the Assemblies of God, a Pentecostal denomination, endorses speaking in tongues but not sanctification, whereas the Church of the Nazarene, a conservative 'Holiness' denomination, endorses sanctification but not speaking in tongues. Both endorse divine healing, though they differ on the imminence of Christ's second coming. Each of these beliefs imposes time costs, lifestyle constraints, and impediments to maintaining relationships with non-Christians or Christians in other denominations. In the language of Iannaccone (1992), they stigmatize believers, raising the cost of participating in secular activities and helping other adherents identify those willing to be active in congregation life.

To measure strictness in an environment in which denominations are differentiated, we define a denomination to be strict if the row mean of the nine doctrinal dummy variables is greater than or equal to 0.5, which applies to 45% of the denominations in the sample. Figure 2 shows the distribution for the row mean of the nine doctrine variables for US denominations. The cutoff of 0.5 captures a break in the distribution between the top two quintiles of denominations and the rest; the cutoff divides denominations between those above the median and those at the median or below. Empirical results presented in section 4 are robust to raising the strictness cutoff to 0.6, which reduces the share of strict denominations to 32%, and to dropping any individual dimension of strictness from the calculation of the row mean.

In Iannaccone's (1992) club good model of religious organizations, which we incorporate

into our model of denominations in section 3, stricter groups elicit greater participation from their members by raising the perceived cost of secular goods and services. To examine how strictness relates to religious participation among the denominations in our data, we use the General Social Surveys in 2000, 2002, and 2004, which sample the US population on religion, politics, and social behavior. The GSS contains detailed data on the denominational affiliation of individuals who self-identify as Protestant, where the GSS denominations span two thirds of those in our data.[15] In unreported results, we find that, controlling for age, gender, and educational degree, individuals in the GSS belonging to strict denominations (according to our definition) are 25% more likely than individuals in non-strict denominations to attend religious services at least once a week. These findings are consistent with survey evidence from other sources (Iannaccone, 1998b), which show that the strictness of the religious group to which individuals belong correlates positively with the time and money that individuals contribute to church organizations. In the US, strict denominations thus succeed in attracting individuals with a relatively strong willingness to participate actively in church life.

In terms of organization, belonging to a denomination means a congregation agrees to govern itself according to a pre-specified structure. There is well-recognized variation in the degree of centralization among denominational governance systems.[16] The most decentralized system is a congregational polity, in which the congregation retains control over the hiring and firing of pastors and religious doctrine (Chaves, 1993b). The denomination, through national or international bodies, operates at arms' length. It provides congregations with a range of services, including recommending pastoral candidates, providing guidance on theology, publishing educational material, training pastors and lay leaders, extending loans for church construction, organizing national ministries to reach new converts, raising funds to support global operations, and organizing relief in response to disasters (as in Haiti following the 2010 earthquake). In return for these services, congregations pay fees to the denomination.[17] Local churches, in effect, use the denomination as a consulting service.

In centralized denominations, control rights reside not in the congregation but higher up

[15] For one-third of the individuals in the GSS, the denomination affiliation given (e.g., Other Baptist, Other Presbyterian, Church of God) is too aggregate to match to the denominations in our sample.

[16] Bloom, Sadun, and Van Reenen (2009) suggest that regional variation in the organization of religion may affect organizational choices by private firms. They find that multinational firms are more prone to centralized decision making in regions in which hierarchical religions (Catholicism, Eastern Orthodoxy, and Islam) are more prevalent.

[17] In the United States, individual congregations on average keep 79% of the revenues they generate, a share that has remained stable over time (Chaves, 1998).

in the denominational hierarchy. Denominational bodies above the congregation screen applicants to the ministry, assign pastors to churches, discipline pastors, and set religious doctrine for member churches. The denomination, in effect, has the power to license its brand – including the denomination name, religious doctrine, and governance structure – to individual congregations and decide who will manage each church. There are two common forms of centralized governance. In an episcopal (or connectional) structure, power resides in the bishopric, as in the United Methodist Church, the Evangelical Lutheran Church, and the Mormon Church. The chief authority over congregations within a region is a bishop, who ordains pastors, assigns pastors to churches, adjudicates disputes, and performs administrative duties. A council of bishops controls church doctrine. A second hierarchical system is the presbyterian structure, as in the Presbyterian Church USA and the Reformed Church. Power resides in a regional governing body known as the presbytery, which consists of a pastor and an elder from each congregation, and other church leaders. The presbytery ordains, installs, and removes pastors and establishes and dissolves congregations. Above the presbytery is a general assembly, which resolves disputes at the presbytery level and settles issues of religious doctrine.

We define a denomination to be decentralized if it has a congregational polity, which as seen in Table 3 applies to 55% of denominations. Among the denominations, the correlation between having a congregational polity and being strict is -0.16 (and insignificant), implying that decentralized denominations are weakly less likely to have a strict religious doctrine.

Denominations tend to enter a country by supporting missionaries or organizing mass revival meetings, as documented in an expanding literature (e.g., Brouwer, Gifford, and Rose, 1996). Once it has established itself in a market, a denomination may grow by attracting new members to existing congregations or by adding congregations. Figure 3 plots the log number of affiliated Christians against the log number of congregations, where each data point represents the worldwide total for a denomination. The linear relationship between adherents and congregations suggests that denominational expansion occurs more on the extensive margin (adding congregations) than on the intensive one (adding members to existing congregations).

3. THEORY

To briefly outline our framework, we present a model of competition between religious denominations. There are many countries and each country is segmented by geography into

many regional markets. First, each denomination decides whether to enter each regional market. If entry takes place a denomination establishes one congregation in a region. Second, to manage the congregation the denomination (the principal) works with a pastor (the agent). The denomination and the pastor have the same objective of maximizing a weighted sum of congregation membership and monetary income. However, the pastor exerts effort, which raises congregation members' utility, and bears the cost of this effort, where effort levels are subject to contractual incompleteness. The pastor chooses his effort level and – depending on the governance structure – either the pastor or the denomination sets the membership fee to charge each congregation member. Third, within each regional market the denominations that have entered compete to attract congregation members, who choose which denomination to attend. (there is no competition between regional markets). Fourth, competition among denominations determines congregation membership in each regional market and each denomination-pastor pair bargain over the monetary surplus that they jointly generate. Finally, aggregating across regional markets within a country determines the numbers of congregations and congregation members that each denomination has in each national market.

In what follows, we proceed by deriving the demand for participation in denominations, characterizing the interaction between denominations and pastors in supplying religious services, solving for the market equilibrium, and deriving comparative statics for relative denomination size, where we distinguish denominations by their strictness and governance structure.

3.1 Properties of the indirect utility function

In this subsection we explicitly derive the congregation members' indirect utility. To do so we model the congregation members' choice of participation intensity given their choices of denomination, drawing on the club-good framework of Iannaccone (1992). In this framework, congregants derive utility from religious participation and the consumption of a secular good. One example of the secular good is government-provided social services, which are substitutes for the club goods and other church-provided services, as documented by Berman (2000), Hungerman (2005), Gruber and Hungerman (2007), and Chen (2010). To be specific, the congregants are identical and each obtains utility,

$$u(.) = (S^d + K^d)^{1/d}, \qquad (1)$$

where $K = R^{\alpha}Q^{1-\alpha}$, $Q = \bar{R}$, and α and d are constants between 0 and 1. Equation (1) says that

utility is CES between the secular good, whose quantity is *S*, and that of religious participation, whose sub-utility is *K*. *K*, in turn, depends on the congregant's own participation intensity, *R*, whose expenditure share is α, and the average participation intensity of the other members of the same congregation, $Q = \bar{R}$. Each congregant has income *I*, and pays the shadow prices π_S and π_R for *S* and *R*, respectively. π_S captures both the explicit and implicit prices for obtaining *S*. When *S* is allocated via a price mechanism, π_S will be an explicit price; when *S* is quantity rationed, as under government provision of services, π_S will be the implicit queuing cost (e.g., delays in scheduling, waiting in line) to obtain the good. Each congregant pays a per-person membership fee, *p*, which may take the form of volunteer work or donations.[18] The congregant then maximizes utility (1) subject to the budget constraint and taking other members' choices of participation as given. At the Nash-equilibrium the choice of R is the same for all congregants, and the indirect utility function is

$$V(.) = \frac{I-p}{\Pi} D^{1/d}, \Pi = \pi_S^{-\rho} + \pi_R^{-\rho}\alpha^{\frac{\rho}{d}}, D = \pi_S^{-\rho} + \pi_R^{-\rho}\alpha^{\rho}, \qquad (2)$$

where $\rho = d/(1-d)$ and $\rho/d > 1$ is the substitution-elasticity between *S* and *K* in (1).

It is straightforward to show, using (2), that $-\beta \equiv \partial V/\partial p < 0$; i.e., an increase in the membership fee decreases members' disposable income and reduces utility. We show in the Appendix that (see also Iannaccone 1992):

Lemma 1. $\frac{\partial V}{\partial \pi_S} > 0$ if

$d > \alpha$, and (3.1)

$\frac{\pi_S}{\pi_R} > \left(\frac{1-d}{d-\alpha}\right)^{\frac{1}{\rho}} \frac{1}{\alpha}$. (3.2)

Condition (3.1) requires that the secular good and religious participation are close substitutes, which is consistent with Hungerman's (2005) and Gruber and Hungerman's (2007) findings that increases in social spending by the US government are correlated with decreases in charitable activities by US Christian churches. Condition (3.2) requires that π_S is not too low (i.e., secular goods are not too cheap relative to religious goods). To see the intuition for Lemma 1, consider

[18] We leave unspecified whether the membership fee is paid in donations of time or money owing to Gruber's (2004) empirical finding that religious giving and religious attendance are substitutes.

an increase in π_S, holding π_R constant. Real income falls,[19] which tends to reduce utility, but it also raises individual and average participation intensity in a congregation, as long as (3.1) holds, consistent with our findings from the GSS discussed in section 2.[20] Under (3.2), the value of religious participation, R, is sufficiently high such that the utility gains from higher participation more than offset the loss in real income. We also show in the Appendix that

Lemma 2. Given (3.1) and (3.2), then as long as $\frac{\pi_S}{\pi_R}$ is not too high, $\frac{\partial^2 V}{\partial(\pi_S)^2} > 0$. If $\frac{\pi_S}{\pi_R}$ is too high, then $\frac{\partial^2 V}{\partial(\pi_S)^2} < 0$.

To see the intuition of Lemma 2, note that the Nash equilibrium of the club-good model is inefficient, as a congregant does not internalize the benefits of his/her own participation on other members and so under-participate. When $\frac{\partial V}{\partial \pi_S} > 0$, the increase in π_S alleviates the efficiency loss and moves indirect utility V closer to the efficient level. If π_S is not too high, the efficiency gain is sufficiently large that V rises at an increasing rate with π_S. However, if π_S is too high, V is already close to the efficient utility level, leaving little room for further efficiency gain and causing V to increase with π_S at a decreasing rate. We provide a numerical example to show how V changes with π_S in Appendix Figure A1. Hereafter, we assume parameter values are such that

$$\frac{\partial^2 V}{\partial(\pi_S)^2} > 0 \text{ and } \frac{\partial V}{\partial \pi_S} > 0. \quad (4)$$

3.2 Model setup and the demand for religion

In this subsection we lay out the market structure of our model and examine the congregation members' choice of denominations. Each country k has many regional markets, indexed by m. In market m of country k, a total number of O_k^m individuals choose among religious organizations indexed by j. To be present in a regional market, a denomination must establish a congregation, incurring fixed cost, f_k, which implies that each denomination j will

[19] Consistent with this conception of the costs of religious participation, Lipford and Tollison (2003) find that increased religious participation is associated with lower individual income.

[20] We follow Iannaccone (1992) and model strictness as a way to alleviate the free-rider problem in producing worship services. Strictness may also help deal with adverse selection.

establish no more than one congregation in each regional market *m*.[21] Denomination *j* provides its congregations with access to its credence goods, whose additional value in utility (relative to a congregation with no denominational affiliation) is δ_{jk}. Each congregation is managed by a pastor, who oversees worship services and outreach to its members. The pastor exerts effort e_{jk}^m. As e_{jk}^m increases so does the quality of the congregation's services.

Members of the congregation enjoy services provided by the church, including a personal relationship with the pastor, and contribute time and money to help provide worship services, outreach to new members, charitable activities, and other club goods. We adopt a discrete choice framework and specify that the utility for person *i* in country *k* from participating in denomination *j* in local market *m*, U_{ijk}^m, is given by,

$$U_{ijk}^m = (\delta_{jk} + e_{jk}^m) + V_{jk}^m(\pi_{Sjk}, \pi_{Rjk}, I_{jk}^m - p_{jk}^m) + \varepsilon_{ijk}^m, \qquad (5)$$

where e_{jk}^m is the pastor's effort level, which captures the pastor's contribution to the religious services perceived by congregants. The indirect utility *V(.)* is given by equation (2), and we assume that the shadow prices π_{Sjk} and π_{Rjk} are constant across regions within a country. ε_{ijk}^m is an iid extreme value error term, observable to person *i*. Implicit in (5) is our assumption that there is no competition between regional markets (since they are geographically segmented); i.e. the individuals in market *m* only derive utility from the denominations that have chosen to enter *m*. To match our data we focus on individual choices among Protestant denominations, with other religious groups implicitly remaining in the background.[22] To derive the total number of

[21] Implicitly, we assume that to serve a market a denomination must engage in foreign direct investment, implying that there is no "export" option. In practice, some denominations do reach members through radio and television programming, which are forms of exporting religious services. Since we lack data on the extent to which individual denominations use radio and TV ministries, such activities are outside of the scope of our analysis.

[22] Our assumption in equation (5) that ε_{ijk}^m is iid extreme value implies independence of irrelevant alternatives (IIA). IIA allows us to estimate the model with data on a subset of the religious choices available to individuals in a country. This approach applies to the following decision structures: (a) a nested structure in which individuals first choose among religious aggregates (e.g., Protestantism, Catholicism, Judaism, Islam, etc.), before choosing among individual denominations or groups within these aggregates, in which case our analysis would apply to the sub-branch of the decision tree that applies to choice among Protestant denominations; or (b) a non-nested structure in which individuals choose among all religious groups simultaneously, in which case we would be applying IIA and estimating outcomes among the Protestant subset of choices available. Under either structure, we control for unobserved religious options using country fixed effects, which capture market competitiveness, as seen in (6). Finally, to keep the discussions focused we exclude the possibility of an outside good, as in Anderson, de Palma and Thisse (1992). Adding an outside good does not affect our analyses except to change the expression for P_k^m.

individuals who participate in denomination *j*, X_{jk}^{m}, we apply Anderson, de Palma and Thisse (1992) and Feenstra (2004) to obtain:

$$X_{jk}^{m} = \frac{\exp[\delta_{jk} + e_{jk}^{m} + V_{jk}^{m}]}{P_k^m} O_k^m, P_k^m = \sum_j \exp[\delta_{jk} + e_{jk}^{m} + V_{jk}^{m}], \quad (6)$$

where O_k^m is the population in market *m* and P_k^m the competitiveness of market *m*, akin to a price index for religious services. While we focus on Protestant denominations, other religious groups are implicitly captured in P_k^m, which we control for in the estimation using country fixed effects. Following a long tradition in the trade literature (Helpman and Krugman, 1986), we assume that the religious market is monopolistically competitive, such that a given denomination does not internalize the effects of its actions on P_k^m. By equation (6), $\partial \ln X_{jk}^{m} / \partial p_{jk}^{m} = -\beta$, where the parameter $\beta > 0$ measures the elasticity of demand for church membership; a high β indicates elastic demand. Equation (6) also implies that $\partial \ln X_{jk}^{m} / \partial e_{jk}^{m} = 1$.

3.3 Organizational structure and pastor incentives

In this subsection we lay out the timing of our model, explain the objective and organizational structure of the denomination, and examine the denomination and the pastor's choice for effort level and membership fee. Timing is as follows. (i) The denomination decides whether or not to enter country *k* and market *m*. (ii) Price and effort levels, p_{jk}^{m} and e_{jk}^{m}, are chosen, which determine congregation membership. (iii) The denomination and pastor bargain over the monetary surplus generated in market *m*. Bargaining results from incomplete contracts (Grossman and Hart, 1986): we assume no contract written at stage (ii) can govern trade at stage (iii). We assume parties' outside options are 0 and that each gets half the monetary surplus.[23]

Following Besley and Ghatak's (2005) formulation of objectives in non-profit organizations, we assume that the pastor values both the number of congregation members, with weight γ, and monetary income from serving the congregation. Likewise, a denomination values the number of believers it attracts, also with weight γ, as well as the monetary income its

[23] Both assumptions are innocuous and are made to simplify the exposition. Our results hold up when the outside option is non-zero or when the Nash-bargaining share is a constant between 0 and 1.

congregations generate.[24] In addition, we assume that the pastor serves members at marginal cost, g_k, and that the cost of his effort, e_{jk}^m, is given by,

$$c(e_{jk}^m) = \exp(h_k e_{jk}^m), \tag{7}$$

per congregation member, where $h_k > 0$ affects effort costs. When h_k is low, the pastor can easily remain connected with congregation members (e.g., by visiting members on week days).[25]

We classify the organizational structure of a denomination as decentralized (D) or centralized (C), which is chosen by the denomination at an earlier time and taken as given. Under the D structure, the pastor has control rights, which gives him the right to choose the membership fee, p_{jk}^m.[26] The joint monetary surplus for the congregation is $X_{jk}^m (p_{jk}^m - g_k)$, where g_k is the pastor's variable cost for serving the congregation, meaning the pastor's payoff is[27]

$$X_{jk}^m \gamma + 0.5 X_{jk}^m (p_{jk}^m - g_k) - f_k - X_{jk}^m c(e_{jk}^m). \tag{8}$$

The first order conditions for effort and the membership fee are, respectively,

$$c'(e_k^D) + c(e_k^D) = \gamma + \frac{1}{2}(p_k^D - g_k), \tag{9}$$

$$p_k^D = \frac{1}{\beta} + g_k + 2[c(e_k^D) - \gamma]. \tag{10}$$

Due to logit demand in (6), indirect utility, V_{jk}^m, and market competitiveness, P_k^m, do not affect

[24] As compared with Besley and Ghatak (2005), we (i) assume that the principal and the agent have the same mission objective (i.e., congregation membership) and so abstract away from the matching between principals and agents, and (ii) consider an incomplete-contract environment. The weighting parameter, γ, affects the price level (see equations (10) and (12)) and so denomination size, but does not affect how denomination size varies with the key parameters of our model, h_k, and π_{Sjk}. Therefore, Propositions 1 and 2, below, still hold even if the denomination and the pastor place different utility weights on the number of believers.

[25] We assume that each congregation has a single pastor. In practice, the organizational structure of a congregation may be more complex and may depend on the characteristics of the congregants (e.g., congregations containing wealthier members may have more pastors per congregant and may choose to donate money over time). We abstract away from these considerations owing to the fact that we lack data on the employment structure of congregations.

[26] Consider the following extension to incorporate elements of the framework describing the delegation of authority in Aghion and Tirole (1997). Suppose the project of congregation-building is the vector (connection, membership fee), where a successful connection between the pastor and members of the congregation causes the utility of members to rise. There is uncertainty about the correct way to connect with members, with a pastor-preferred connection option and a denomination-preferred connection option. The D structure allocates formal authority over the vector (connection, membership fee) to the pastor. Compared with our current framework, the pastor has even stronger effort incentives under the D structure since he can choose not only his preferred price but also his preferred connection option. Such a setting would strengthen results derived below.

[27] In our setting the allocation of control rights has no impact on bargaining power. To relax this assumption, suppose control rights increase bargaining power. Then under the D structure the pastor has even stronger incentives since he receives more than half the surplus. This setting would strengthen our results. In other words, our results hold up as long as control rights do not *decrease* bargaining power too much.

fees or effort, though they do affect the number of adherents; in the rest of this subsection, we drop the index for region (m) and denomination (j). Equation (9) says that a higher fee provides the pastor with stronger incentives to exert effort, as the left-hand side of (9) is increasing in effort. Equation (9) also says that the pastor has stronger incentives to exert effort when his marginal effort cost, h_k, is lower. Equation (10) says that an increase in effort cost, $c(e_k^D)$, leads to a more than one-for-one increase in membership fees. This is due to the hold-up problem under incomplete contracts. Since the pastor captures only half of the monetary surplus, he is not fully compensated for his effort. To alleviate hold-up, he over-compensates his effort in pricing. In (10), the pastor internalizes only his own non-monetary benefit to believers and not the denomination's. The other terms in (10) say that the membership fee is high if variable cost, g_k, is high, or demand is inelastic (β is low). From (9), (10) and (7),

$$e_k^D = \frac{1}{h_k} \ln \frac{1}{2\beta h_k}, \tag{11}$$

where h_k measures the pastor's effort cost, as defined in equation (7). Equation (11) says that pastor effort is high when the effort cost, h_k, is low.

Under the C structure, the control rights over the congregation rest with the denomination, such that the denomination chooses the membership fee. Since the denomination's payoff is $\gamma X_{jk} + X_{jk}(p_{jk} - g_k)/2 - f_k$,[28] it selects the fee,

$$p_k^C = \frac{1}{\beta} + g_k - 2\gamma. \tag{12}$$

Equations (10) and (12) imply that the membership fee is lower under the C structure than under the D structure: $p_k^C < p_k^D$. This is because the cost of pastor effort does not enter into the denomination's payoff, leading the denomination to ignore the effort cost in pricing. Equations (7) and (6) still hold under the C structure, and the first order condition for pastor effort is still equation (9), except that fee is p_k^C. Plugging (12) into (9) we obtain

$$e_k^C = \frac{1}{h_k} \ln \frac{1}{2\beta(h_k + 1)}. \tag{13}$$

Equations (11) and (13) say that the effort level is lower under the C structure than the D

[28] We choose to have the denomination bear the church fixed cost, f_k, in order to simplify the expressions for the entry threshold and the number of churches and believers. Who bears f_k has no effect on the first order conditions.

structure: $e_k^C < e_k^D$. Under the C structure, the denomination sets prices and ignores the pastor effort cost in its pricing decision. For the pastor, lack of control rights under the C structure aggravates the hold-up problem, creating weak incentives to invest in effort.

To summarize, the denomination and the pastor disagree about pricing; the denomination prefers the lower price, p_k^C, as defined in (12), but the pastor prefers the higher price, p_k^D, as defined in (10). Relative to the C structure, the D structure provides stronger incentives to the pastor by allocating control rights to him, which results in high effort but also a high membership fee.[29] Since we do not observe effort levels or membership fees in our data, we next examine predictions about the numbers of believers and congregations under the C and D structures.

3.4 Market equilibrium and denomination size

Since our data has the numbers of congregations and adherents in country *k* for denomination *j*, we aggregate across religious markets *m* within country *k* to derive these variables in this subsection. We first derive results under the D structure; results for the C structure are analogous. Under the D structure, the denomination is active in markets where pastor utility is non-negative. Plugging (10) into pastor's payoff (8), the denomination enters local market *m* if and only if

$$\frac{\exp[\delta_{jk} + e_k^D + V_{jk}(., p_k^D)]}{P_k} \frac{O_k^m}{2\beta} \geq f_k, \tag{14}$$

where P_k and V_{jk} are invariant across markets because price and effort level are invariant across markets. Intuitively, the denomination enters larger markets and markets with lower entry costs. We rewrite the population in local market *m* as $O_k^m = O_k s_m$, where s_m is the size of local market *m*, with cdf $G_k(.)$, and O_k is a shifter reflecting the total population of country *k*. Equation (14) then gives the threshold market size for entry:

$$\underline{s}_k^D = \frac{2\beta f_k P_k \exp[-\delta_{jk} - e_k^D - V_{jk}(., p_k^D)]}{O_k}, \tag{15}$$

Equation (15) says that a denomination enters more markets the lower is the fixed cost or the larger is country *k*. Following literature on city size (Gabaix, 2009), we assume the distribution

[29] Consistent with these predictions, in US congregations pastor salaries rise more quickly with church attendance in denominations with congregational polities than in hierarchical denominations (McMillan and Price, 2003).

of regional market size, $G_k(.)$, is Pareto with lower bound b and shape parameter $a > 1$, such that $G_k(s) = 1 - (b/s)^a$. For expositional ease we assume that there is a unit measure of regional markets in country k, which implies that the number of markets denomination j enters, or the number of congregations j has, is $n_{jk}^D = 1 - G(\underline{s}_k^D)$. Using (15) and $G_k(.)$, we show that,

$$\ln n_{jk}^D = a \ln \frac{B_1}{f_k} + a[\ln \frac{O_k}{P_k} + e_k^D + \delta_{jk} + V_{jk}(., p_k^D)], B_1 = \frac{b}{2\beta}$$

$$\ln X_{jk}^D = (a-1) \ln \frac{B_2}{f_k} + a[\ln \frac{O_k}{P_k} + e_k^D + \delta_{jk} + V_{jk}(., p_k^D)], B_2 = (\frac{ab^a}{a-1})^{\frac{1}{a-1}} \frac{1}{2\beta}, \quad (16)$$

where $X_{jk}^D = \int_{\underline{s}_k^D}^{\infty} X_{jk}^m dG(s_k^m)$ is the aggregate number of adherents in country k for denomination j. Equation (16) implies that the intensive margin, X_{jk}^D / n_{jk}^D, does not depend on market size and that all the adjustment of X_{jk}^D is through the extensive margin, n_{jk}^D, consistent with Figure 3. Such predictions are typical of models with firm heterogeneity (Melitz, 2003).

Under the C structure, the total number of congregations and adherents are:

$$\ln n_{jk}^C = a \ln \frac{B_1}{f_k} + a[\ln \frac{O_k}{P_k} + e_k^C + \delta_{jk} + V_{jk}(., p_k^C)],$$

$$\ln X_{jk}^C = (a-1) \ln \frac{B_2}{f_k} + a[\ln \frac{O_k}{P_k} + e_k^C + \delta_{jk} + V_{jk}(., p_k^C)], \quad (17)$$

where the coefficients B_1 and B_2 are as defined in equation (16). With these results in hand, we derive comparative statics. We first examine the effect of religious doctrine on denomination size. We consider how shocks to the market for secular goods affect the relative size of strict groups. From club-good utility, changes in the price of the secular good change the demand for strictness. For denomination j in country k, we assume that the shadow price for the secular good can be decomposed as, $\pi_{Sjk} = \pi_{Sj} + \pi_{Sk}$, for all local markets m. π_{Sj} is high for the adherents of denomination j if denomination j is strict; π_{Sk} is high for the population of country k if country k has a weak supply of social services (implying higher queuing costs and therefore higher shadow prices for these services) or if country k has strong demand for social services. The first property follows Iannaccone's (1992) conception that membership in a strict religious group raises the cost of consuming secular goods. The second property follows from the standard notion that price is negatively (positively) correlated with supply (demand) shocks.

What happens to participation in denominations when the shadow price of the secular

good increases? Suppose, for instance, that the availability of social services in country *k* falls. Then π_{Sk} increases, and utility increases for all denominations in country *k*, strict or not, since $\partial V/\partial \pi_S > 0$, by equation (4). However, there is an additional effect, as well. The increase in indirect utility is higher for strict denominations, for which π_{Sjk} is higher, since $\partial^2 V/\partial(\pi_S)^2 > 0$ by equation (4). In other words, strict denominations face a relatively large increase in demand if government provision of social services falls. Summarizing,

> *Proposition 1*. Weaker government provision of (and/or stronger demand for) social services raise the size of strict denominations by more than less strict ones:
>
> $$\frac{\partial^2 \ln G_{jk}^O}{\partial(\pi_{Sk})\partial(\pi_{Sj})} > 0, \quad \text{where } G = X, n \text{ and O = D, C.}$$

The Appendix contains the proof.

Turning to the effect of organizational structure on size, by equations (16) and (17), the size of a decentralized denomination relative to a centralized one is,

$$\ln \frac{n_{jk}^D}{n_{jk}^C} = \ln \frac{X_{jk}^D}{X_{jk}^C} = a[(e_k^D - e_k^C) + (V_{jk}^D - V_{jk}^C)] + B_3, \qquad (18)$$

where B_3 is a constant. Equation (18) implies that there is an ambiguous ranking of absolute size for centralized and decentralized denominations, as a comparison depends on the elements of the indirect utility function $V_{jk}(.)$. However, we can examine the differential impacts that a change in the marginal cost of pastor effort has on the size of decentralized and centralized denominations. Suppose h_k decreases. Then pastor effort increases and size increases for both C and D structures. Intuitively, given that the D structure provides the pastor with stronger incentives, the decrease in h_k should have a larger impact under the D structure. We show in the appendix that[30]

[30] It is possible to extend the analysis to incorporate ownership of church property. Following Grossman and Hart (1986), we assume that ownership and control rights rest with the same party. Under the D structure the local congregation owns the church, but under the C structure the denomination owns the church. In practice, under a congregational polity, the congregation tends to own church buildings, while under episcopal or presbyterian polities, the denomination typically controls church property. Ownership affects the pastor's incentives by changing his outside option, should bargaining fail. Under the D structure, the denomination's outside option remains 0, but the pastor controls the church and should bargaining fail the pastor converts the church into an independent entity, in which case the denomination input no longer affects demand. We assume that the monetary surplus shrinks to the fraction $d_k^D < 1$ of the size when bargaining is successful. The denomination then gets fraction $(1 - d_k^D)/2$ of the monetary surplus in bargaining, while the pastor receives fraction $(1 + d_k^D)/2$. Under the C structure, the denomination owns the church. Should bargaining fail, pastor effort no longer affects demand and the monetary

Proposition 2. A change in the cost of pastor effort has a larger impact on the size of decentralized (D) denominations than centralized (C) denominations:

$$\frac{\partial \ln(G_{jk}^{D} / G_{jk}^{C})}{\partial h_k} < 0, \text{ where } G = X, n.$$

To summarize, our model has two predictions: (1) Doctrine: Weaker supply of or stronger demand for social services raises the number of adherents and congregations more for strict denominations than less strict ones (Proposition 1); and (2) Organization: A decrease in the pastor's cost of serving congregants raises the numbers of adherents and congregations more for a decentralized denomination than a centralized one (Proposition 2).[31] Although we have focused on Protestant denominations in deriving these predictions, our framework can be applied to competition among other religious groups, as well.

4. EMPIRICAL SPECIFICATION

4.1 Empirical Specifications

The predictions of our model guide the empirical specification. We approximate indirect utility, $V_{jk}(.)$, using its second-order Taylor expansion; i.e. $V_{jk}(.)$ is a second-order polynomial involving the variables π_{Sjk}, π_{Rjk}, and $I_k - p_k$. We assume that π_{Rjk} is country-k specific and let the vector $\mathbf{Z_k}$ represent the variables I_k, p_k and π_{Rk}. We also assume that the general quality of denomination j's credence good in country k is $\delta_{jk} = \varsigma_j - c_1 t_{jk}$, where t_{jk} captures communication costs for denomination j in country k (e.g., distance to denomination headquarters) and includes an iid random-cost component (which allows the ranking of denominations across countries to differ). We measure π_{Sk} using the vector $\mathbf{H_k}$, which includes the supply of and demand for social services in country k, and π_{Sj} by the strictness of denomination j, STR_j (recall that $\pi_{Sjk} = \pi_{Sj} + \pi_{Sk}$). The empirical specification for $V_{jk}^{O} + \delta_{jk}$ is then:

$$V_{jk}^{O} + \delta_{jk} = \gamma_j + \gamma_k + c_2 \mathbf{Z_k} STR_j + \eta_1 \mathbf{H_k} STR_j - c_1 t_{jk}, \qquad \text{O = D, C,} \tag{19}$$

---

surplus collected by the denomination shrinks to the fraction $d_k^C < 1$ of the size under successful bargaining. The pastor's outside option is 0. The denomination receives the share $(1+ d_k^C)/2$ of the monetary surplus in bargaining and the pastor receives the share $(1 - d_k^C)/2$. Other derivations go through and Propositions 1 and 2 hold.

[31] Both predictions are for the countries where a given denomination is present. In the Appendix we derive the conditions under which denomination j enters country k. In our empirical exercises we explicitly control for entry.

where the *c*'s are constants, and O = {*Decentralized, Centralized*}. γ_j and γ_k are denomination and country fixed effects, which absorb the variables with *j*- and *k*-specific subscripts (e.g. p_k^O, $\mathbf{Z_k}$, and ς_j). By Proposition 1, we have that $\eta_1 < 0$.

Plugging equation (19) into (16) and (17), it follows that,

$$\ln X_{jk}^O = f^O(h_k) + \gamma_j + \gamma_k + c_2\mathbf{Z_k}STR_j + \eta_1\mathbf{H_k}STR_j - c_1 t_{jk},$$

$$\ln n_{jk}^O = f^O(h_k) + \gamma_j + \gamma_k + c_2\mathbf{Z_k}STR_j + \eta_1\mathbf{H_k}STR_j - c_1 t_{jk}, \quad (20)$$

In equation (20), X_{jk}^O and n_{jk}^O are, respectively, the numbers of adherents and congregations that denomination *j* has in country *k*, and h_k is the marginal cost of pastor effort in country *k*. Proposition 2 implies that $\partial f^D / \partial h_k < \partial f^C / \partial h_k$. We approximate $f^O(.)$ by $\lambda_1\mathbf{R_k} + \eta_2\mathbf{R_k}DEC_j$, where $\mathbf{R_k}$ measures the pastor cost of serving congregants in country *k* and DEC_j measures the decentralization of denomination *j*, where by Proposition 2, $\eta_2 > 0$. Equation (20) implies the following regressions:

$$\ln X_{jk} = \gamma_j + \gamma_k + \eta_2\mathbf{R_k}DEC_j + \eta_1\mathbf{H_k}STR_j + \lambda_3\mathbf{Z_k}STR_j + \lambda_4 t_{jk} + u_{jk},$$

$$\ln n_{jk} = \gamma_j + \gamma_k + \eta_2\mathbf{R_k}DEC_j + \eta_1\mathbf{H_k}STR_j + \lambda_3\mathbf{Z_k}STR_j + \lambda_4 t_{jk} + v_{jk}. \quad (21)$$

In equation (21), u_{jk} and v_{jk} are error terms capturing unobserved costs (assumed uncorrelated with the regressors), and $\mathbf{Z}_k$ is expanded to include the competitiveness of the country's religious market (P_k) and country size (O_k).[32] By Proposition 1, $\eta_1 < 0$: stronger supply of (or weaker demand for) social services reduces the size of strict denominations by more than non-strict ones; by Proposition 2, $\eta_2 > 0$: a lower cost of pastor effort increases the size of decentralized denominations by more than centralized ones.

4.2 Regression variables and estimation method

[32] To see how the variables in (16) and (17) are captured in (21), by assumption, δ_{jk} (denomination *j*'s additional value in *k*) is in the terms γ_j and t_{jk}. By approximation, f_k (fixed entry cost), O_k (population), P_k (market competitiveness), I_k (congregants' income), g_k (pastor variable cost) and π_{Rk} (shadow price of religious participation) are in γ_k and $\mathbf{Z_k}$; for π_{Sjk} (shadow price of secular good), its country-*k* component is in γ_k and $\mathbf{H_k}$ and its denomination-*j* component in γ_j and STR_j; for h_k (pastor effort cost) its level effect is in γ_k and its interaction with organizational structure (working through price p_k and effort level e_k) captured by the term $\mathbf{R_k}DEC_j$.

Following equation (21), we regress the log size of a denomination in a country, measured as the number of adherents or congregations in 2005, on country fixed effects, γ_k, denomination fixed effects, γ_j, and interactions between country and denomination characteristics.[33] Denomination fixed effects absorb doctrinal strictness and governance structure, the quality of a denomination's credence goods, other determinants of denomination productivity, and entry barriers specific to a denomination and constant across countries. Country fixed effects absorb national market size (population, urbanization, average income, education, etc.), barriers to the import of religion common across denominations, variable costs in providing services to congregants common across denominations, and the competitiveness of the religious market in a country (represented by the variety of religious options available in a country). The key regressors are interactions between a denomination's governance structure (DEC_j =1 if a denomination has a congregational polity and is decentralized) or religious doctrine (STR_j =1 if the denomination is above the median in terms of doctrinal strictness) and country characteristics that capture the cost to pastors of connecting with congregants or the supply of and demand for social services. Table 4 provides summary statistics on regression variables.

Consider first measures of social service demand and supply, $\mathbf{H_k}$.[34] Following the literature (Berman, 2000; Hungerman, 2005; Gruber and Hungerman, 2007), we assume that the club goods produced by congregations substitute for social services provided by the state. In terms of state-provided social services, we focus on health care. In many countries, governments are the primary providers of health services, especially for the poor or middle class.[35] These services are among the best measured social services provided by the state; data on the provision of other social services, such as welfare programs, aid to children in poor families, disability insurance, etc., are unavailable for most low and middle-income countries. We assume that the price of health services responds to the supply of health-care personnel and infrastructure and to demand shocks for health care. In many high-income countries, the government provides health

[33] Although the WCD counts adherents in 1970 and 2005, we lack data for most regressors prior to 1970, limiting our analysis to the 2005 cross section. However, we do use the 1970 WCD data in our treatment of selection bias.

[34] Implicitly, we assume that the supply of social services in a country does not simply adjust to demand in a manner that keeps prices constant across national markets (i.e., we presuppose the existence of idiosyncratic national factors that affect either supply – such as the historical legacy of training for health care workers – or demand – such as cultural attitudes or preferences – that create differences in the shadow prices of social services across countries).

[35] For the subsample of 35 OECD countries, there are data on social spending, overall and by type. For these countries in 2007 (close to our sample year of 2005), the correlation between total social spending per capita and health spending per capita is 0.77, suggesting that health related spending correlates well with government transfers.

care at a set price, using quantity rationing to allocate supply. In developing countries, it is increasingly common for the government to impose user fees for health services (Leive and Xu, 2008; Peters et al., 2008); where fees are set below market levels, the providers of these services often demand side payments to deliver care (Kruk et al., 2008). Whether allocated via quantity-rationing or a price mechanism, the effective cost of obtaining health services is likely to be related to the supply of personnel who deliver these services and the resources they have at their disposal (Whitehead, Dahlgren and Evans, 2001). We measure the supply of health services using medical personnel (nurses and midwives) per capita,[36] log hospital beds per capita, and health expenditure as a share of GDP, from World Development Indicators averaged over 1970-2004. While religious organizations do not provide medical services per se, they offer spiritual (e.g. prayer, belief in an afterlife, faith healing) and material (e.g., meals, home visits for the sick) substitutes for medical services. We examine whether more expansive health services means weaker demand for services from religious groups.

The demand for social services provided by the state tends to be greater where the incidence of adverse shocks is higher. Following natural disasters or disease outbreaks, health care systems are severely taxed (Noji, 1997; Warring and Brown, 2005), restricting the availability of health care to the population. We measure aggregate shocks using the incidences of natural disasters and disease outbreaks based on data from the International Emergency Event Database (www.emdat.be). While such shocks are temporary, they are often severe in nature, leading to large disruptions in consumption. Anthropological evidence from traditional societies shows that the number of religions present in a region is positively correlated with disease load (Fincher and Thornbill, 2008), consistent with the idea that religious organizations provide insurance against the risk of contagion. We measure shock incidence as the number of events that occurred in a country over 1970 to 2004 (for disasters) or 1995-2004 (for disease outbreaks),[37] divided by the number of years in the period, which is the annualized shock incidence. Following Yang (2008), we define a serious natural disaster as an earthquake over

[36] Physicians are an obvious additional type of medical personnel. However, in many poor countries physicians play a relatively small role in the delivery of health care, with nurses being more prevalent (Clemens, 2007). Among the poorest 30 countries in the sample, the median nation has 0.5 physicians and 5 nurses per 10,000 people, such that the ratio of nurses to physicians is 10 to one. In the rest of the sample, the ratio of nurses to physicians is 3 to one. Below, we discuss results including physicians per capita interacted with strictness as a regressor but we do not include the variable in estimating the principal components of health services.

[37] We use a shorter window for disease outbreaks than for natural disasters because country coverage of disease outbreaks broken by type of disease is incomplete in the1970s and 1980s.

seven on the Richter scale, a windstorm (i.e., hurricane) lasting five days or more, or a landslide or volcanic eruption that affects more than 1000 people. Disease measures cover cholera, dengue fever, influenza/SARS, and meningococcal outbreaks that affect more than 1000 people. Serious natural disasters are surprisingly common events, with mean annual probabilities of occurrence of 1% (hurricanes) to 3% (earthquakes, volcanic eruptions). Mass disease outbreaks are also common, with mean annual occurrence probabilities of 0.3% (influenza/SARS) to 2% (cholera). We also examine how strictness interacts with financial development, which may capture the potential to hedge against environmental risk through financial markets.

We measure the cost to pastors of communicating with congregants, $\mathbf{R_k}$, using communications and transportation infrastructure, including telephone mainlines per capita, cellular subscriptions per capita, road network (total length and fraction of roads paved), and passenger cars per capita.[38] A pastor's responsibilities include communicating with congregants (to encourage participation in church events), reaching out to new converts, conferring with church leaders on managing the congregation, and attending local events in the community. Pastor costs for outreach are likely to be lower where a larger fraction of the population have access to mainline and cellular phones (because it is easy for the pastor to call his congregants during week days), and/or where there is a larger network of paved roads and passenger vehicles are readily available (because it is easy for the pastor to visit his congregants during week days). The literature suggests that improved land transportation infrastructure increases economic activity disproportionately for the service sector (Chandra and Thompson, 2000), perhaps due to lower costs of connecting consumers to service hubs. Our infrastructure data are from the WDI, averaged over 1991-2005,[39] and show substantial variation across countries. For example, the number of cars per 100 people has a mean of 13.4 but a standard deviation of 16.2.

Although we control for country fixed effects, additional country characteristics (e.g., education, average income) may have different effects on strict versus non-strict or centralized versus decentralized denominations. If these characteristics are correlated with our main regressors, the estimation may be subject to omitted-variable bias. To address this concern, we include, as additional controls, interactions between decentralization and strictness and country

[38] As a matter of convention, we measure usage or access rates (e.g., cellular subscriptions per capita) in levels and factor quantities (e.g., hospital beds or passenger cars) as log values (which implicitly are in log per capita terms, given that log population interacted with strictness and decentralization appears as a regressor).

[39] Measures of communications infrastructure are unavailable for many countries before 1990, which accounts for why we average their values over a shorter time span than for health services.

characteristics that past work has shown to correlate with religiosity (Barro and McCleary, 2005; McCleary and Barro, 2006; Sacerdote and Glaeser, 2001).[40] Our results are robust to the inclusion or exclusion of these additional variables. Additionally, we employ placebo tests and examine individual types of natural disasters (e.g., earthquakes) and disease outbreaks (e.g., influenza/SARS), as we explain in subsections 5.2 and 5.3.

Another estimation issue is that most denominations are not present in most countries (see Table 2), creating potential problems with sample selection. That is, in the log specification in (21) observations with zero adherents are dropped. Under OLS, the regressors may be correlated with the expectation of the error term conditional on a denomination being present in the country. To address the issue, we compare results using three estimation methods: OLS, a Heckman (1979) correction for sample selection, and a nonparametric correction for sample selection, motivated by Das, Newey, and Vella, (2003). In practice, we find similar estimates across the three estimators, suggesting sample selection is not important for the estimation.

In either Heckman or nonparametric approaches, we need variables that are correlated with a denomination's presence in a country in 2005 but not independently correlated with the error terms in equation (21). We use two instruments for denomination presence in 2005. One (available for all denominations) is an indicator for whether the denomination was present in the country in 1970, with the identifying assumption being that presence in 1970 is correlated with the error for denomination size in 2005 only through denomination and country fixed effects. A second instrument (missing for some denominations) is the entry decisions in 1970 of denominations with a similar number of adherents in the United States.[41] The reasoning behind this instrument is that size in the United States, the home country for all denominations in our sample, captures a denomination's average attraction to adherents, similar to firm sales being a sufficient statistic for firm productivity in the Melitz (2003) model. Since denomination productivity affects entry, the entry decisions of denominations with similar numbers of US

[40] The additional controls are the percentages of the adult population with primary, secondary, and tertiary education (Barro and Lee, 2010), log per capita GDP, log population, the urbanization rate, log life expectancy, the total fertility rate, log distance from the United States, whether a country's official language is English, an index for the government regulation of religion (Grim and Finke, 2006), whether the country had a state religion in the past, the Freedom House rule of law index, an index for ethnic fractionalization (Alesina and La Ferrara, 2005), the fraction of the population that had migrated to the US as of 1970, and indicators for whether Catholicism, Islam, Orthodoxy, Hinduism or Buddhism, or Judaism is the dominant religion in a country.

[41] We define similar sized denominations using a size window of log 3 (matching to each denomination, other denominations with log US size plus or minus 1.5). Because the window for neighboring denominations is truncated for the largest and smallest groups, the instrument is not defined for these denominations.

adherents are likely to be correlated. The identifying assumption is that the unobserved barriers to entry of similarly US-sized denominations are uncorrelated. In nonparametric estimation, we use a linear probability, probit, or logit model to estimate the probability a denomination is present in a country in 2005 and then construct dummy variables that capture the value of the predicted probability of presence based on dividing predicted values into 50 equal-sized bins.[42] We include these dummies in the second-stage regression for log denomination size.

5. EMPIRICAL RESULTS

5.1 Main estimation results

Table 5 presents baseline OLS results.[43] We show coefficient estimates for four sets of interactions: between denomination strictness and (a) country incidence of natural disasters, (b) country incidence of disease outbreaks, and (c) country health infrastructure; and between a denomination being decentralized and country communication and transportation infrastructure. The data contain multiple measures of a country's infrastructure, which are likely to be correlated with each other. Because including these measures together introduces collinearity into the regression, we begin by using the first principal component of the infrastructure variables and later examine the results for the individual measures. We treat disasters, disease outbreaks and health services similarly.[44] By construction, the first principal components have mean zero and a standard deviation of one.

The first column of Table 5 shows that the interactions between strictness and the incidences of natural disasters and disease outbreaks are positive and precisely estimated. To understand the results, recall that the regressions include country and denomination fixed effects. Interpreting the within-denomination variation, the results indicate that a strict denomination will tend to attract more adherents in countries with a higher incidence of disasters, be they

[42] Results are similar when we use bins of 100 instead of 50 in the second-stage estimation. We also experimented with using the polynomials of estimated propensity scores and obtained similar results.

[43] The results here and in Table 6 include the additional control variables listed in note 36. To save space we do not report their coefficient estimates, which are available from us upon request. The results without these controls are similar, and also available from us upon request.

[44] For disasters, we use the first principal component of four incidence variables: earthquakes, landslides, volcanic eruptions, and windstorms; for disease outbreaks, we use the first principal component for four events: cholera, dengue fever, influenza/SARS, and meningococcal outbreaks; for health services, we use the first principal component of three variables: medical personnel per capita, log hospital beds, and health expenditure as a share of GDP; and for communications and transportation infrastructure, we use the first principal component of five variables: telephone mainlines per capita, cellular subscribers per capita, log road network per square kilometer, percent roads paved, and log passenger cars.

geological, meteorological, or biological in origin. Equivalently, the within-country variation indicates that a country that has a higher incidence of disasters will tend to have its Christian believers more concentrated in strict denominations. The coefficient estimates suggest that the impact of disasters on denomination size is large. A one standard deviation increase in the incidence index is associated with an increase in the relative size of strict denominations of 22 log points for either natural disasters (e.g., going from Austria to Nicaragua) or disease outbreaks (e.g. going from Italy to Nepal). In column (1), we also see that the interaction between strictness and the provision of health services is negative and precisely estimated. A strict denomination will have more adherents in countries with worse provision of health services (or, equivalently, a country with worse health services will tend to have more of its believers in strict groups).

These results are consistent with Proposition 1, which says that the relative size of strict denominations is larger in countries in which the shadow price of secular goods and services is greater. Strict denominations do better in countries in which the net demand for social services is stronger, where higher net demand may come from weaker government supply of social services (measured here in terms of health infrastructure) or stronger public demand for services associated with the risk of shocks to income or health. In our model, stronger demand for or weaker availability of social services increases queuing (or user fees) and therefore the price of obtaining services, making membership in a strict religious organization (with its superior capacity for producing club goods) more attractive.

In the second column of Table 5, the interaction between denomination decentralization and country provision of communication and transportation infrastructure is positive and precisely estimated. Decentralized denominations attract more adherents in countries in which the supply of communications and transportation infrastructure is greater. This finding is consistent with Proposition 2, which states that the relative size of decentralized denominations is larger in countries in which the marginal cost to pastors of connecting with congregants is lower. From our model, lower cost to pastors of connecting with congregants has a larger effect on the size of decentralized denominations, owing to stronger pastor effort incentives created by their having control rights. Our finding of positive effects of infrastructure on relative denomination size is broadly consistent with findings in the literature on how public infrastructure affects industrial productivity, and provides empirical evidence that governance structure affects performance for international organizations.

In column (3), we combine the strictness and decentralization interactions in a single regression, which leaves results unchanged. In columns (4)-(5), we measure denomination size using the log number of congregations, instead of the log number of adherents. The results are qualitatively the same. Because results for adherents and congregations are similar, we limit the presentation of further results to regressions with log adherents as the dependent variable. Later results are robust to using log congregations as the dependent variable, instead.

Table 6 contains results for alternative estimators (see Appendix Table A1 for the first stage results). As Table 2 shows, many denominations have not entered certain countries. To address sample selection, we estimate two alternative models. Columns (1) and (2) show results for a Heckman estimator, in which we use as instruments either denomination presence in the country in 1970 (first column) or lagged presence and average presence in 1970 of denominations that attract a similar number of adherents in the United States (second column). Columns (3)-(9) present results for a nonparametric correction for sample selection, in which we first estimate the probability of presence in 2005 using a linear probability, probit, or logit model and then use dummy variables for the predicted probability of presence in 2005 as regressors in the second stage estimation of log adherents in 2005. The instruments for presence in 2005 are the same as the Heckman model. Both the Heckman and nonparametric results are similar to column (3) of Table 5, suggesting that self-selection into entry does not matter much for the coefficient estimates. To streamline the exposition, we present further results for two estimators: OLS and a nonparametric correction for sample section based on a first stage probit model, which corresponds to column (6) in Table 6.

5.2 Placebo tests

In the regressions in Tables 5 and 6, we assume that we have included the relevant denomination and country characteristics that capture the logic of Propositions 1 and 2. To examine whether our results may simply be artifacts of the data, and unrelated to the workings of our model, we conduct placebo tests by interacting country variables with theoretically irrelevant denomination characteristics, and by interacting denomination strictness and decentralization with theoretically irrelevant country characteristics.

In Table 7, we consider placebos for health services and transportation infrastructure. The public health services that we examine – medical personnel per capita, the supply of hospital

beds, and public health expenditure as a share of GDP – are labor, capital, or spending inputs that are likely to help individuals weather health shocks that affect their productivity and life expectancy. One concern is that these health services may be correlated with unobserved components of country income, in which case the negative strictness-health service interaction that we find may be a byproduct of richer countries having weaker preferences for strict religious doctrine. As a placebo for health services, we consider the supply of dentists per capita, which is increasing in average income, suggesting that dental care is a normal good. While greater availability of dental care may enhance the quality of life, it does not represent the type of health service that theory suggests substitutes for the club goods provided by religious groups. In columns (1) and (2), we replace the strictness-health service interaction with the interaction between strictness and dentists per capita. The coefficients on the interaction are small and very imprecisely estimated, implying there is no relation between the availability of dental services and the success of strict denominations. These results help allay concerns that we may have misinterpreted the strictness-health service interaction in Tables 5 and 6.

A related issue applies to the interaction between denomination decentralization and communication and land transportation infrastructure. Infrastructure is meant to capture the cost to pastors of connecting with congregants. However, the supply of transportation infrastructure might be correlated with unobserved country characteristics. For example, suppose decentralized governance structures were more likely to be chosen in higher income countries, then the positive interaction that we find between decentralization and infrastructure might simply be picking up a positive correlation between decentralization and unobserved components of country income. To examine this possibility, we use air transportation services, measured either as log passenger departures or log air carrier departures, as placebos. Air transportation is not an input in the provision of pastor services because church members are drawn overwhelmingly from the local area. Thus, according to our model, air transportation should have no effect on pastor effort cost and we should find no result for air transportation. Columns (3)-(5) of Table 7 show results for interactions between decentralization and air transport. Coefficients are *negative*, rather than positive, and imprecisely estimated in all cases. These results suggest that the positive interaction between decentralization and infrastructure is not driven by omitted-variable bias. To threaten our identification, the omitted country variables must be correlated with land transportation but uncorrelated with air transportation.

One might be concerned that what matters for congregation size is not the cost to pastors of reaching out to congregants but the alternative options that potential congregants have to interact with others. To gauge the importance of social interactions for our results, in Appendix Table A2 we present regressions in which we split the sample of countries into above or below the median level of population density (similar findings obtain for splitting the sample according to above or below the median urbanization rate). Comparing columns (1) and (2) of Table A2 with column (3) of Table 5 or columns (3)-(5) of Table A2 with columns (3) and (5) of Table 6, the results for the two sub-samples are similar to each other and also similar to the full sample. This helps allay concerns that opportunities for social interaction undermine our exercise.

Turning to theoretically irrelevant denomination characteristics, in Table 8 we replace denomination strictness with the frequency of Holy Communion. Communion is a practice conducted during worship services that symbolizes Christ's last supper prior to his crucifixion, at which he shared bread and wine with his disciples. Nearly all Christian denominations include some form of communion in their liturgy, which centers on simulating the taking of bread and wine, but they vary greatly in the frequency with which they practice the ritual. Some groups share communion weekly, others monthly, and still others quarterly or annually. The Bible does not dictate the frequency of communion. The frequency of its practice reflects, in part, the preferences of believers for pomp and circumstance in worship. We use communion frequency as a placebo for strict religious doctrine, as the ritual captures ceremonial features of worship but is not related to the stigmatizing features of doctrine that matters in theory for the denomination capacity to product club goods. We identify a denomination as practicing frequent communion if it does so at least monthly, which applies to 39% of the sample; results are similar when we define frequent communion to be either weekly or quarterly. Monthly communion has a correlation of -0.22 with strictness and -0.09 with decentralization.

The first two columns of Table 8 are based on OLS; the second two columns are based on a nonparametric correction for sample selection. Relative to Table 5, we replace the interaction between strictness and disasters, disease, and health services with the interaction between communion frequency and these country variables. All communion frequency interactions are small quantitatively and imprecisely estimated. Thus, we find no significant interaction between country characteristics and theoretically unimportant features of religious practice.

5.3 Extended regression results

So far, we have focused on the interactions between key denomination characteristics and the principal components of relevant country characteristics. Next, we examine interactions between the denomination variables and the individual elements of disaster incidence, disease outbreaks, health services, and communications and transport infrastructure.

In Table 9, we present interactions between denomination strictness and the incidence of specific types of disasters. Other regressors are the same as in Table 5. For disasters, there is a positive and significant interaction between strictness and three of four measures: earthquakes, landslides, and volcanic eruptions, which in Table 4 are the disasters with a relatively high annual incidence. The impact of disaster incidence on denomination size is large quantitatively. Using results in panel (b), increasing the incidence of disasters by one standard deviation is associated with an increase in the relative size of strict denominations by 19 log points for earthquakes (going from Italy to the Philippines) and 23 log points for either landslides (going from Austria to Colombia) or volcanic eruptions (going from Argentina to Papua New Guinea).

Turning next to biological events, Table 10 presents interactions between strictness and the outbreak incidences of cholera, dengue fever, influenza/SARS, and meningococcal illness. Strictness interacts positively with all but meningococcal outbreaks, with the strongest results for influenza/SARS. A one standard deviation increase in the incidence of influenza outbreaks is associated with an increase in the relative size of strict denominations of 17 log points.

In Table 11 we present the interactions between strictness and health services. There is a negative and significant interaction between strictness and medical personnel per capita and log hospital beds; for health expenditure as a share of GDP the interaction is negative but imprecisely estimated. The results in panel (b) imply that increasing medical personnel by one standard deviation is associated with a reduction in the relative size of strict denominations by 32 log points (e.g., going from Ghana to Poland), with a one standard deviation increase in hospital beds associated with a 43 log point decrease in the relative size of strict groups (e.g., going from Ghana to Uruguay). Two additional results in Table 11 are for physicians per capita and financial development. The interaction of the former with strictness is imprecisely estimated, whereas the latter is negative and precisely estimated. The absence of a significant interaction between strictness and the supply of physicians may reflect the relatively small role that physicians, as opposed to nurses, play in the delivery of health care in many poor countries (see note 32). The

negative interaction between strictness and financial development suggests that in countries with well-organized financial markets individuals are less reliant on assistance from religious organizations and more able to insure themselves against risk through private means.

In Table 12, we consider the interaction between a denomination being decentralized and individual communications and transportation infrastructure variables. Decentralization interacts positively with telephone mainlines per capita, cellular subscribers per capita, log passenger cars, and the size of a country's road network, though coefficients are not precisely estimated in all cases. Whether intended or not, improvements in communications and transportation infrastructure appears to result in larger market shares for less hierarchical religious groups.

5.4 Discussion

What do our coefficient estimates imply about the relative performance of Protestant denominations in sample countries? Consider the primary country characteristics that affect the relative size of strict versus non-strict denominations: natural disasters, disease outbreaks, and delivery of health services.[45] Within sample countries, strict denominations are on average 18.2 log points larger than non-strict denominations. Based on coefficients from column (3) of Table 5, cross-country differences in the incidence of natural disasters explain 11.2% of this size difference, cross-country differences in the provision of health services explain 8.2%, and cross-country differences in the incidence of disease outbreaks explains less than one percent.

To further illustrate the quantitative significance of our results, we present two examples, one involving Guatemala and Honduras, the other Guinea and Senegal. Both pairs consist of neighboring countries that have similar per capita GDPs, and we examine which factors matter for explaining within-pair differences in the relative size of strict denominations. The exercise amounts to a double differencing as we consider the average log relative size of strict denominations in one country minus that in another.

First, consider Guatemala and Honduras. In Guatemala, the average size advantage of strict denominations is 41.7 log points, versus 23.8 in Honduras, for a double difference of 17.9 log points. The two countries have relatively similar per capita GDPs ($4675 in Guatemala, $3028 in Honduras), identical patterns of disease outbreaks, and very similar delivery of health

[45] The effects of communication and transportation infrastructure on the relative size of decentralized denominations are similar, and we do not discuss them to save space; e.g., in the Guinea-Senegal example, the difference in infrastructure explains 13.3% of the relative size difference in decentralized denominations.

services. Where they differ is in the incidence of natural disasters. Owing to its distinct geography, Guatemala has active volcanoes, whereas Honduras does not, resulting in Guatemala having an over eight percent higher annual frequency of either volcanic eruptions or of severe earthquakes. Using coefficient estimates from column (3) of Table 5, the difference in the incidence of natural disasters can account for 17.7% of the relative size difference in strict denominations between the two countries.

Our next example is Guinea and Senegal, two neighboring East African countries that have similar per capita GDPs ($1012 in Guinea, $1373 in Senegal). The average relative size advantage of strict denominations is 148.8 log points in Guinea and 59.4 log points in Senegal, for a double difference of 89.5 log points. While the two countries have nearly identical incidences of natural disasters, Guinea has a higher incidence of disease outbreaks and poorer delivery of health services. Again using coefficients from column (3) of Table 5, these two factors together can account for 11.0% of the relative size advantage of strict denominations in Guinea versus Senegal. These examples illustrate the manner in which disasters, disease, and health services affect the relative performance of strict denominations across countries.

6. FINAL DISCUSSION

In the last four decades, religious groups headquartered in the United States have expanded rapidly across borders (e.g. Woodberry and Shah, 2004), much as US multinational enterprises have sought new markets abroad. In both cases, globalization has been made possible by the dismantling of government barriers. Much as US multinationals rely on their advantages in organization and intellectual property to compete in foreign markets (Bloom, Sadun, and Van Reenen, 2009), US Christian denominations succeed on the basis of their governance structure and religious doctrine. Along these dimensions, denominations are heterogeneous.

The literature provides explanations for why strict religious groups have prospered in Israel (Berman, 2000) and Indonesia (Chen, 2010), based on Iannaccone's (1992) model of religious groups as clubs. Our contribution is to show theoretically and empirically how denominations compete for believers and how country characteristics affect the market value of a denomination's attributes, which is helpful for understanding the global expansion of Protestant Christianity. Strictness is more desirable in countries in which individuals are more exposed to shocks associated with natural disasters and disease outbreaks, and less desirable in countries

with better health services. Weak governments and weak institutions may thus favor strict religious organizations. What may in part account for the recent globalization of Protestant Christianity is the lowering of state barriers to religion (Barro and Hwang, 2007), coupled with the slow expansion of state capacity in many developing countries, leaving individuals without adequate means to insulate themselves against risk.

The traditional Christian church, encompassing Catholics, Eastern Orthodox, and Anglicans, is strongly hierarchical, with the bishopric controlling church doctrine and the hiring and placement of pastors and other religious personnel. The Protestant Reformation introduced greater diversity in organization form into Christianity (Ekelund, Hebert, and Tollison, 2006), but the advent of Protestantism did not mean a complete break with centralized control. Some Protestant denominations maintain the hierarchical features of the traditional church, whereas as others endow local congregations with considerable power.

In theory, congregational control implies stronger incentives to pastors to invest in building churches. Our finding that decentralized denominations attract more adherents in countries with better communication and transportation infrastructure is consistent with this reasoning. Our results also help account for the attraction of the non-traditional church in countries as they develop. Development typically brings with it improvements in infrastructure, creating advantages for more decentralized religious groups. The process of economic development thus appears to change the composition of religious organizations, leading to less strictness (to the extent that development brings greater insulation from risk, through either state programs or private markets) and more decentralization (to the extent that improved infrastructure strengthens managerial investment incentives).

There is variation in doctrine and organization within non-Christian religions, for which our framework is relevant. For example, the radical form of Sunni Islam practiced by al-Qaeda and the Taliban is stricter than the main branches of Sunni Islam. Shia Islam (e.g. Iran, Yemen) has a hierarchy of Imams and tends to be more centrally organized than Sunni Islam (e.g. Egypt, Indonesia). Among the countries in which Shia and Sunni Islam are present, there is variation in the government provisions of public services. Our finding that weak governments and institutions favor strict religious groups suggests that future research could explore the link between weak states or weak local and regional institutions and radical Islam.

APPENDIX

1. Lemmas 1 and 2

To prove Lemma 1, equation (2) implies that

$$\frac{\partial V}{\partial \pi_S} = \frac{I-p}{\Pi^2}\left(\frac{\partial D^{1/d}}{\partial \pi_S}\Pi - D^{1/d}\frac{\partial \Pi}{\partial \pi_S}\right)$$

$$= \frac{I-p}{\Pi^2}\rho\pi_S^{-\rho-1}\left(-\frac{D^{1/d-1}\Pi}{d} + D^{1/d}\right) = \rho V\pi_S^{-\rho-1}\left(\frac{1}{\Pi} - \frac{1}{dD}\right), \qquad \text{(A1)}$$

After some algebra, $\frac{1}{\Pi} - \frac{1}{dD} > 0 \Leftrightarrow \pi_R^{-\rho}(d\alpha^{\rho} - \alpha^{\frac{\rho}{d}}) - \pi_S^{-\rho}(1-d) > 0$, which holds if $d\alpha^{\rho} - \alpha^{\frac{\rho}{d}} > 0$ (recall that $\rho = d/(1-d) > d$), or $d > \alpha$ (this is equation (3.1) in the text) and $\frac{\pi_S^{\rho}}{\pi_R^{\rho}} > \frac{1-d}{(d-\alpha)\alpha^{\rho}}$, which implies equation (3.2) in the text.

To prove Lemma 2, equation (A1) above implies that

$$\frac{\partial^2 V}{\partial(\pi_S)^2} = \frac{\partial V}{\partial \pi_S}\rho\pi_S^{-\rho-1}\left(\frac{1}{\Pi} - \frac{1}{dD}\right) + \rho V(-\rho-1)\pi_S^{-\rho-2}\left(\frac{1}{\Pi} - \frac{1}{dD}\right) + \rho V\pi_S^{-\rho-1}\left[-\frac{(-\rho\pi_S^{-\rho-1})}{\Pi^2} + \frac{-\rho\pi_S^{-\rho-1}}{dD^2}\right]$$

$$= V\pi_S^{-2(\rho+1)}\left[\rho\left(\frac{1}{\Pi} - \frac{1}{dD}\right)^2 - (\rho+1)\pi_S^{\rho}\left(\frac{1}{\Pi} - \frac{1}{dD}\right) + \rho\left(\frac{1}{\Pi^2} - \frac{1}{dD^2}\right)\right]$$

$$= V\pi_S^{-2(\rho+1)}\left[\rho\left(\frac{1}{\Pi} - \frac{1}{dD}\right)^2 - \left(\frac{1}{\Pi^2} - \frac{1}{dD^2}\right)B\right], B = 1 + (\rho+1)\pi_S^{\rho}\pi_R^{-\rho}\alpha^{\rho}$$

$$= V\pi_S^{-2(\rho+1)}\left\{\left(\frac{1}{\Pi} - \frac{1}{dD}\right)\left[\rho\left(\frac{1}{\Pi} - \frac{1}{dD}\right) - B\left(\frac{1}{\Pi} + \frac{1}{dD}\right)\right] + B\frac{1-d}{d^2D^2}\right\}$$

$$= V\pi_S^{-2(\rho+1)}\left[\left(\frac{1}{\Pi} - \frac{1}{dD}\right)C + B\frac{1-d}{d^2D^2}\right], C = \frac{\rho d - Bd - \Pi(\rho+1)\pi_S^{\rho}}{d\Pi}$$

$$= V\pi_S^{-2(\rho+1)}\left(\frac{C\pi_S^{\rho+1}}{\rho V}\frac{\partial V}{\partial \pi_S} + B\frac{1-d}{d^2D^2}\right). \qquad \text{(A2)}$$

In equation (A2) the variable $B > 0$, and $C < 0$, because the numerator of C is $(\rho-1)(d-1) - 2 - (\rho+1)(d+1)\pi_S^{\rho}\pi_R^{-\rho}\alpha^{\rho}$. Therefore, $\frac{\partial^2 V}{\partial(\pi_S)^2} > 0$ if $\frac{\partial V}{\partial \pi_S} \le 0$. In addition, $\frac{\partial^2 V}{\partial(\pi_S)^2} > 0$ as long as $0 < \frac{\partial V}{\partial \pi_S} < \frac{B(1-d)}{d^2D^2} / \frac{(-C\pi_S^{\rho+1})}{\rho V}$. Finally, $\frac{\partial^2 V}{\partial(\pi_S)^2} < 0$ if π_S is large because the term $\frac{C\pi_S^{\rho+1}}{\rho V}\frac{\partial V}{\partial \pi_S}$ has $\pi_S^{\rho+1}$ but the term $B\frac{1-d}{d^2D^2}$ has only π_S^{ρ}.

To illustrate the intuition for Lemmas 1 and 2, let $I = 1$, $\pi_R = 1$, $\alpha = 0.3 < d = 0.8$. Then equation

(2) in the text simplifies to $V = \frac{[(\pi_S)^{d(\rho-1)} + (\delta_R)^{-\rho d}]^{1/d}}{(\pi_S)^{\rho} + (\delta_R)^{-\rho}}$, where $\delta_R = \alpha^{1/d}$. Figure A1 plots V against π_S, and it shows that: (a) V is an increasing function of π_S when π_S is not too low ($\pi_S \geq 2.6$); (b) V is a convex function of π_S when π_S is not too high ($\pi_S \leq 4.2$); and (c) V is an increasing concave function of π_S when $\pi_S \in [2.6, 4.2]$. (a) illustrates Lemma 1 and corresponds to the case when equation (3.2) in the text holds. (b) and (c) illustrate Lemma 2. Figure A1 is similar to Figure 1 in Iannaccone (1992), except that the latter has log(V) and log(π_S) on the axes.

2. Entry into country k

We assume that to enter a country, a denomination incurs a separate fixed cost, F_k, which captures the cost of sending missionaries abroad or organizing a ministry. Under the D structure, to determine the condition under which a denomination enters country k, note that the denomination receives variable profits $0.5\, X_{jk}^{m}\ (p_{jk}^{m} - g_k)$ from regional market m and total variable profit $\int_{\underline{s}_k^D}^{\infty} \frac{1}{2}(p_k^D - g_k) X_{jk}^{m} dG(s_k^m) = \frac{1}{2}(p_k^D - g_k)\ X_{jk}^{D}$ from country k. Using the expression for X_{jk}^{D} in (16), denomination j enters country k if

$$\ln \frac{p_k^D - g_k}{2} + \ln(\frac{B_2}{f_k})^{a-1} + a(\ln \frac{O_k}{P_k} + e_k^D + \delta_{jk} + V_{jk}^D) \geq \ln F_k,\ B_2 = (\frac{ab^a}{a-1})^{\frac{1}{a-1}} \frac{1}{2\beta}$$

Similarly, under the C structure, denomination j enters country k if

$$\ln \frac{p_k^C - g_k}{2} + \ln(\frac{B_2}{f_k})^{a-1} + a(\ln \frac{O_k}{P_k} + e_k^C + \delta_{jk} + V_{jk}^C) \geq \ln F_k.$$

3. Proposition 1

Since $\pi_{Sjk} = \pi_{Sj} + \pi_{Sk}$, $\frac{\partial^2 \ln G_{jk}^O}{\partial(\pi_{Sk})\partial(\pi_{Sj})} = \frac{\partial^2 \ln G_{jk}^O}{2\partial(\pi_{Sjk})^2} = \frac{a\partial^2 V_{jk}^O}{2\partial(\pi_{Sjk})^2} > 0$, $G = X$, n and O = D, C, where the last inequality is by equation (4).

4. Proposition 2

We show that $\partial[\ln \frac{G_{jk}^D}{G_{jk}^C}] / \partial h_k < 0$ if $\beta > 0.22$ or $\frac{1}{h} > 0.77$, where $G = X$, n. Let μ be such that $\ln \mu_{jk}^O = e_k^O + \delta_{jk} + V_{jk}^O(., p_k^O) - \ln P_k$, O = C and D. By equation (18), $\partial[\ln \frac{G_{jk}^D}{G_{jk}^C}] / \partial h_k$ has the same sign as $\partial[\ln \frac{\mu_{jk}^D}{\mu_{jk}^C}] / \partial h_k$, and we drop the subscripts j and k in the derivations below. By equations

(16) and (17), $\partial[\ln\frac{\mu_{jk}^D}{\mu_{jk}^C}]/\partial h = (\frac{\partial e^D}{\partial h} - \frac{\partial e^C}{\partial h}) + (\frac{\partial V^D}{\partial p^D}\frac{\partial p^D}{\partial h} - \frac{\partial V^C}{\partial p^C}\frac{\partial p^C}{\partial h})$. By equations (2), (10) and (12), $\partial V^D/\partial p^D = -\beta$, $\frac{\partial p^C}{\partial h} = 0$, and $\frac{\partial p^D}{\partial h} = 2c'(e^D)\frac{\partial e^D}{\partial h} + 2\frac{\partial[c(e^D)]}{\partial h}$, where $\frac{\partial[c(e^D)]}{\partial h}$ shows how much $c(e^D)$ shifts following a change in h, holding e^D constant. Equations (9) and (10) imply that $c'(e^D) = \frac{1}{2\beta}$ and so $\frac{\partial V^D}{\partial p^D}\frac{\partial p^D}{\partial h} = -\frac{\partial e^D}{\partial h} - 2\beta\frac{\partial[c(e^D)]}{\partial h}$. Therefore,

$$\partial[\ln\frac{\mu_{jk}^D}{\mu_{jk}^C}]/\partial h = -\frac{\partial e^C}{\partial h} - 2\beta\frac{\partial[c(e^D)]}{\partial h} \qquad \text{(A5)}$$

To see the intuition for equation (A5), suppose h_k decreases. Then under the D structure, both effort level and price increase, but the effect of effort level dominates, and the term $-2\beta\frac{\partial[c(e^D)]}{\partial h}$ reflects the net effect of effort level on $\ln\mu^D$. Under the C structure, however, effort level increases but price does not (since the denomination ignores pastor effort in pricing), and the term $-\frac{\partial e^C}{\partial h}$ reflect the total effect of effort level on $\ln\mu^C$. Using equations (11) and (13) we can show that the effects on $\ln\mu^D$ and $\ln\mu^C$ both increase with $\frac{1}{h}$, but the effect on $\ln\mu^D$ increases faster with $\frac{1}{h}$. Therefore, when $\frac{1}{h}$ is large the effect on $\ln\mu^D$ dominates and $\partial[\ln\frac{\mu_{jk}^D}{\mu_{jk}^C}]/\partial h < 0$. To be rigorous, by equations (11), (13) and (A5), we have $\partial[\ln\frac{\mu_{jk}^D}{\mu_{jk}^C}]/\partial h = \frac{1}{h^2}(\ln\frac{1}{2\beta} + \ln\frac{1}{h+1} + \frac{h}{h+1} - \ln\frac{1}{2\beta h}) = \frac{1}{h^2}(\ln\frac{h}{h+1} + \frac{h}{h+1})$, which is negative if and only if $\ln\frac{h+1}{h} - \frac{h}{h+1} > 0$. This holds if $\frac{1}{h} > 0.77$. In addition, since $e^C = \frac{1}{h}\ln\frac{1}{2\beta(h+1)} > 0$, we implicitly assume $\frac{1}{2\beta(h+1)} > 1$, or $\frac{1}{h} > \frac{2\beta}{1-2\beta}$, which implies that $\frac{1}{h} > 0.77$ if $\beta > 0.22$. Therefore, $\partial[\ln\frac{\mu_{jk}^D}{\mu_{jk}^C}]/\partial h < 0$ if $\frac{1}{h} > 0.77$ or $\beta > 0.22$.

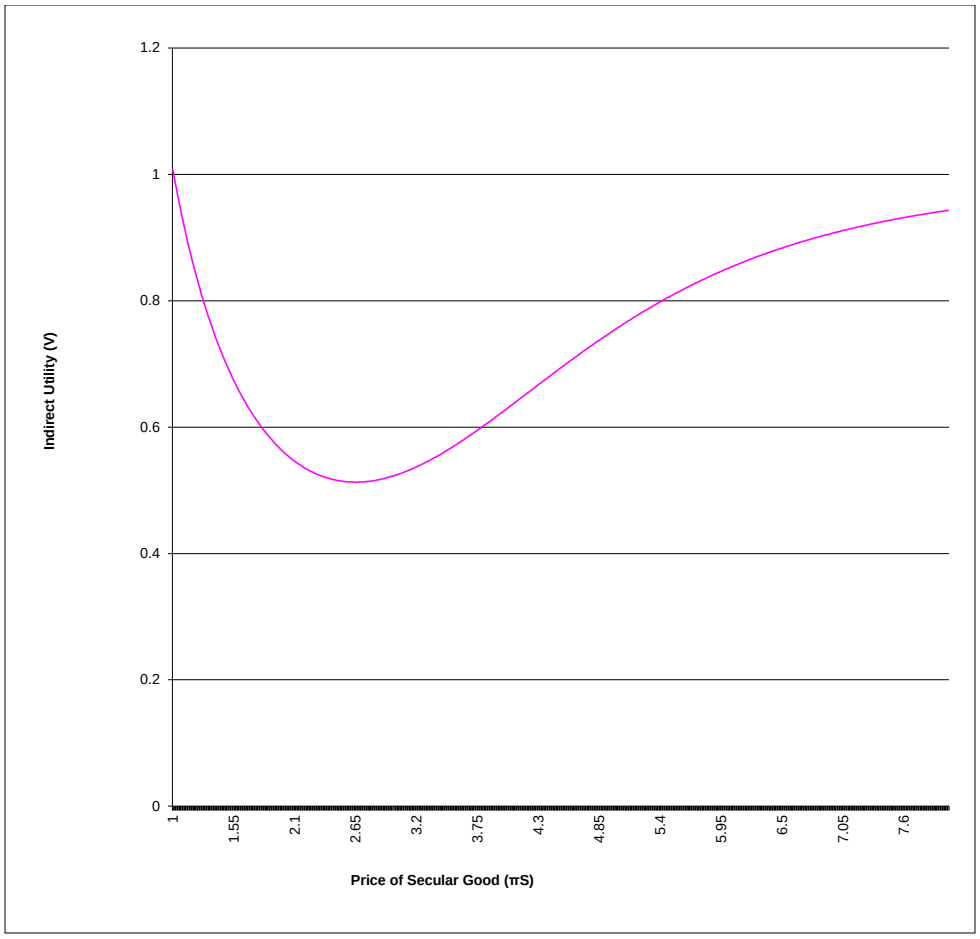

Figure A1: Numerical Example for V and π_S

Table A1: First stage results for Heckman and nonparametric estimation

Model	Linear Pr	Probit	Logit	Linear Pr	Probit	Logit
	(1)	(2)	(3)	(4)	(7)	(5)
Presence 1970	0.887***	25.60***	76.57***	0.878***	25.97***	73.84***
	(0.005)	(0.764)	(1.718)	(0.006)	(0.866)	(1.901)
Ave. Presence 1970, Similar Denom.				-0.131***	-2.899*	-6.070*
				(0.049)	(1.582)	(3.115)
Strict*Natural disasters	0.00295	0.0882	0.153	0.00148	0.0516	0.094
(1st principal component)	(0.003)	(0.090)	(0.179)	(0.003)	(0.129)	(0.239)
Strict*Disease outbreaks	-0.00261	-0.069	-0.182	-0.00348	-0.145	-0.313
(1st principal component)	(0.004)	(0.104)	(0.205)	(0.004)	(0.124)	(0.240)
Strict*Health services	0.00107	-0.184	-0.36	0.00188	-0.205	-0.431
(1st principal component)	(0.006)	(0.193)	(0.388)	(0.007)	(0.244)	(0.471)
Decentralized*Infrastructure	-0.0146*	-0.0866	-0.219	-0.0184**	-0.232	-0.438
(1st principal component)	(0.008)	(0.243)	(0.470)	(0.009)	(0.296)	(0.553)
Adjusted R squared	0.812	--	--	0.82	--	--
Observations	9,660	9,292	9,292	9,660	9,292	9,292

The dependent variable is the dummy variable for a denomination being present in a country in 2005. Columns 1, 3, 4 and 6 are the first stage estimation for columns 3, 5, 6 and 8 of Table 6, respectively. Column 2 is the first stage for columns 1 and 4 of Table 6. Column 5 is the first stage for columns 2 and 7 of Table 6.

Table A2: Splitting the Sample of Countries by Population Density

Estimation method	OLS		Non-parametric/Linear probability model			
Median population density	Below	Above	Below	Above	Below	Above
	(1)	(2)	(3)	(4)	(7)	(5)
Decentralized*Infrastructure	0.778**	0.814*	0.874**	0.940**	1.050**	0.865*
(1st principal component)	(0.358)	(0.411)	(0.350)	(0.442)	(0.502)	(0.434)
Instrument set	--	--	A	A	B	B
Observations	730	872	730	872	629	786
Adjusted R squared	0.521	0.567	0.704	0.701	0.717	0.713

The dependent variable is the log number of adherents. In columns (1), (3), and (7), the sample is countries with below median population density in 2000; in columns (2), (4), and (5) the sample is countries with above median population density in 2000. Regressions in columns (1) and (2) replicate the specification in column (3) of Table (7); regressions in columns (2) and (3) replicate the specification in column (3) of Table 6; and regressions in column (7) and (5) replicate the specification in column (5) of Table 6. Coefficient estimates for other regression variables are suppressed for expositional convenience. Standard errors clustered by country. *** p<0.01, ** p<0.05, * p<0.10.

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Table 1: The 35 largest Protestant denominations, 2005

Denomination	Headquarters country	Global adherents (millions)	Share of global Protestants	Number of countries present
Anglicans	Britain	74.4	0.103	140
Assemblies of God	US	42.4	0.059	149
Seventh-day Adventist Church	US	16.7	0.023	216
Southern Baptist Convention	US	11.9	0.017	110
Jehovah's Witnesses	US	11.1	0.015	214
SIM Church	US	11.0	0.015	14
New Apostolic Church	Switzerland	7.4	0.010	149
Church of God (Cleveland)	US	7.0	0.010	124
Ch of Jesus Christ of Latter-day Saints	US	6.7	0.009	146
American Baptist Churches in the USA	US	5.7	0.008	11
SFM/NPY/FFFM	Swed/Norw/Finl	4.0	0.006	37
Church of the Foursquare Gospel	US	3.7	0.005	59
United Methodist Church (USA)	US	3.7	0.005	44
Presbyterian Church (USA)	US	3.4	0.005	20
Africa Inland Church	Britain/US	3.2	0.004	7
Christian and Missionary Alliance	US	3.2	0.004	50
Methodist Church of Great Britain	Britain	2.9	0.004	18
Pentecostal Assemblies of God (Canada)	Canada	2.9	0.004	29
United Pentecostal Church	US	2.4	0.003	90
Christian Aviation Ministries	US	2.1	0.003	7
Christian Brethren (Open)	US	1.9	0.003	43
Baptist Unions/BWA	US	1.9	0.003	44
PEMS France	France	1.9	0.003	6
Pres Ch of East Africa (Ch of Scotland)	Britain	1.8	0.003	3
Evangelical Alliance Mission	US	1.6	0.002	28
Salvation Army	US	1.6	0.002	86
Apostolic Church Missionary Movement	Britain	1.5	0.002	7
OMS International	US	1.4	0.002	11
Church of the Nazarene	US	1.2	0.002	102
Evangelical Lutheran Ch in America	US	1.1	0.002	19
Church of God of Prophecy	US	1.0	0.001	81
Churches of Christ (Instrumental)	US	1.0	0.001	31
Zion Christian Church	South Africa	0.9	0.001	5
Former AUCECB	Russia	0.9	0.001	13
Moravian Church	US	0.9	0.001	31

This table is based on the global membership of denominations outside of the US.

Table 2: Presence of US denominations abroad in 1970 and 2005

		Denomination present in 1970		
		No	Yes	Total
Denomination present in 2005	No	9,891	2	9,893
				(0.865)
	Yes	305	1,242	1,547
				(0.135)
	Total	10,196	1,244	11,440
		(0.891)	(0.109)	

This table shows the number of cases in which a US denomination (N = 130) is present in a country (N = 88) in 1970 and 2005.

Table 3: Governance structure and religious doctrine of US denominations

Variable	Mean	St. Dev.
Denomination is decentralized (congregational polity)	0.554	0.499
Denomination is theologically strict (row mean > .5)	0.446	0.499
Is evangelism an essential function of all churches and believers?	0.808	0.396
Is repentance and conversion essential for all believers?	0.754	0.432
Is bible considered inerrant or infallible?	0.746	0.437
Is the damnation of non-believers emphasized?	0.700	0.460
Is imminence of 2nd coming of Christ emphasized?	0.262	0.441
Is sanctification emphasized?	0.223	0.418
Is speaking in tongues emphasized?	0.208	0.407
Are drinking, smoking, cultural activities, or dress restricted?	0.246	0.450
Is ongoing practice of divine healing emphasized?	0.292	0.457

The sample is 130 US Protestant denominations.

Table 4: Summary statistics for country variables

Variable	Mean	St. Dev.
log GDP per capita	7.63	1.60
log population	16.33	1.39
mean % primary education (Barro & Lee)	33.00	13.85
mean % secondary education (Barro & Lee)	33.12	19.07
mean % tertiary education (Barro & Lee)	10.46	8.48
urban population/total population	0.40	0.22
log life expectancy	4.16	0.16
total fertility rate	3.74	1.69
log distance to US	8.93	0.45
= 1 if English official language	0.18	0.39
Immigrants in US/total population	0.01	0.01
= 1 if Islam dominant religion	0.22	0.41
= 1 if Catholicism dominant religion	0.40	0.49
= 1 if Orthodox dominant religion	0.07	0.25
= 1 if Judaism dominant religion	0.01	0.11
= 1 if Buddhism, Hinduism dominant religion	0.07	0.25
regulation of religion index (Grim & Finke)	2.68	2.65
= 1 if country had state religion in 1970	0.42	0.50
rule of law index (Freedom House)	0.00	0.98
ethnic fractionalization index (Alesina et al.)	0.39	0.25
annual incidence of landslides (>1000 affected)	0.02	0.04
annual incidence of eruptions (>1000 affected)	0.03	0.09
annual incidence of wind storms (5+ days)	0.01	0.02
annual incidence of earthquakes (>7 Richter)	0.03	0.09
annual incidence of military conflict	0.20	0.29
annual incidence of cholera (>1000 affected)	0.02	0.74
annual incidence of dengue fever (>1000 affected)	0.01	0.33
annual incidence of flu/SARS (>1000 affected)	0.003	0.18
annual incidence of meningococcal (>1000 affected)	0.01	0.32
log hospital beds	0.98	0.98
medical personnel per 1,000	3.81	3.86
public health expenditure/GDP x 100	3.87	2.10
dentists per 1,000	0.37	0.35
fixed mainlines per 1,000	16.59	19.52
cellular subscriptions per 1,000	15.70	15.87
passenger cars per 100	13.44	16.22
roads paved (%)	49.72	32.69
log road network per square km	-1.30	1.44
log annual air carrier departures	10.14	1.82
log annual air passengers carried	14.10	2.15

Table 5: Baseline results

	Dependent variable					
	Log adherents			Log congregations		
Regressors	(1)	(2)	(3)	(4)	(7)	(5)
Strict*Natural disasters	0.218***		0.228***	0.126**		0.132***
(1st principal component)	(0.056)		(0.056)	(0.050)		(0.050)
Strict*Disease outbreaks	0.215***		0.217***	0.187**		0.188**
(1st principal component)	(0.073)		(0.077)	(0.079)		(0.081)
Strict*Health services	-0.400***		-0.367***	-0.313**		-0.282**
(1st principal component)	(0.143)		(0.138)	(0.135)		(0.130)
Decentralized*Infrastructure		0.531***	0.531***		0.531***	0.420***
(1st principal component)		(0.120)	(0.192)		(0.120)	(0.151)
Adjusted R squared	0.615	0.606	0.633	0.593	0.606	0.612
Observations	1,613	1,980	1,602	1,613	1,980	1,602

The dependent variable is either the log number of adherents (columns 1-3) or the log number of congregations (columns 4-6). Regressions include country dummies, denomination dummies, and interactions between Decentralized and Strict and the following country characteristics: percentages of the adult population with primary, secondary, and tertiary education (Barro and Lee, 2010), log per capita GDP, log population, the urbanization rate, log life expectancy, the total fertility rate, log distance of the country from the United States, a dummy for whether a country's official language is English, the Grim and Finke (2006) index of the government regulation of religion, a dummy for whether the country had a state religion in the past, the Freedom House rule of law index, the Alesina and La Ferrara (2005) ethnic fractionalization index, the fraction of the population that had migrated to the US as of 1970, and dummy variables for whether Catholicism, Islam, Orthodoxy, Hinduism or Buddhism, or Judaism is the dominant religion in a country . Standard errors clustered by country. *** p<0.01, ** p<0.05, * p<0.10.

Table 6: Heckman and nonparametric estimation

Estimation procedure	Heckman		Nonparametric			Nonparametric		
1st stage estimation	Probit	Probit	Linear Pr	Probit	Logit	Linear Pr	Probit	Logit
	(1)	(2)	(3)	(4)	(7)	(5)	(6)	(9)
Strict*Natural disasters	0.197***	0.227***	0.185***	0.196***	0.191***	0.239***	0.216***	0.219***
(1st principal component)	(0.076)	(0.084)	(0.050)	(0.054)	(0.052)	(0.062)	(0.063)	(0.064)
Strict*Disease outbreaks	0.189**	0.251**	0.204**	0.158*	0.164**	0.268***	0.227**	0.231**
(1st principal component)	(0.093)	(0.098)	(0.083)	(0.084)	(0.082)	(0.092)	(0.088)	(0.089)
Strict*Health services	-0.341**	-0.376**	-0.336**	-0.340***	-0.325**	-0.353**	-0.341**	-0.342**
(1st principal component)	(0.167)	(0.177)	(0.129)	(0.126)	(0.124)	(0.155)	(0.151)	(0.151)
Decentralized*Infrastructure	0.586**	0.621**	0.450**	0.373*	0.386**	0.466**	0.382**	0.394**
(1st principal component)	(0.233)	(0.251)	(0.185)	(0.192)	(0.188)	(0.190)	(0.185)	(0.181)
Instrument set	A	B	A	A	A	B	B	B
Adjusted R squared	--	--	0.664	0.661	0.661	0.675	0.671	0.672
Observations	11,960	9,660	1,602	1,602	1,602	1,415	1,415	1,415

The dependent variable is the log number of adherents. Regressions include country dummies, denomination dummies, and interactions between Decentralized and Strict and other country characteristics (see notes to Table 5). Columns 1-2 use a Heckman estimator, with a probit model used to estimate the first stage probability of a denomination being present in a country; columns 3-8 use a nonparametric estimator, with a linear probability, probit, or logit model used to estimate the first stage probability of a denomination being present. The instrument set refers to the additional variables used in the first stage estimation, with set A including lagged denomination presence in 1970 and set B including set A plus the average of lagged presence in 1970 for denominations with a similar size in the US. Standard errors are clustered by country. *** p<0.01, ** p<0.05, * p<0.10.

Table 7: Placebo tests for health services and transportation infrastructure

Estimation method	OLS	Nonparam.		OLS		Nonparametric	
Regressors	(1)	(2)	Regressors	(3)	(4)	(7)	(5)
Strict*Natural disasters	0.236***	0.214***	Strict*Natural disasters	0.206***	0.179**	0.179***	0.204***
(1st principal comp.)	(0.063)	(0.070)	(1st principal comp.)	(0.056)	(0.068)	(0.067)	(0.057)
Strict*Disease outbreaks	0.280***	0.299***	Strict*Disease outbreaks	0.226***	0.237***	0.241***	0.224***
(1st principal comp.)	(0.083)	(0.093)	(1st principal comp.)	(0.075)	(0.087)	(0.086)	(0.075)
Strict*Dentists per capita	**0.122**	**-0.037**	Strict*Health services	-0.410***	-0.342**	-0.374**	-0.404***
	(0.344)	**(0.384)**	(1st principal comp.)	(0.138)	(0.161)	(0.157)	(0.140)
Decentralized*Infrastructure	0.659***	0.472**	**Decentralized*Log**	**-0.145**	**-0.069**	**-0.125**	**-0.171**
(1st principal comp.)	(0.201)	(0.197)	**Air transport**	**(0.110)**	**(0.123)**	**(0.125)**	**(0.106)**
Air transport measure	--	--		Passengers	Carriers	Passengers	Carriers
Adjusted R squared	0.629	0.669		0.626	0.664	0.665	0.625
Observations	1,606	1,418		1,579	1,420	1,395	1,607

The dependent variable is the log number of adherents. Regressions include country dummies, denomination dummies, and interactions between Decentralized and Strict and other country characteristics (see notes to Table 5). In columns 1 and 2, dentists per capita serve as a placebo for health services; in columns 3-6, air transport serves as a placebo for land transportation and communication infrastructure. Except for the boldfaced regressors above, the specifications in columns 1, 3, and 4 correspond to that in column 3 of Table 5 and the specifications in columns 2, 5 and 6 correspond to that in column 7 of Table 6. Standard errors are clustered by country. *** p<0.01, ** p<0.05, * p<0.10.

Table 8 Placebo tests for doctrinal strictness of denominations

Estimation method	OLS		Nonparametric	
1st stage estimation	--	--	Probit	Probit
	(1)	(2)	(3)	(4)
Communion*Natural disasters (1st principal component)	**-0.044 (0.091)**	**-0.094 (0.094)**	**-0.046 (0.086)**	**-0.085 (0.088)**
Communion*Disease outbreaks (1st principal component)	**0.006 (0.120)**	**0.008 (0.114)**	**0.029 (0.111)**	**0.043 (0.109)**
Communion*Health services (1st principal component)	**-0.022 (0.137)**	**0.029 (0.143)**	**0.040 (0.131)**	**0.105 (0.142)**
Decentralized*Infrastructure (1st principal component)		0.635*** (0.206)		0.423* (0.216)
Instrument set			B	B
Adjusted R squared	0.612	0.633	0.656	0.674
Observations	1,531	1,520	1,367	1,357

The dependent variable is the log number of adherents. Regressions include country dummies, denomination dummies, and interactions between Decentralized and Strict and other country characteristics (see notes to Table 5). The frequency of communion serves as a placebo for the strictness of religious doctrine. Except for the boldfaced regressors above, the specifications in columns 1 and 2 correspond to those in column 3 of Table 5 and the specifications in columns 3 and 4 correspond to those in column 7 of Table 6. See notes to Table 6 on the definition of the instrument set. Standard errors are clustered by country. *** p<0.01, ** p<0.05, * p<0.10.

Table 9: Extended results for strictness interactions with natural disasters

	log adherents			
(a) OLS	Landslides	Volcanic Eruptions	Wind Storms	Earthquakes
Strict*Disaster incidence	**6.915*** **	**2.509*** **	**-0.317**	**1.782***
	(2.401)	**(0.517)**	**(4.016)**	**(0.921)**
Strict*Disease outbreaks	0.228***	0.211***	0.183**	0.199***
(1st principal component)	(0.079)	(0.076)	(0.085)	(0.075)
Strict*Health services	-0.361***	-0.396***	-0.375**	-0.379***
(1st principal component)	(0.136)	(0.137)	(0.152)	(0.142)
Decentralized*Infrastructure	0.536***	0.556***	0.549***	0.525***
(1st principal component)	(0.195)	(0.195)	(0.202)	(0.198)
Adjusted R squared	0.633	0.633	0.631	0.632
Observations	1,602	1,602	1,602	1,602
(b) Nonparametric (Instr. Set B)				
Strict*Disaster incidence	**7.200*** **	**2.615*** **	**-3.864**	**1.901** **
	(2.310)	**(0.602)**	**(4.162)**	**(0.935)**
Strict*Disease outbreaks	0.283***	0.261***	0.238**	0.260***
(1st principal component)	(0.090)	(0.093)	(0.091)	(0.087)
Strict*Health services	-0.358**	-0.380**	-0.390**	-0.372**
(1st principal component)	(0.151)	(0.155)	(0.154)	(0.157)
Decentralized*Infrastructure	0.481**	0.498**	0.454**	0.440**
(1st principal component)	(0.191)	(0.194)	(0.204)	(0.194)
Adjusted R squared	0.675	0.674	0.673	0.673
Observations	1,415	1,415	1,415	1,415

Regressions include country dummies, denomination dummies, and interactions between Decentralized and Strict and other country characteristics (see notes to Table 5). Except for the boldfaced regressors above, the specifications in panel (a) correspond to those in column 3 of Table 5 and the specifications in panel (b) correspond to those in column 7 of Table 6. See notes to Table 6 on the instrument set. Standard errors are clustered by country. *** p<0.01, ** p<0.05, * p<0.10.

Table 10: Extended results for strictness interactions with disease outbreaks

	log adherents			
(a) OLS	Cholera	Dengue Fever	Flu/SARS	Meningo-coccal
Strict*Disease incidence	**0.224***	**0.036**	**0.860*****	**-0.096**
	(0.117)	**(0.189)**	**(0.299)**	**(0.420)**
Strict*Natural disasters	0.207***	0.200***	0.204***	0.205***
(1st principal component)	(0.053)	(0.057)	(0.053)	(0.053)
Strict*Health services	-0.445***	-0.410***	-0.323**	-0.413***
(1st principal component)	(0.144)	(0.144)	(0.143)	(0.144)
Decentralized*Infrastructure	0.539***	0.539***	0.525***	0.540***
(1st principal component)	(0.187)	(0.185)	(0.192)	(0.185)
Adjusted R squared	0.632	0.632	0.632	0.632
Observations	1,602	1,602	1,602	1,602
(b) Nonparametric (Instr. Set B)				
Strict*Disease incidence	**0.193**	**-0.086**	**1.085*****	**0.021**
	(0.138)	**(0.208)**	**(0.318)**	**(0.610)**
Strict*Natural disasters	0.217***	0.228***	0.206***	0.225***
(1st principal component)	(0.060)	(0.067)	(0.060)	(0.060)
Strict*Health services	-0.422***	-0.392**	-0.288*	-0.395**
(1st principal component)	(0.154)	(0.152)	(0.156)	(0.152)
Decentralized*Infrastructure	0.479**	0.467**	0.471**	0.450**
(1st principal component)	(0.190)	(0.186)	(0.185)	(0.193)
Adjusted R squared	0.672	0.672	0.675	0.673
Observations	1,415	1,415	1,415	1,415

Regressions include country dummies, denomination dummies, and interactions between Decentralized and Strict and other country characteristics (see notes to Table 5). Except for the boldfaced regressors above, the specifications in panel (a) correspond to those in column 3 of Table 5 and the specifications in panel (b) correspond to those in column 7 of Table 6. See notes to Table 6 on the instrument set. Standard errors are clustered by country. *** p<0.01, ** p<0.05, * p<0.10.

Table 11: Extended results for strictness interactions with health expenditures

	log adherents				
(a) OLS	Hospital beds	Nurses, Midwives	Health Expend.	Physicians	Financial Develop.
Strict*Health services	**-0.475*** **	**-0.089** **	**-0.050**	**0.010**	**-0.737** **
	(0.181)	**(0.039)**	**(0.054)**	**(0.151)**	**(0.333)**
Strict*Natural disasters	0.191***	0.247***	0.228***	0.226***	0.251***
(1st principal component)	(0.059)	(0.055)	(0.057)	(0.060)	(0.056)
Strict*Disease outbreaks	0.192**	0.176**	0.252***	0.237***	0.286***
(1st principal component)	(0.077)	(0.085)	(0.077)	(0.078)	(0.077)
Decentralized*Infrastructure	0.618***	0.548***	0.629***	0.658***	0.611***
(1st principal component)	(0.200)	(0.180)	(0.197)	(0.195)	(0.196)
Adjusted R squared	0.627	0.633	0.626	0.626	0.625
Observations	1,635	1,602	1,635	1,635	1,631
(b) Nonparametric (Instr. Set B)					
Strict*Health services	**-0.456** **	**-0.087** **	**-0.048**	**0.089**	**-1.052*** **
	(0.197)	**(0.041)**	**(0.056)**	**(0.159)**	**(0.342)**
Strict*Natural disasters	0.191***	0.262***	0.224***	0.224***	0.249***
(1st principal component)	(0.066)	(0.059)	(0.062)	(0.067)	(0.062)
Strict*Disease outbreaks	0.246***	0.218**	0.294***	0.280***	0.303***
(1st principal component)	(0.088)	(0.105)	(0.088)	(0.094)	(0.089)
Decentralized*Infrastructure	0.585***	0.477**	0.601***	0.638***	0.452**
(1st principal component)	(0.198)	(0.185)	(0.198)	(0.194)	(0.196)
Adjusted R squared	0.671	0.675	0.670	0.670	0.667
Observations	1,444	1,415	1,444	1,444	1,441

Regressions include country dummies, denomination dummies, and interactions between Decentralized and Strict and other country characteristics (see notes to Table 5). Except for the boldfaced regressors above, the specifications in panel (a) correspond to those in column 3 of Table 5 and the specifications in panel (b) correspond to those in column 7 of Table 6. See notes to Table 6 on the instrument set. Standard errors are clustered by country. *** p<0.01, ** p<0.05, * p<0.10.

Table 12: Extended results for decentralization interactions with infrastructure

	log adherents			
(a) OLS	Mainline Phones	Cell Phones	Passenger Cars	Road Network
Decentralized*Infrastructure	**0.021***	**0.031****	**0.026****	**0.279****
	(0.012)	**(0.014)**	**(0.011)**	**(0.137)**
Strict*Natural disasters	0.217***	0.216***	0.232***	0.212***
(1st principal component)	(0.057)	(0.056)	(0.055)	(0.056)
Strict*Disease outbreaks	0.220***	0.223***	0.218***	0.221***
(1st principal component)	(0.076)	(0.075)	(0.077)	(0.073)
Strict*Health services	-0.357**	-0.381***	-0.347**	-0.396***
(1st principal component)	(0.146)	(0.142)	(0.139)	(0.138)
Adjusted R squared	0.625	0.625	0.633	0.625
Observations	1,613	1,613	1,602	1,613
(b) Nonparametric (Instr. Set B)				
Decentralized*Infrastructure	**0.016**	**0.018**	**0.029****	**0.214**
	(0.012)	**(0.016)**	**(0.011)**	**(0.145)**
Strict*Natural disasters	0.214***	0.198***	0.233***	0.201***
(1st principal component)	(0.067)	(0.066)	(0.061)	(0.067)
Strict*Disease outbreaks	0.292***	0.302***	0.237***	0.268***
(1st principal component)	(0.092)	(0.091)	(0.088)	(0.084)
Strict*Health services	-0.314*	-0.340**	-0.325**	-0.329**
(1st principal component)	(0.167)	(0.164)	(0.155)	(0.159)
Adjusted R squared	0.668	0.669	0.675	0.666
Observations	1,425	1,425	1,415	1,425

Regressions include country dummies, denomination dummies, and interactions between Decentralized and Strict and other country characteristics (see notes to Table 5). Except for the boldfaced regressors above, the specifications in panel (a) correspond to those in column 3 of Table 5 and the specifications in panel (b) correspond to those in column 7 of Table 6. Standard errors are clustered by country. *** p<0.01, ** p<0.05, * p<0.10.

Figure 1a: Global membership and US membership, 2005

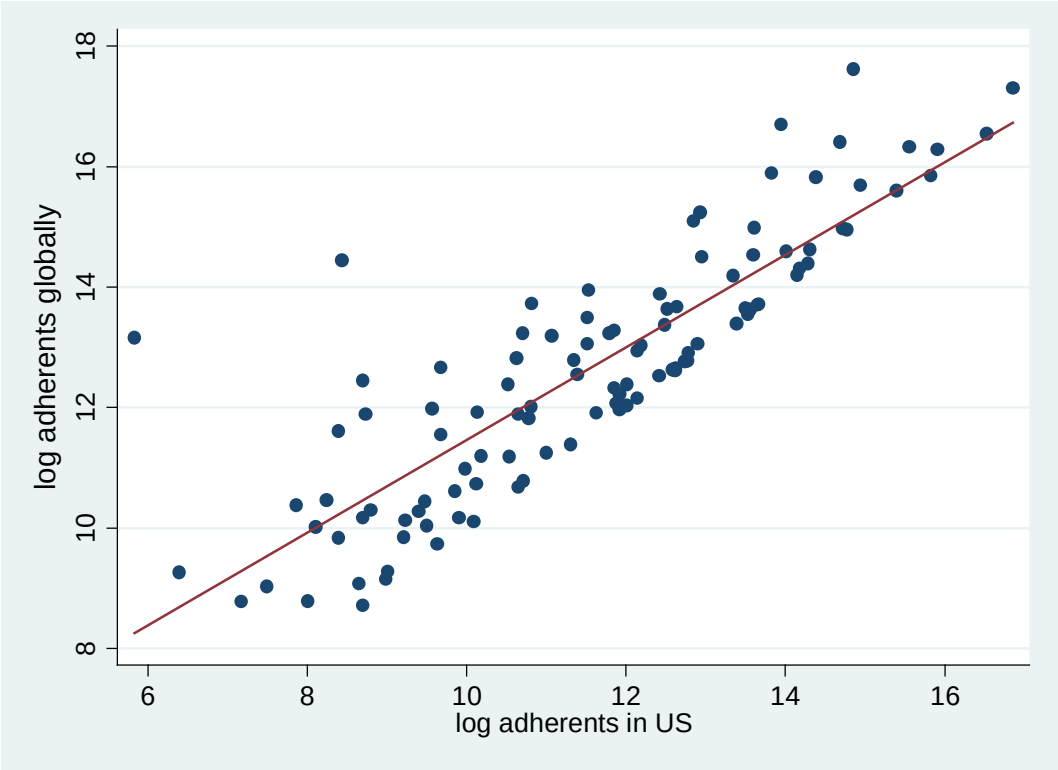

Figure 1b: Numbers of countries entered and US membership, 2005

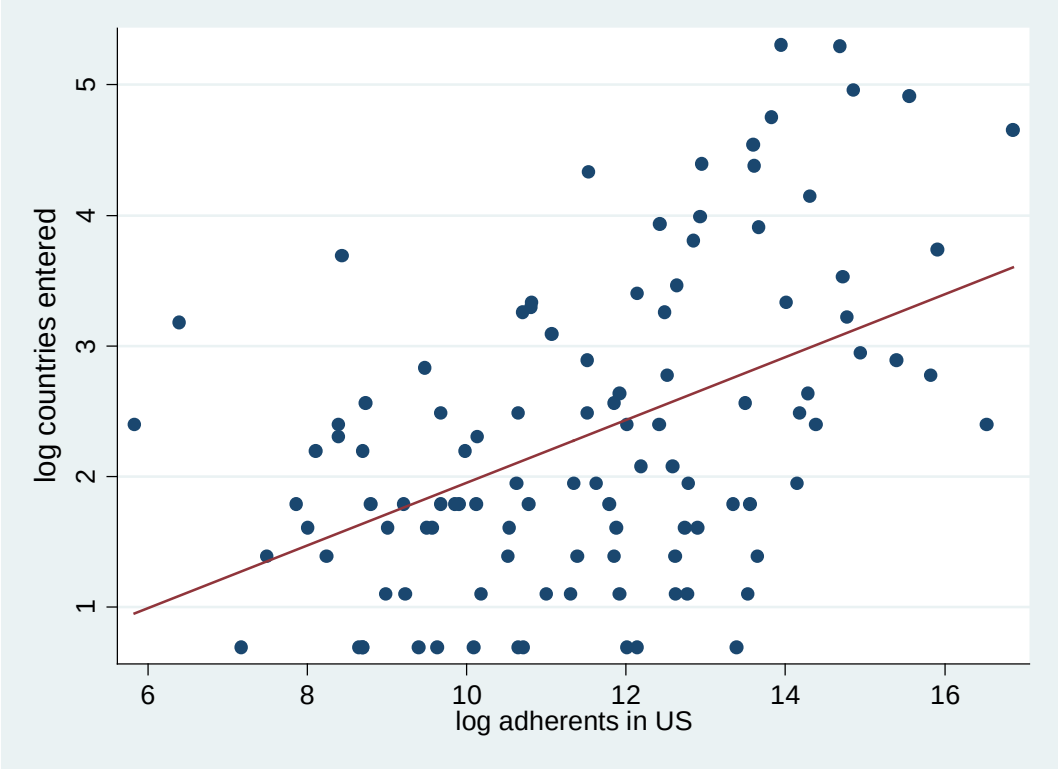

Figure 2: Distribution of doctrinal strictness across US denominations

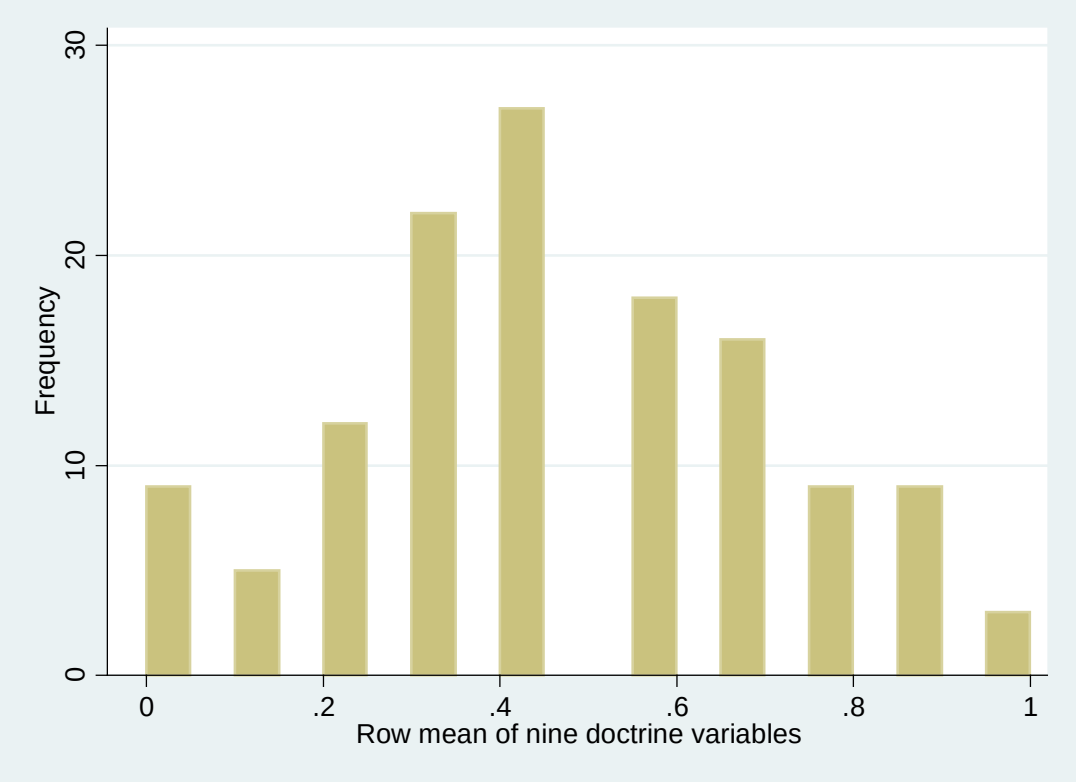

Figure 3: Global No. of adherents and congregations for US denominations, 2005