# DISCUSSION PAPER SERIES

DP21011

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## INDUSTRIAL ORGANIZATION AND ORGANIZATIONAL ECONOMICS

ISSN 0265-8003

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Discussion Paper DP21011
Published 11 January 2026
Submitted 08 January 2026

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# FAITH-BASED PLATFORMS


## Abstract

We develop a new model of faith-based organizations (FBOs) as multi-sided platforms. Faith-based platforms (FBPs) offer two types of services. The first is a religious service that includes providing a moral narrative, giving guidance and counselling, and proposing access to the divine through prayer, meditation or rituals. The second is a networking service that allows members to connect with members who come for the religious service. By offering both types of service, FBPs benefit from the spill-over effect of the religious service, which helps to screen for trustworthy network members. FBPs are more profitable than organizations that only offer a religious service, often even per capita, and are generally larger in size. The optimal community size depends on the type of interactions the FBP fosters and how much it invests in the quality of the religious service. This can explain the diversity of FBOs that continue to thrive despite secular competition and some recent phenomena that cannot be fully explained by existing models of FBOs, such as the growth of religion in some urban settings and the emergence of religious communities that have grown very large without sacrificing high profits per member.



JEL Classification: Z12, L14

Keywords: N/A



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Acknowledgements
We are grateful for useful comments from seminar and workshop participants at the Geneva Graduate Institute, University of Louvain, Bocconi University, University College Dublin, Toulouse School of Economics, University of Copenhagen, the 2024 ASREC meeting in Princeton and the Arne Ryde Workshop on Culture, Institutions, and Development. Emmanuelle Auriol and Paul Seabright acknowledge TSE-IAST funding from the French National Research Agency (ANR) under the Investments for the Future (Investissements d'Avenir) program, grant ANR-17-EURE-0010. Eva Raiber acknowledges financial support from the French government under the ``France 2030'' investment plan managed by the ANR-17-EURE-0020, and by the Excellence Initiative of Aix-

Marseille University - A*MIDEX.

# Faith-Based Platforms*

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**Keywords:** religion, faith-based organisations, platforms
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# 1 Introduction

Faith-based organizations (FBOs) are important socioeconomic actors that demand time, money, and commitment from their members. Globally, about 70% of people attend religious services at least occasionally, and 20% do so weekly.[1] Financial contributions are substantial: in the United States, FBO revenues exceed 2% of personal income, and even in developing countries where incomes are low, members often donate a significant share of their earnings (Grim and Grim, 2016; Auriol et al., 2020b; Alfonsi et al., 2022). Religious practices persist even in countries where governments oppose some faith-based views, such as China (Pew Research Center, 2023), and thrive in growing economies (Lowes et al., 2025; Barro et al., 2025). What drives these high levels of engagement with FBOs, even amid secular competition?

We develop a model of FBOs as multi-sided platforms. Platforms are intermediaries that create benefits by putting different users in contact with each other. They may be for-profit firms but can also be partnerships, not-for-profits, or looser associative enterprises. Our central insight is that FBOs, when organized as platforms, have a comparative advantage over secular organizations in supplying services that involve networking or community-building. Participation in religious activities provides a credible signal of member commitment and reliability, so demand for religious services acts as a screening device. By combining religious services with opportunities for networking, faith-based platforms (FBPs) benefit from this screening mechanism.

In our model, FBPs offer two key services. First, they offer a religious service that includes providing moral guidance and a common set of values and norms, as well as the opportunity to access divine power through prayers, rituals, or meditation. We assume that FBPs differ in the quality of the religious service they provide, and can invest in improving that quality. Second, FBPs offer a networking service that consists of communal activities where members are put into contact with each other. Examples include finding a spouse, finding a business partner, or forming a group to provide informal financial services between members, such as insurance. Crucially, those who have a higher demand for the religious service are considered more desirable counterparties. Offering the religious service at a high price, therefore, attracts good network partners by screening out those with a low willingness to pay. FBP members may thus have different motives

[1] Calculation based on the International Social Survey Program's 2018 Religion Module conducted in 38 countries.

for participating and contributing: they want to consume the religious service, they want to be part of the religious network, or they want both.

Understanding FBOs as platforms helps to explain their continued importance and influence, and the diversity of their organizational styles. As we show in the model, the characteristics of both the religious services and the networking services shape the structure and size of FBPs. Some of these characteristics can explain the remarkable growth of religious movements even during periods of economic development that have been predicted, according to secularization theories, to reduce the attractiveness of religion.[2] Examples include the global revival of Pentecostal and evangelical Christianity (Pew Research Center, 2006) and the growth of Hindu organizations in India offering an increasingly varied mix of services (Iyer, 2018).

A further implication of the model is that the role of FBPs depends on the availability of alternative networks. Where strong secular or community-based networks exist, FBPs may focus more narrowly on religious services (Hungerman, 2005; Scheve et al., 2006; Iyer, 2016). In India, for instance, caste networks in rural areas historically provided many of the social and economic benefits that elsewhere came from churches or mosques, making some aspects of Hindu religious practice less communal compared to other world religions (Iyer et al., 2013). Similarly, in countries with comprehensive social security systems, average demand for faith-based networks may be low among people who are well-integrated in the social system, but groups that feel excluded from mainstream services and networks may still sustain strong FBPs. This adds another explanation for the sustained higher religiosity levels among migrant groups observed in Europe countries (Van Tubergen and Sindradottir, 2011; Guveli and Platt, 2023) or the conversions of international Chinese students in the USA to co-ethnic Christian communities (Yang et al., 2018).

In our model, the size of an FBP depends not only on the demand for religious and networking services, but also on the kinds of connections members seek. When members look for exclusive ties, such as a spouse or a best friend, each religious member can form at most one connection. Congestion arises quickly if network demand exceeds the available supply of partners, giving FBPs an incentive to lower the price of the religious service to attract more members. By contrast, when members seek multiple ties, such as business partners, client networks, or friendship circles, each

[2] See Bruce (2017); Stoltz (2020); Stoltz and Voas (2023); Bruce and Voas (2023) for recent defenses of these theories, and Roberts (2024) and Seabright (2024) for two recent, more sceptical views.

religious member can sustain several connections. In this case, FBPs have an incentive to set a higher price for the religious service and maintain a smaller but higher-quality membership. As the dominant types of connections shift, so too does optimal group size. The model, therefore, predicts that FBP size will vary systematically with broader forces such as economic development, demographic change, and technological innovation, which alter the demand for different forms of connection.

A key contribution of our model is its ability to account for the emergence of very large FBPs – "megaFBPs" – that sustain high profits per member, a phenomenon that is difficult to reconcile with the conventional club-goods view of FBOs. In the standard club good framework, free riding implies a negative relationship between group size and contributions.

In Section 5, we discuss how scale and profitability can rise together. First, urbanization expands the pool of potential members while weakening traditional support networks, increasing the value of FBPs that bundle religious services with structured opportunities for social connection. Second, these organizations are often led by charismatic, entrepreneurial leaders who use technology and media to deliver a compelling religious product at low marginal cost. Third, mega FBPs invest heavily in a rich set of networking activities that organize members' interactions far beyond weekly worship. Finally, many of them are structured and managed much like businesses and actively seek out revenue-raising opportunities. Together, these features help explain how certain FBPs grow to extraordinary size while maintaining or even increasing per-capita contributions.

We introduce the model in Section 2, presenting some stylized facts about FBOs that motivate our modelling decisions. We develop the theory behind the general case and discuss a specific example in Section 3. In Section 4, we present comparative statics. In Section 5, we discuss the phenomenon of very large FBOs, before we conclude in Section 6.

## 2 What makes FBOs platforms?

Platforms are intermediaries that create benefits by putting different users in contact with each other, and they typically appropriate as revenue some share of the benefits they create. In this section, we describe how this perspective applies to FBOs and how it differs from the traditional view of FBOs as local clubs, most prominently formalized in Iannaccone (1992).

## 2.1 Faith-based organizations offer multiple services to members with heterogeneous motives

The starting point of our model is that FBPs offer their members at least two types of service. On the one hand, they offer a "religious service" that includes providing moral guidance and a common set of values and norms, as well as promising the opportunity to access a divine power through prayers, rituals, or meditation. On the other hand, FBPs offer a networking service. By being a shared space for meetings and information sharing, FBPs facilitate connections between their members. We do not claim that these are the only services that are offered. For example, religious organizations might offer pure entertainment activities that are in competition with secular entertainment (Gruber and Hungerman, 2008). However, they are two of the most important services offered by FBPs and, as we show in the model, understanding their interaction is key to explaining how FBPs are organized. Members can demand these services in different combinations.

### 2.1.1 The religious service

FBPs offer a setting for their members to interact with the divine either through the mediation of religious leaders, or directly through prayer, meditation, or other rituals. They typically provide a set of narratives that claim to give answers to questions about the purpose of life, while also providing advice on morality and values, and on how one should behave in specific situations. The offer of religious services distinguishes FBPs from secular organizations. While secular organizations might be able to provide a service that is similar in one component, such as meditation guidance or ethical teaching, they do not typically offer the whole bundle.

Uncontroversially, there is evidence that demand for the religious service is a main motive for participation in FBOs. The great majority of respondents to the International Social Survey Programme's 2008 Religion Module, one of the most comprehensive datasets on religion across the world, believe that religion helps people "find comfort in times of sorrow" (78% of respondents) and "find inner peace and happiness" (73%, see Table 1). Many empirical studies corroborate these sentiments, using a variety of statistical and experimental methods to establish causal links between a need for comfort and a demand for religion or "spiritual insurance" (see Bentzen, 2021 and Bentzen, 2018 for global samples; Costa et al., 2023 in Brazil; Liu et al., 2024 in Taiwan; Hasan et al., 2021 in southeast United States). Consistent with this, Auriol et al. (2020b) found in surveys conducted with close to 1000 members of a Pentecostal church in Accra, Ghana, during 2015 and 2019, that by far the most often mentioned reason members gave for going to their church was that "the teaching about God corresponds to what I believe in" (around 90% of respondents). In second place was "I go for the moral guidance to me and my family" (around 50% of respondents). In India, Iyer et al. (2013) show that among 568 religious organizations surveyed, addressing spirituality is the highest-ranked motivation for the organization.

We assume that demand for religious services is correlated with qualities that make a person a good network partner. Individuals who seek such services are often regarded as more reliable and trustworthy; they are more likely to follow shared values and prescribed behaviors, and they may show greater resilience in the face of life shocks (Fruehwirth et al., 2019). Experimental evidence supports this view: in a trust game, Auriol et al. (2020a) find that more religious participants are not only more trusting but also more trustworthy, confirming earlier results by Ahmed (2009). More broadly, the joint bundle of supernatural beliefs, shared rituals, and meaning-making practices is strongly associated with higher trust and prosocial attitudes. The religious tend to adhere to a prescribed set of norms and behaviors such as cooperation and rule-following that are "associated with 'good' economic attitudes, where 'good' is defined as conducive to higher per capita income and growth" (Guiso et al., 2003).

These mechanisms can have tangible economic effects: for instance, counties in the Southeastern United States with higher levels of religiosity recovered more rapidly from hurricanes, as religious communities mobilized cooperation and mutual support to overcome collective challenges (Hasan et al., 2024). A field experiment also showed that supernatural beliefs can shape economic decision-making and improve business performance by reducing perceived risk among small-scale entrepreneurs in the Democratic Republic of Congo (Butinda et al., 2023). At a broader scale, societies whose narratives and rituals reinforced belief in "Big Gods" demanding prosociality were better able to compete with others, particularly in large-scale settings (Norenzayan, 2013), and even counter-empirical supernatural beliefs may persist because they facilitate coordination and collective action (Nunn and de la Sierra, 2017). FBPs thus offer members access to a package of narratives, rituals, and behaviors that foster trust, prosociality, and cooperation, making participants more desirable partners for a wide range of interactions.

Table 1: What does religion do?

Proportion of survey sample agreeing with row and column statements about the role of religion

| | Comfort | Peace & happiness | Friends | Right people |
|---|---|---|---|---|
| Find comfort in times of sorrow | **0.78** | 0.68 | 0.54 | 0.42 |
| Find inner peace and happiness | | **0.73** | 0.52 | 0.41 |
| Make friends | | | **0.57** | 0.38 |
| Meet the right people | | | | **0.43** |

*Notes:* Data from 56971 individuals in 38 countries participating in the International Social Survey Programme's 2008 Religion Module. Each cell reflects the proportion of the total sample who 'agreed' or 'strongly agreed' with both the row and the column statements. The full statements were: 'Practicing a religion helps people: a) find inner peace and happiness, b) make friends, c) gain comfort in times of trouble or sorrow, d) meet the right kind of people".The text in bold refers to the total proportion who agreed with any one of these statements. Participants who could not choose an answer or declined to respond are coded as not agreeing with the statements. See the Appendix for a full list of countries and summary statistics of the sample.

#### 2.1.2 The networking service

FBPs bring people together both physically and virtually through shared narratives, rituals and values. They thus facilitate connections between their members. Examples include forming business partnerships, forming households through marriage, raising children in communities with shared values and behavioral expectations, or forming groups to share risk. About half of respondents to the ISSP agree with the statements that "religion helps people make friends" (57%) or to "meet the right people" (43%, see Table 1).

Meeting the right partner is a central condition for marriage and family formation, and religious communities remain among the most important venues where people find spouses. Many religious groups even organize explicit matchmaking opportunities,[3] and numerous studies show that religiosity is positively correlated with marital happiness and stability (Lehrer and Chiswick, 1993; Perry, 2015). In Ghana, for example, Auriol et al. (2020b) report that 50% of unmarried Pentecostal members believed their most likely chance of finding a spouse was at church, while nearly 30% of married members had in fact met their spouse there. Even in religious traditions that practice gender-segregation at places of worship, such as orthodox Judaism and (most variants of) Islam, parents may preferentially target the children of fellow congregation members as future spouses for their own.

[3] Examples include the Jewish dating platform Jdate (`https://www.jdate.com` ) and the Church of Jesus Christ of Latter-day Saints dating app Mutual (Richardson et al., 2020).

FBOs are also central to child-rearing, including through their schools. In the United States, about 75% of private schools are faith-based (U.S. Department of Education, 2023) and a recent UNESCO report found that in many African countries, one in six primary and secondary schools is operated by Christian denominations (Global Education Monitoring Report Team, 2021). These schools not only provide academic instruction but also shape peer networks and transmit values that parents may consider crucial for their children's development. Indeed, in the 2019 wave of the U.S. National Household Education Survey, 75% of parents who chose a faith-based private school said that the composition of the student body was important or very important to their choice - 23% more than those who reported that the school's religious orientation was important or very important to them (61% of parents).

Risk-sharing is another prominent example of faith-based networking. A large body of empirical evidence shows how FBOs effectively help their members smooth consumption in the face of economic shocks.[4] A network based on shared participation in an FBP may be an effective source of informal insurance, by reducing adverse selection and moral hazard through shared information, and also by giving their members access to a more diverse range of people than they are likely to meet in other social settings. This creates a pool of people who face fewer correlated shocks than in other typically studied informal insurance networks, such as geographically constrained villages or kin-based networks (Hersey, 2024; Platteau, 2019).

Many of the features that make religious organizations good for risk-sharing also make them good settings for fostering other types of business interactions. For example, Murphy et al. (2022) show that attendance at the same church in western Kenya significantly increases the diffusion of agricultural advice and other useful information. A number of studies have shown that participation in religious networks is associated with the expansion of more extensive trade in both contemporary (Richman, 2006) and historical contexts (Ensminger, 1997; Greif, 1993), though there is controversy about the degree to which this association is causal (Edwards and Ogilvie, 2011).

[4] See for example, Chen (2010) and Ager and Ciccone (2016) and the studies surveyed in Seabright (2026).

## 2.2 Leaders of faith-based organizations determine quality and pricing of the services

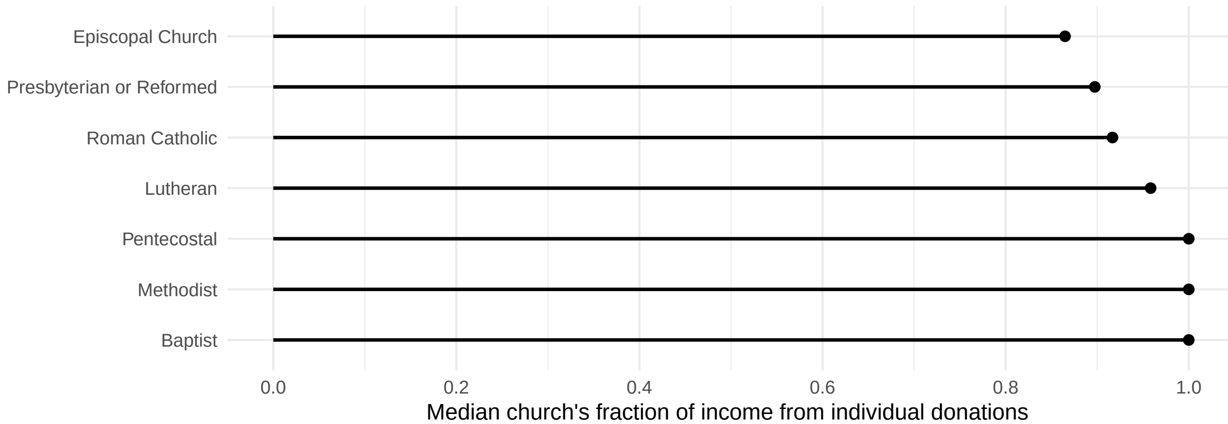
Leaders of FBOs make many choices that determine the quality of the religious service. A preacher can be more or less inspiring, staff more or less available, music of higher or lower quality, and buildings more or less comfortable or open.

In Brazil, for example, Corbi and Sanches (2025) show that denomination leaders strategically chose between small rented properties and more permanent, elaborate buildings, directly influencing members' experience. In India, Iyer et al. (2013) document wide heterogeneity in leaders' decisions on services such as religious education or proselytization, with choices varying according to the degree of local competition. In the United States, Engelberg et al. (2016) study Methodist congregations and show that replacing a low-quality pastor with a high-quality one substantially increases church growth. And in Kenya, Bauer et al. (2024) find in lab-in-the-field experiments that Pentecostal pastors differ in their attitudes toward out-groups, with members' preferences strongly aligned to their leaders'. Together, these studies highlight that leaders matter and that the quality of religious goods varies, supporting a model in which decision makers actively choose quality at a given cost. There is ample evidence that such actions of religious entrepreneurs are important in practice (Searing et al., 2025; King et al., 2025; Mundey et al., 2019; Hull et al., 2010).

What might be the objectives of these leaders? In our baseline model, religious leaders maximize the profit of the FBP. This should not be understood as equating FBPs with secular firms (nor as implying that all secular organizations are purely motivated by profit). Rather, it reflects the reality that FBPs face costs and must balance them with their revenues. For example, Corbi and Sanches (2025) show that the average Brazilian church gets about 72% of its revenue from members, while in India, Iyer et al. (2013) documents that Hindu temples similarly rely primarily on donations. Figure 1 shows that the vast majority of congregations in the USA raise 100% of their income from member donations. Even in denominations that rely less on individual donations, such as the Episcopal or Presbyterian churches, the median congregation raises about 85% of its income from its members.

There is also evidence that FBOs respond to changes in the cost of religious staff. For instance, shocks that alter the incentives for talented individuals to pursue religious vocations can shift the

Figure 1: Median shares of congregation income from individual members' donations




*Notes:* Data from 2815 Christian congregations appearing in the USA National Congregations Survey waves I to IV.

supply of religious staff. Engelberg et al. (2016) show how oil price shocks reduced the supply of Methodist preachers in Oklahoma, while Ebaugh et al. (1996) link the decline in Catholic nuns to expanding professional opportunities for women in high-income countries.

By modeling FBPs as profit-maximizing organizations, we do not suggest that leaders necessarily appropriate profits for their personal enrichment (though they may do). Rather, the model demonstrates that, compared to FBOs focused mainly on religious services, religious platforms can generate substantial rents. These rents may be allocated in various ways: toward charitable activities, reinvestment in organizational infrastructure, efforts to expand doctrinal influence and attract converts, or, in some cases, leaders' private consumption or the pursuit of personal ideological objectives.

A key implication of the baseline profit-maximizing model is that leaders need not intrinsically value either membership size or member quality to devote substantial attention to both. Nonetheless, our main results do not depend on the profit-maximizing assumption, and section 3.5 considers an extension that incorporates alternative leader motives.

Another central assumption of our baseline model is that FBPs charge members for the services they consume. While monetary contributions are the lead example, these fees can also take the form of time investments (e.g., volunteering, missionary work) or in-kind contributions. We further assume that FBPs can observe which services members consume, and charge them differently according to their consumption. For this, participation in religious and networking activities needs to be at least partly visible – for instance, through attendance at communal events or engagement in individual practices such as prayer or counseling. Payments may be tied to specific rituals with suggested donation amounts, but they can also be elicited through social norms, community monitoring, or subtle cues from staff. The degree of pressure exerted on members to meet such obligations may vary across organizations and individuals. In this way, FBPs are able to engage in price discrimination between members who have different demands for the religious and the network service.

### 2.3 How are platforms different from clubs?

A central framework in the economics of religion builds on Iannaccone (1992), which models religious communities as providers of club goods. Buchanan (1965) had originally defined club goods as sharing with public goods the property of non-rivalry (consumption by one individual does not reduce the amount available to others, except when congestion occurs), while sharing with private goods the property of excludability (non-members can be prevented from consumption). Clubs thus enable economies of scale in the provision of non-rival goods, while membership fees cover the costs of provision. Iannaccone (1992) extended this framework by emphasizing that, in the case of religious communities, the quality of the club good depends on members' own investments of time, energy, and resources. Such member contributions are typically subject to free-rider problems, which excludability alone cannot resolve.

Instead, faith-based clubs incentivize contributions to the public good by demanding high levels of sacrifice from their adherents. For example, they may impose restrictions on behavior, such as prohibiting drinking alcohol or requiring members to observe the Sabbath. These sacrifices serve two functions. First, the sacrifices screen for members who have a high willingness to pay to participate in the religious activities of the club. Second, the sacrifices increase the cost (through stigma) of secular, non-club activities - thereby making public good contributions more attractive to adherents and raising the overall quality of the club. The club goods model has been productively applied across the economics of religion literature and beyond.[5]

[5] Amongst other applications, it has been used to explain the persistence of extremist religious organizations (Iannaccone and Berman, 2006); the effectiveness of suicide missions (Berman and Laitin, 2008); the workings of Christian (Iannaccone, 1994), Jewish (Berman, 2000) and Muslim sects (Berman and Stepanyan, 2004); the provision of informal insurance in Indonesian Muslim communities after a macro-economic shock (Chen, 2010); international competition between religious denominations (Hanson and Xiang, 2013); and household conversions from Catholicism

A religious club consists of a leaderless and homogeneous group of users in an FBO that offers a single service to all. Three main features of the platform model may better capture the functioning of FBOs. First, the presence of different types within the same FBO is at the heart of our model - in particular, types with a high demand for religious services and types with a high demand for networking services (who may overlap but are not necessarily the same). Distinguishing between the two services helps explain the existence and relevance of individual religious practices (private prayers, rituals, confession sessions) within a more or less marked communal setting.[6]

Second, we give a central role to religious leaders, who act as principals and can internalize many of the externalities between members. Third, the quality of the religious service is determined by leaders, who can charge the members that consume it (unlike in the club goods model, where religious expenditure is non-contractible).

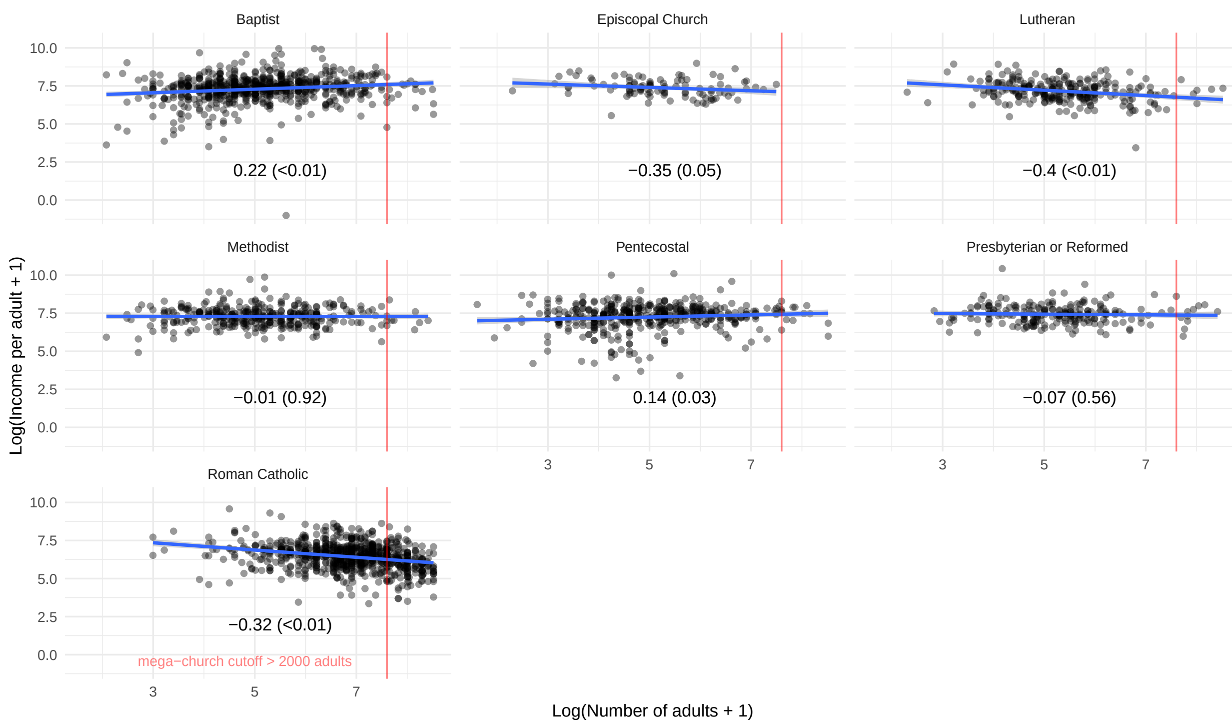
These features of the platform model enable us to address two shortcomings of the club goods model of religion. First, a key prediction of the sacrifice and stigma model is that there should be a decreasing relationship between the size of religious institutions and the levels of sacrifice they demand. We should see small groups providing a high quality of service and eliciting high levels of sacrifice from their members, while larger groups will provide a lower quality of religious service and extract fewer sacrifices from their members. In Figure 2, we see that this relationship does not hold across all Christian denominations in the USA National Congregations survey. While the negative correlation between income and size is true for traditional denominations such as the Lutheran or Episcopal churches, the correlation is significantly positive for denominations such as Baptist or Pentecostal churches.

The sometimes positive correlations between donations per member and size are most striking with so-called megachurches, extremely large congregations formally defined as Protestant Christian churches with more than 2000 attendees per week (Hunt, 2020). They are an increasingly common form of congregation in countries as diverse as the USA, South Korea, Nigeria and Brazil (Burgess, 2020; Adogame et al., 2024). By one estimate, although less than 0.5% of all churches in the USA

to Evangelicalism after the introduction of a cash transfer program in Ecuador (Buser, 2015). Theoretical extensions to the club goods model include extending it to a dynamic setting to explain why religious groups may tolerate or even need free riders (McBride, 2015); extending it to a setting with religious competition and discrimination (Carvalho and Sacks, 2021); and using it as a basis to discuss the interplay between the production of personal and social identities (Carvalho, 2016). See the recent survey in Seabright (2026).

[6] In contrast, the club goods model is rather tailored to religions with regular communal gatherings, such as Christianity, Islam, or Judaism.

Figure 2: Correlations between income and size across Christian congregations in the USA




*Notes:* The figure shows correlations between the number of regular adult members and the income per member for Christian congregations in the USA. Each point represents a Christian congregation in one of 4 waves of the USA National Congregations Survey, conducted in 1998, 2006, 2012 and 2018. Congregations are grouped by their self-reported denominations. Regression lines of log(income per adult + 1) against log(number of adults + 1) are plotted in blue and correlation coefficients are shown along with p-values in parentheses. See Appendix for further details on the dataset and analysis.

are megachurches, they account for 33% of all people who attend a Christian church on an average Sunday (Hunt, 2020).In section 5, we draw on work published in the field of megachurch studies[7] to discuss how the platform perspective can help us understand the organizational and structural characteristics of this increasingly common and surprising form of FBO—characteristics that are not comfortably explained by the club goods model.

Second, for all its explanatory power, the club goods model does not explain what is special to FBOs as compared to secular clubs. Our platform model gives religious beliefs and rituals a central role in the explanation of FBOs. Demand for religious beliefs signals high quality in matches that are fostered by the shared rituals and practices that generate the network service. These features of religious beliefs and the externalities they generate set FBPs apart.

# 3 The theoretical model: General case

## 3.1 Setup

We develop a model where FBPs provide two services to members or potential members who differ in their valuation of the services, and who also care to varying degrees about the characteristics of the other members. We assume that they do so under monopolistic competition, where FBPs compete without seeking to take their competitors' reactions explicitly into account.[8] Each FBP faces a downward-sloping demand curve, whose shape depends on a potentially large number of choices that the FBP makes.[9] There is also a competitive supply of a networking service that sets a ceiling to the (quality-adjusted) price that can be charged.

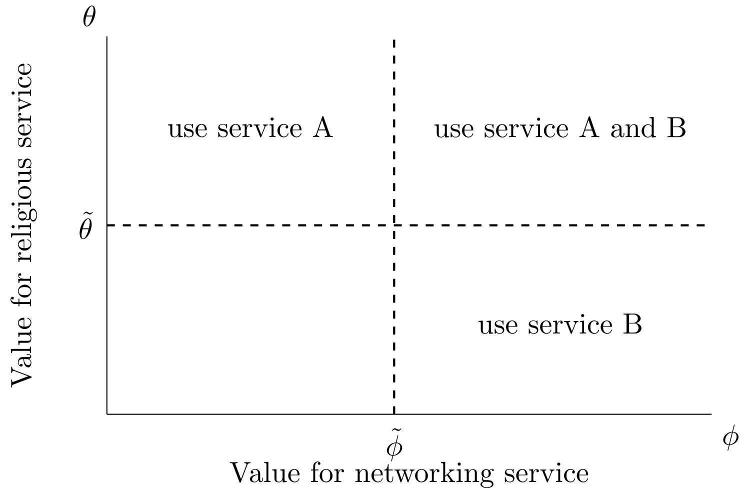
The two services supplied by the platform are a **religious service** $A$ (such as prayers, ritual, moral guidance or spiritual comfort) at price $p_A$, and a **networking service** $B$ at price $p_B$. Service $B$ consists of having access to users of service $A$. The members of the platform can purchase service

[7]See Adogame et al. (2024) and Bauman (2022) for recent reviews.

[8]The notion that FBOs compete and members switch depending on their cost-benefit analysis is underlined by Barro and McCleary (2024), who find that conversion is higher in more pluralistic environments and where switching costs are lower.

[9]This allows us to explore multi-dimensional competitive strategies, without having to solve for the simultaneous decisions of these FBPs in the multiple dimensions. However, to show that our qualitative findings are not an artefact of this modeling choice, we develop in Appendix A a model of spatial competition between FBPs in which strategic interactions are explicitly modeled and transport costs represent the ease of switching between FBPs. We show that if members care about the "quality" of other members, even when competition between FBPs is intense (as measured by the transport cost tending to zero), FBPs can still make substantial rents in equilibrium.

Figure 3: Illustration of $\theta$ and $\phi$ and the types of users




$A$ only, service $B$ only, or both. The platform can invest in the quality of the religious service $q_A$ at convex cost $C(q_A)$. $C(q)$ is a strictly increasing and convex function with $C(0) = C'(0) = 0$. Quadratic functions, such as $C(q) = \kappa\frac{q^2}{2}$ with $\kappa > 0$, which we use for an example below, satisfy this assumption.

### 3.1.1 Users

There is a continuum of potential users $i$ of services $A$ and $B$, of types $(\theta_i, \phi_i)$, with $\theta$ and $\phi$ distributed independently on $\mathbb{R}^+$ according to density $f(\theta)$ and cumulative distribution function $F(\theta)$ for $\theta$ and to density $g(\phi)$ and cumulative distribution function $G(\phi)$ for $\phi$.[10] We assume that the hazard rate function of $\phi$, $h(\phi) = \frac{g(\phi)}{1-G(\phi)}$ is weakly monotone increasing.[11] Users derive gross utility $\theta_i \alpha q_A$ from consuming service $A$ and $\phi_i \beta q_B$ from consuming service $B$, where $\alpha > 0$ and $\beta > 0$.

We denote by $n^*$ and $m^*$ the equilibrium numbers of purchasers of service $A$ and service $B$, respectively. The marginal user of service $A$ is characterized by $\tilde{\theta}$ where $\tilde{\theta}\alpha q_A - p_A = 0$, while the marginal user of service $B$ is characterized by $\tilde{\phi}$ where $\tilde{\phi}\beta q_B - p_B = 0$. These are illustrated in

[10] We focus on potential users – individuals with a positive latent demand for at least one of the services. This set may represent either the entire population or only a subset of it. To capture the entire population, one can also allow types in the negative domain, representing individuals with a dislike for the services. While this extension does not alter the comparative statics, it could be useful for analyzing the nature of competition that FBPs face.

[11] Most usual distributions satisfy this assumption. This is for instance the case of the uniform distribution, the exponential distribution, Gaussian, and Poisson.

Figure 3. The market share of service $A$ is therefore:

$$n^* = 1 - F\left(\frac{p_A}{\alpha q_A}\right) \tag{1}$$

and the market share of service $B$ is

$$m^* = 1 - G\left(\frac{p_B}{\beta q_B}\right) \tag{2}$$

#### 3.1.2 Networking service

The FBP puts users of service $B$ in contact with users of service $A$. Users of the networking $B$ service care about the quality of the users they can connect with, as captured by the exogenous parameter $\theta$, and they regard the willingness of users to pay for religious service $A$ as a signal of that quality. We represent the average quality $q_B$ of users of $A$ by the average $\theta$ of religious users $i$ of the platform:

$$\bar{\theta} = E(\theta/joining) = \int_{\frac{p_A}{\alpha q_A}}^{+\infty} \frac{\theta f(\theta)}{n^*} d\theta. \tag{3}$$

We can now consider what a networking service consists of. There are two different situations, corresponding to whether or not there is congestion. Networking users want to build a connection with religious users. However, each of the latter can only interact with a limited number of networking users. The severity of this constraint depends on the type of networking service in question. For example, if service B users are mainly interested in finding a (monogamous) marriage partner, there will be only as many connections as there are service A users who are unmarried and willing to get married. Alternatively, if service B users are interested in finding professional clients, each service A user can have connections to several of them. We call a system congested if there are more service B users than possible connections with service A users, and we call it uncongested if there are fewer service B users than possible connections.

To be more specific, the utility derived from joining the FBP for an individual $i$ who seeks interactions with high-quality members is assumed to be equal to min $\left\{\nu \frac{n^*}{m^*}, 1\right\} \phi_i \beta \bar{\theta}$, where $\nu \geq 0$. This utility increases with $\bar{\theta}$, the average moral or spiritual quality of the congregation and with min $\left\{\nu \frac{n^*}{m^*}, 1\right\}$ the probability of a successful match. Intuitively, this probability depends on the proportion of religiously motivated members $n^*$ compared to those who come for networking $m^*$. This ratio is multiplied by $\nu > 0$, which captures the number of successful connections each religious member can maintain. For example, it will be typically lower than one for the marriage market, and presumably larger than one for business interactions. We, therefore, need to distinguish two cases.

- **Uncongested systems:** $\nu \frac{n^*}{m^*} \geq 1$**.** In uncongested systems, there is no rationing, and the overall expected quality of the service $B$ is:

$$q_B^u = \bar{\theta} = \int_{\frac{p_A}{\alpha q_A}}^{+\infty} \frac{\theta f(\theta)}{n^*} d\theta = \int_{\frac{p_A}{\alpha q_A}}^{+\infty} \frac{\theta f(\theta)}{1 - F\left(\frac{p_A}{\alpha q_A}\right)} d\theta \tag{4}$$

Differentiating this equation with respect to $p_A$ and $q_A$ yields:

$$\frac{dq_B^u}{dp_A} > 0 \quad \text{and} \quad \frac{dq_B^u}{dq_A} = -\frac{p_A}{q_A}\frac{dq_B^u}{dp_A} < 0. \tag{5}$$

- **Congested systems:** $\nu \frac{n^*}{m^*} < 1$**.** In congested systems, the networking service will be subject to rationing. If there is rationing, the probability that user $j$ can match with a user $i$ is given by $\nu \frac{n^*}{m^*}$. With rationing, that is assuming $m^* > \nu n^*$, the overall expected quality of the service $B$ is

$$q_B^c = \frac{\nu n^*}{m^*}\bar{\theta} = \nu \int_{\frac{p_A}{\alpha q_A}}^{+\infty} \frac{\theta f(\theta)}{m^*} d\theta = \nu \int_{\frac{p_A}{\alpha q_A}}^{+\infty} \frac{\theta f(\theta)}{1 - G(\frac{p_B}{\beta q_B^c})} d\theta \tag{6}$$

It implies that $q_B^c$, if it exists, is a fixed point of this equation. Multiplying left and right by $m^*$, it solves: $q_B^c \left(1 - G(\frac{p_B}{\beta q_B^c})\right) = \nu \int_{\frac{p_A}{\alpha q_A}}^{+\infty} \theta f(\theta) d\theta$. Since the function $q_B^c \left(1 - G(\frac{p_B}{\beta q_B^c})\right)$ is monotone increasing from 0 when $q_B^c = 0$, and to infinity when $q_B^c \to +\infty$, and since $\nu \int_{\frac{p_A}{\alpha q_A}}^{+\infty} \theta f(\theta) d\theta$ is positive, $q_B^c$ exists and is unique. Moreover, since $\nu \int_{\frac{p_A}{\alpha q_A}}^{+\infty} \theta f(\theta) d\theta$ is decreasing in $p_A$ and increasing in $q_A$, differentiating this equation with respect to $p_A$ and $q_A$ gives:

$$\frac{dq_B^c}{dp_A} < 0 \quad \text{and} \quad \frac{dq_B^c}{dq_A} = -\frac{p_A}{q_A}\frac{dq_B^c}{dp_A} > 0. \tag{7}$$

The interpretation of the derivatives in Equations 5 and 7 is as follows: Raising the price of good $A$ lowers the demand for service $A$ and decreases the number of service $A$ users. It thereby raises the average quality of service $A$ users (since only users with a high $\theta$ will be willing to pay the new, higher price). In turn, this will raise the attractiveness of the platform to consumers of service $B$ if access to other members is uncongested. In that case, the higher average quality of service $A$ users will attract more service $B$ users who impose no congestion externality on existing service $B$ users. If access is congested, on the other hand, raising the price of $A$ reduces the attractiveness of the platform by reducing the number of service $A$ users, which means that extra service $B$ users impose a substantial congestion externality on existing consumers of service $B$.

### 3.2 The platform price-quality strategy

We now consider how the religious platform sets its prices $p_A$, $p_B$ and chooses the quality $q_A$ of service $A$. It solves:

$$\begin{aligned} \max_{p_A, p_B, q_A} \quad & \Pi = n^*[p_A - C(q_A)] + p_B m^* \\ s.c. \quad & n^* = 1 - F\left(\frac{p_A}{\alpha q_A}\right) \\ & m^* = 1 - G\left(\frac{p_B}{\beta q_B}\right) \end{aligned} \tag{8}$$

where $q_B = q_B^u$ defined in equation (4) if the system is uncongested and $q_B = q_B^c$ defined in equation (6) if it is congested (i.e., if $\nu n^* < m^*$). We can now state:

**Proposition 1.** *Let $\varepsilon_{n^*,p_A} = -\frac{\partial n^*}{\partial p_A}\frac{p_A}{n^*}$ be the price elasticity of the demand for service A of quality $q_A$. To maximize its profit, the platform chooses the price and quality vector solution of the following equations:*

$$\frac{p_A - C(q_A)}{p_A} = \frac{1}{\varepsilon_{n^*,p_A}} - \frac{p_B}{p_A}\frac{\partial m^*}{\partial n^*} \tag{9}$$

$$C'(q_A)q_A = p_A \tag{10}$$

$$\frac{p_B}{\beta q_B} = \frac{1 - G\left(\frac{p_B}{\beta q_B}\right)}{g\left(\frac{p_B}{\beta q_B}\right)} \tag{11}$$

*Proof.* See appendix 9.1.1. □

### 3.2.1 The price of service $A$

Equation (9) is the standard monopoly price equation where the Lerner index (the LHS term) equals one over the price elasticity of demand, plus a distortion proportional to $-\left(\frac{\partial m^*}{\partial n^*}\right)$, which reflects the externality generated by religious members on those seeking interaction with them. When matching is congested, the distortion term is negative (as $\frac{\partial m^*}{\partial n^*} > 0$). All else equal, therefore, the platform chooses a lower price $p_A$ when network access to religious members is congested, compared to a situation with no externalities. In contrast, it chooses a higher price $p_A$ when the matching service is uncongested.[12]

### 3.2.2 The quality of service $A$

One contribution of the paper, compared to the standard club good model, is to endogenize the quality of the religious service $q_A$. Equation (10) shows the optimal investment level in quality from the platform's perspective. First, it is easy to see that $q_A^*$, the solution to (10), exists and is unique.[13] Second, it shows that $q_A^*$ is strictly increasing in $p_A$. Interestingly, the function determining the optimal quality level for a given price $p_A$ in (10) does not include a distortion. There is a dichotomy result: for a given price, the quality is undistorted by the externality generated by service $A$ users. However, because $p_A$ is set to internalize the externality that the quality of the pool of adherents imposes on the revenues from service $B$, the distortion affects quality indirectly, through its impact on $p_A$. The higher the price $p_A$, the higher the quality $q_A$ chosen by the FBP.

### 3.2.3 The price of service $B$

Finally, equation (11) shows that the religious platform fine-tunes its price $p_B$ so that the fraction of users of service $B$ is constant.[14] We deduce that the platform chooses the price $p_B = \nu q_B \Phi$ so that $m^* = 1 - G(\Phi) \quad \forall q_B > 0$. For instance, with a uniform distribution on $[0, M]$ $m^* = \frac{1}{2}$.[15]

[12]The distortion is equal to: $-\frac{p_B}{p_A}\left(\frac{\partial m^*}{\partial p_A} / \frac{\partial n^*}{\partial p_A}\right) = \frac{\alpha}{\beta}\left[\left(\frac{p_B}{q_B}\right)^2 g\left(\frac{p_B}{\beta q_B}\right) / \frac{p_A}{q_A} f\left(\frac{p_A}{\alpha q_A}\right)\right] \frac{dq_B}{dp_A}$. It is positive in uncongested cases so that $\frac{dq_B^u}{dp_A} > 0$ and negative in congested ones so that $\frac{dq_B^c}{dp_A} < 0$.

[13]Under our assumptions about the cost function, the LHS of equation (10) is strictly increasing from 0 when $q_A = 0$ to infinity when $q_A \to +\infty$. It necessarily crosses $p_A \geq 0$ once and only once, which proves the existence and uniqueness of $q_A^* \geq 0$.

[14]Indeed let $\Phi > 0$ be such that $\frac{1}{\Phi} = \frac{g(\Phi)}{1-G(\Phi)} = h(\Phi)$. It is easy to see that $\Phi > 0$ exists and is unique since $\frac{1}{\phi}$ is decreasing in $\phi$ and varies continuously between $\infty$ and 0, while, under our assumptions, the hazard rate function of $\phi$, $h(\phi)$ is increasing in $\phi$ or constant. They therefore cross once and only once.

[15]That is, $h(x) = \frac{1}{M-x}$ so that $\Phi = \frac{M}{2}$ and $m^* = 1 - G\left(\frac{M}{2}\right) = 1 - \frac{M}{2M} = \frac{1}{2}$.

Equation (11) implies that the optimal fraction of users of the networking service is uniquely determined by the distribution of $\phi$. In particular, when the marginal cost of providing service $B$ is zero, this fraction is invariant to changes in $\beta$ and in the quality of the networking service $q_B$. The intuition is the same as in a standard monopoly pricing model: the monopolist sets price so that the loss in revenue from the marginal consumer induced by a price increase exactly offsets the gain in revenue from inframarginal consumers. Any parameter that scales consumers' willingness to pay proportionally - such as $\beta$ or $q_B$ - therefore leaves the optimal markup, and hence the equilibrium fraction of users, unchanged.

When the marginal cost of providing service $B$ is positive, this invariance result breaks down. In that case, the optimal price–quality ratio $\Phi_B \equiv p_B/(\beta q_B)$ solves an implicit monopoly pricing condition of the form

$$\Phi_B - \frac{1 - G(\Phi_B)}{g(\Phi_B)} = \frac{c_B}{\beta q_B}.$$

Under standard regularity conditions on demand (so that the left-hand side is strictly increasing in $\Phi_B$), an increase in $\beta$ reduces $\Phi_B$ - and hence increases the equilibrium fraction of users $m^* = 1 - G(\Phi_B)$ - whenever the effective quality of the networking service does not fall too sharply with $\beta$.[16] That is, whenever

$$q_B + \beta \frac{dq_B}{d\beta} > 0.$$

However, even with a zero marginal cost, a change in the distribution of $G$ may impact $m^*$.[17]

Given that FBPs will adjust their offer to keep the number of $B$ users constant, the overall group size is determined by service $A$ users. Depending on which type of interaction is fostered within the community, with a high or low $\nu$ implying congestion or no congestion, FBPs will implement different strategies in quality $q_A$ and price $p_A$. If there is no congestion, they will charge a price $p_A$ higher than if they only offered service $A$. Everything else being equal, the group will be smaller. If there is congestion, FBPs will charge a price lower than the stand-alone price, and the group will

[16]To illustrate the intuition, consider a linear demand curve $p = \beta a - \beta b q$ with constant marginal cost $c$. The monopoly quantity is $q^* = (\beta a - c)/(2\beta b)$, which is independent of $\beta$ when $c = 0$, but strictly increasing in $\beta$ when $c > 0$. In our model, demand is generally non-linear and the quality of service $B$ may itself depend on equilibrium choices. As shown in Appendix 9.1.2, with positive marginal cost the sign of $d\Phi_B/d\beta$ is governed by $q_B + \beta(dq_B/d\beta)$; the condition stated in the text is sufficient for the equilibrium fraction of users of service $B$ to increase with $\beta$.

[17]If a distribution $G_1(\phi)$ hazard-rate dominates $G_2(\phi)$ then $\Phi_1 \geq \Phi_2$ so that, everything else being equal, the price of service $B$ increases with distribution 1 compared to 2. In other words, hazard rate dominance, which implies stochastic dominance, leads to a higher price of service $B$.[18] As the $\phi$ distribution shifts to the right (i.e. towards higher values), the price of the $B$ service increases and the proportion of users decreases.

be larger.

### 3.3 The size and profitability of the FBP compared to a stand-alone FBO

We can now compare the profit and size of an FBP to those of a stand-alone FBO that supplies only the religious service (and not the networking service).

**Proposition 2.** *Let $\beta > 0$. Relative to a stand-alone FBO supplying only the religious service $A$:*

1. *The FBP is strictly larger in size if:*
   - *The networking service is congested; or*
   - *The networking service is uncongested and $F$ weakly hazard-rate dominates $G$.*[19]
2. *The FBP is strictly more profitable.*

*Proof.* See appendix 9.1.3. □

The result that the FBP is strictly larger in size (given a strictly positive demand for the networking service) follows from the facts that:

- if demand is congested, the externality from the presence of members demanding networking service induces the FBP to lower its price for the religious service relative to the stand alone price, thereby increasing the number of members using the religious service even without counting the members using the networking service;
- if demand is uncongested, the fact that $F$ hazard-rate dominates $G$[20] means that the proportion of members enrolled by the FBP in the networking service will exceed the proportion enrolled by the stand alone FBO in the religious service.

The result that an FBP is (strictly) more profitable than a stand-alone FBO follows from the observation that the FBP can always replicate the stand-alone FBO's pricing and quality for service $A$. It will always choose to do so if $\beta > 0$, since it can set a price close to, but strictly below 1, and thereby enrol a strictly positive number of users of the networking service to yield an

[19] That is, for all $x \geq 0 : \frac{f(x)}{1-F(x)} \leq \frac{g(x)}{1-G(x)}$.

[20] Note that this requirement is merely a sufficient condition. The conclusion may remain valid even if the condition does not hold (see the proof of Proposition 2).

increase in profit. If it sets a lower price than this, it will be because such a price yields strictly higher profit.

### 3.4 The uniform-quadratic example

In this section, we consider a parametric example to illustrate the results of Propositions 1 and 2, and to set up the exploration of comparative statics. We assume that the cost of quality of service $A$ follows a quadratic function, and that $\theta$ and $\phi$ are distributed independently and uniformly on $[0,1]$. Solving the optimization problem of the platform yields the counterpart of Proposition 1 for this quadratic-uniform example:

**Proposition 3.** *Let $C(q_A) = \kappa \frac{q_A^2}{2}$ and let $\beta\kappa < 4\alpha^2$, where $\alpha, \beta, \kappa > 0$, and $c_B = 0$. Assume $\theta, \phi \sim U[0,1]$ i.i.d. The strategy that maximizes profit yields the following prices and quality of service A:*

- $p_B = \frac{\beta q_B}{2}$ *and* $p_A = \kappa q_A^2$.
- $q_A$ *depends on the state of congestion as follows:*

$$\begin{cases} q_A^c = \frac{4\alpha^2 - \beta\kappa\nu}{6\kappa\alpha} \ \ \textit{so that} \ \ q_B^c = \nu\left(1 - \left(\frac{\kappa}{\alpha} q_A^c\right)^2\right) & \textit{if } \beta\kappa < \frac{3-2\nu}{\nu^2}\alpha^2 \\ q_A^u = \frac{\alpha + \sqrt{\alpha^2 + \frac{3}{4}\beta\kappa}}{3\kappa} \ \ \textit{so that} \ \ q_B^u = \frac{1}{2}\left(1 + \frac{\kappa}{\alpha} q_A^u\right) & \textit{otherwise} \end{cases}$$

*Proof.* See appendix 9.2.1 □

Starting from a situation where there is no demand for the networking service $B$ (i.e., if $\beta = 0$), it is easy to see that $q_A^c = q_A^u = \frac{2\alpha}{3\kappa}$, while when $\beta > 0$ then $q_A^c < \frac{2\alpha}{3\kappa} < q_A^u$. That is, compared to a standalone FBO offering only service A, $q_A$ for an FBP is higher if there is no congestion and lower if there is congestion. Since the price of service $A$ is $p_A = \kappa q_A^2$, the price of service $A$ is also higher if the networking service is uncongested, and lower if it is congested.

The frontier between the two regimes depends on the exogenous parameters. When $\beta\kappa \geq \frac{3-2\nu}{\nu^2}\alpha^2$, there is no congestion, so that the quality of the service $B$ is $q_B^u = \frac{1}{2}\left(1 + \frac{\kappa}{\alpha} q_A^u\right)$. There is congestion when $\beta\kappa < \frac{3-2\nu}{\nu^2}\alpha^2$. This condition requires that the RHS $\frac{3-2\nu}{\nu^2}\alpha^2$ be strictly positive, which is equivalent to $\nu < 1.5$. In other words, if $\nu$ is large, then the networking service is never congested. In contrast, if $\nu$ is small (i.e., smaller than $\tilde{\nu} = \frac{\sqrt{13}-1}{4} \simeq 0.65$) then the networking service will always be congested.[21]

We can now derive closed-form solutions to show that in addition to being more profitable than a stand-alone FBO[22], the FBP is larger and, over some parameter ranges, is also more profitable per capita.

**Proposition 4.** *Let the conditions of Proposition 3 hold. Then let $\pi^0$ denote the stand-alone FBO's per-capita profit and let $\pi^*$ denote the FBP's per-capita profit. Then $\pi^0 = \frac{2\alpha^2}{9\kappa}$. Then relative to a stand-alone FBO supplying only the religious service A:*

1. *The optimal composition of the FBP is $m^* = \frac{1}{2}$ and $n^* = 1 - \frac{\kappa}{\alpha} q_A$ such that*

$$\begin{cases} n^{c*} = \frac{1}{3} + \beta \frac{\kappa\nu}{6\alpha^2} \in [\frac{1}{3}, 1] & \text{if } \beta\kappa < \frac{3-2\nu}{\nu^2}\alpha^2 \\ n^{u*} = \frac{2-\sqrt{1+\frac{3\beta\kappa}{4\alpha^2}}}{3} \in [0, \frac{1}{3}] & \text{otherwise} \end{cases}$$

2. *The overall size of the FBP is greater than the size of the stand-lone FBO, which is given by $n^0 = \frac{1}{3}$.*

3. *For some parameter ranges, the FBP also achieves higher profits per capita.*

   - *If the uncongested regime applies and parameters satisfy $\frac{8}{27} \leq \frac{\beta\kappa}{4\alpha^2} < 1$, then $\pi^{u*} > \pi^0$.*
   - *If the congested regime applies and parameters satisfy $\frac{1}{\nu} \leq \frac{\beta\kappa}{\alpha^2} \leq \min\{4, \frac{3-2\nu}{\nu^2}\}$, then $\pi^{c*} > \pi^0$.*

*Proof.* See appendix 9.2.2 □

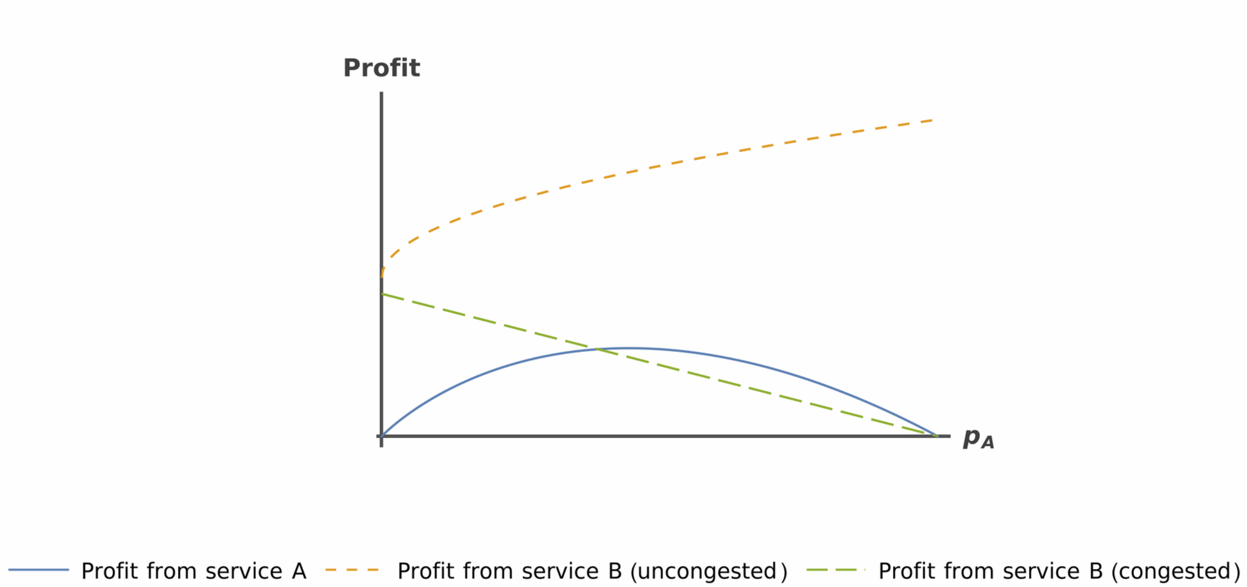
Figures 4 and 5 illustrate the uniform-quadratic example. Taking Figure 4 first, Panel 4a shows how the profits of the two services vary as a function of $p_A$. At $p_A = 0$, everyone consumes service A, but it generates no revenue. Once the price increases, the number of A users decreases, and profits from A users increase until their maximum, after which profits from A users decrease with

[21] Since Proposition 3 is established under the assumption that $\beta\kappa < 4\alpha^2$, the threshold value of $\nu$ below which the service is always congested is such that $\frac{3-2\nu}{\nu^2} = 4$. Solving this second-degree equation, the positive root is $\tilde{\nu} = \frac{\sqrt{13}-1}{4} \simeq 0.65$.

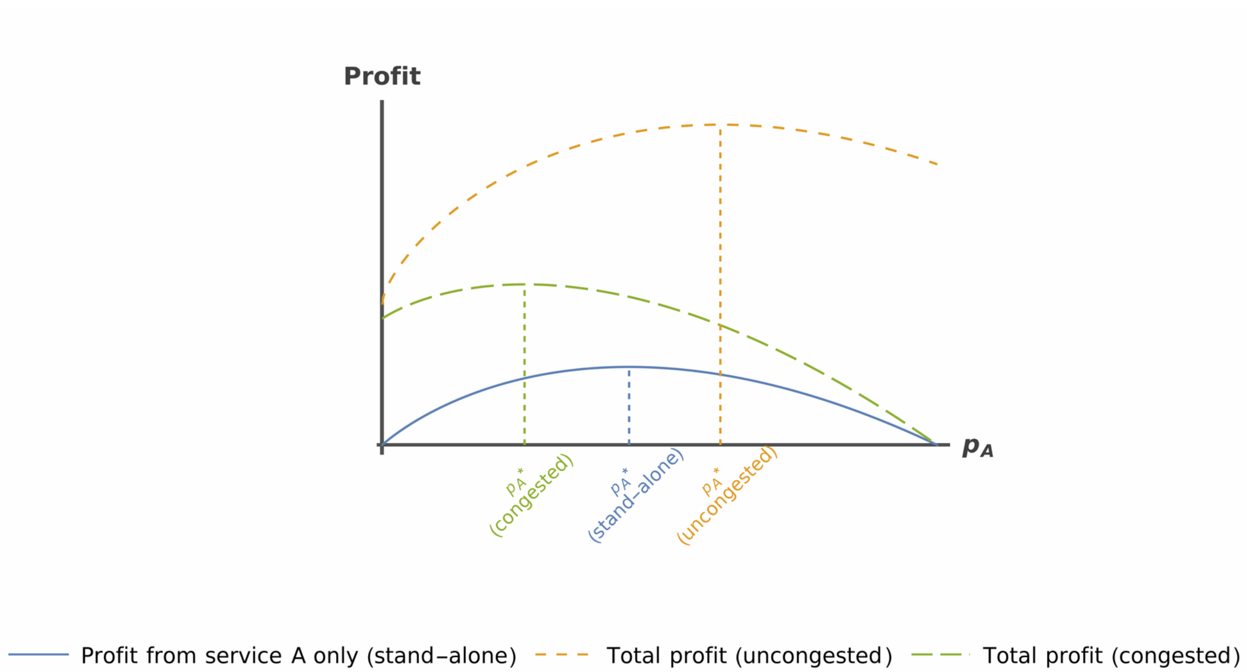
[22] Since $\beta > 0$, the profit result of Proposition 2 holds and the FBP is strictly more profitable than the stand-alone FBO.

Figure 4: Profit functions as a function of $p_A$: congested and uncongested cases

(a) Profits from service $A$ and service $B$ users




(b) Total profits from service $A$ and service $B$, and from service $A$ only




*Notes*: Numerical example using uniform type distributions and quadratic cost functions as described in Section 3.4. The functional forms of profits and demand are provided in Appendix 9.4. Parameter values used for both panels are $\alpha = 1.8$, $\kappa = 1.5$, $\beta = 2.3$, and $\nu = 0.45$. All results are obtained on a grid of $n = 500$ points over the domain $0 \leq p_A \leq \alpha^2/\kappa$. Panel (b) combines stand-alone profits from service A with profits from service B under the uncongested and congested specifications, and vertical dashed lines indicate the numerically obtained maximizers.

the price. In the uncongested case, increasing the price $p_A$ increases profits from B users as it screens for higher-quality A users. In the congested case, while an increase in price $p_A$ screens for members with a higher $\theta$, it also decreases the chances of having a match and thus decreases the quality of service B $q_B$ and the profit from the it.

Panel 4b illustrates the profits from $A$ users and the total profit from $A$ and $B$ users as a function of the price of service $A$. If there is no demand for the networking service (or the FBO cannot offer it) the optimal price is at the maximum of the service A profit curve, denoted "stand-alone price". In the congested case, the profit-maximizing price $p_A$ lies to the left of the stand-alone price, while in the uncongested case, it lies to the right. This illustrates that FBPs offering both services are more profitable than FBOs only offering service A. Also, FBPs in the uncongested case charge a higher price $p_A$ (and offer higher quality $q_A$), and are smaller and generally more profitable than congested FBPs. In Appendix section 9.4, we equally illustrate profits as a function of quality of service $A$ in Figures 8 and 9.

Figure 5 illustrates Proposition 3. The platform seeks to enrol exactly half the users of the network service B. To achieve this goal, it fine-tunes the price of the network service as a function of its quality so that $p_B = \frac{\beta q_B}{2}$. When there is no demand for the networking service $\beta = 0$, enrolment of religious service $A$ users is also a constant proportion at $n^* = \frac{1}{3}$. In contrast, when there is positive demand for networking services, the enrolment of service $A$ users depends on whether or not the networking service is congested. When the networking service is congested the fraction of users of the religious service is $n^{c*} \geq \frac{1}{3}$. This is a case where the FBP increases the quality-to-price ratio (it decreases both the quality of the religious service and its price, but the price declines faster than the quality) to attract more users of service $A$ in an attempt to lower the congestion.

When the networking service is uncongested, the fraction of service $A$ users is $n^{u*} \leq \frac{1}{3}$. Compared to a situation where there is no demand for a networking service, the FBO increases both the quality of the religious service and its price to attract the most demanding service $A$ users. This strategy where price increases faster than quality lifts the quality of service $B$ and allows the platform to charge a higher price for it.

In both cases, the size of the FBP increases compare to the stand-alone FBO: $m^* + n^*(1-m^*) > m^* = \frac{1}{2} > n^0 = \frac{1}{3}$. Whether or not the $B$ service is congested, the FBO platform is (much) larger

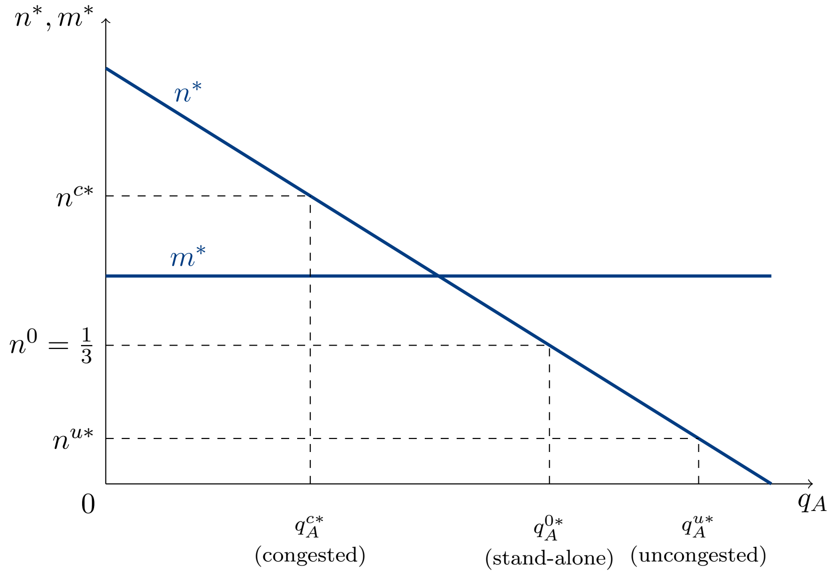



Figure 5: Numbers of users enrolled by the FBP for service $A$ and $B$ in the uniform-quadratic example.

than the stand-alone FBO.

As suggested in the case of Proposition 1, the result that the platform enrols a constant proportion of users of the network service depends on the assumption of zero marginal cost of providing that service. As shown in Appendix 9.1.2, with positive marginal cost the share of network service users enrolled is $m^* = \frac{1}{2} - \frac{c_B}{2\beta q_B}$, which is not constant.

### 3.5 Alternatives to profit maximization

Our model explains how the platform function of FBOs can account for them making positive rents in equilibrium. This does not imply that the goal of their leaders must be solely to maximize profits, though the need to make enough revenue to cover their costs is an important constraint on FBOs' viability. Religious movements have historically emerged from a wide range of motivations, as documented by Seabright (2024, pp. 202-207). Many of these underlying motives lie outside the scope of our model, whose primary focus is to explain the organizational choices of FBPs along the dimensions of size, quality, and pricing. However, leaders may also care about goals other than profits, particularly those related to membership.

FBO leaders may prioritize reaching a large audience of spiritually minded individuals, expanding their religious influence, and/or retaining devout members. To capture such motives, we can extend the model by assuming that platforms maximize $V$, a weighted sum of profits and, $n^*$, membership of spiritually minded followers. Specifically, $\gamma < 1$ denotes the weight placed on profits and $1-\gamma$ the weight placed on $n^*$ membership. The FBP objective function becomes: $V = \gamma\Pi + (1-\gamma)n^*$.

The platform maximizes $V$ with respect to $(p_A, q_A, p_B)$:

$$\begin{aligned} \max_{p_A,q_A,p_B} \quad & V = \gamma\Big[n^*[p_A - C(q_A)] + m^* p_B\Big] \ + \ (1-\gamma)n^* \\ s.c. \quad & n^* = 1 - F\left(\frac{p_A}{\alpha q_A}\right) \\ & m^* = 1 - G\left(\frac{p_B}{\beta q_B}\right) \end{aligned} \tag{12}$$

where $q_B = q_B^u$ defined in equation (4) if the system is uncongested and $q_B = q_B^c$ defined in equation (6) if it is congested (i.e., if $\nu n^* < m^*$).

The counterpart to Proposition 1 is now:

**Proposition 5.** *The platform chooses optimal quality and prices $(p_A^\gamma, p_B^\gamma, q_A^\gamma)$ to satisfy:*

$$\frac{p_A - C(q_A)}{p_A} = \frac{1}{\varepsilon_{n^*,p_A}} - \frac{p_B}{p_A}\frac{\partial m^*/\partial p_A}{\partial n^*/\partial p_A} - \frac{1-\gamma}{\gamma p_A}, \tag{13}$$

$$C'(q_A)q_A = p_A, \tag{14}$$

$$\frac{p_B}{\beta q_B} = \frac{1 - G\left(\frac{p_B}{\beta q_B}\right)}{g\left(\frac{p_B}{\beta q_B}\right)}, \tag{15}$$

*where $\varepsilon_{n^*,p_A} \equiv -\left(\partial n^*/\partial p_A\right)\left(p_A/n^*\right)$ is the price elasticity of demand for service A.*

*Proof.* See appendix 9.3. □

As suggested by intuition, all else equal, the price of Service A is lower when the FBP cares about the number of spiritually minded members. In other words, when leaders care about reach and influence as well as profits, they deliberately set lower prices for the religious service in order to expand $n^*$. Equation 14 shows that quality of the religious service will correspondingly be lower. Pricing of network services, however, will be unaffected for given service quality (though service quality may be affected through the changing composition of members paying for the religious service).

Overall, it is reasonable to assume that profits matter for most religious leaders, if only because revenues are needed to sustain operations. However, non-monetary objectives—such as mission, influence, or member welfare—may also play a central role. The framework is flexible enough to incorporate such a range of leadership motives.[23] When these additional motives place weight on membership size or service quality, they have a first-order impact on the FBP's strategic choices.

## 4 Comparative statics

Understanding FBOs as platforms provides new insights into their organizational choices and offers a framework to discuss how changes in exogenous parameters influence the structure of FBPs. We focus on four changes: (i) innovations that reduce the cost of providing the religious service, (ii) increases in the demand for the religious service, (iii) increases in the demand for faith-based networking, and (iv) changes in the type of connections the FBP fosters.

To interpret these effects, it is helpful to bear in mind the general result from Proposition 1, equation (9), which shows that FBPs with congested networking are larger, have lower prices and invest less in the quality of the religious service than do those with uncongested networking. An increase in $\beta$, the demand for networking, tends to accentuate these differences, since it gives more weight to the platform aspect in the FBP's objective function. Conversely, an increase in $\alpha$, the demand for religious services, tends to dampen the differences. A fall in $\kappa$ is more nuanced.

We summarize the directions of comparative static effects in Appendix Table 3, for the uniform-quadratic case, which, unlike the general case, allows for the sign of the effect to be derived unambiguously in 22 cases out of 24 (see Appendix 10). We maintain the simplifying assumption that the marginal cost of providing the networking service is zero. Under this assumption, the platform always enrolls a fixed share of networking users by adjusting the price and quality of service $B$: higher quality leads to a higher price, and vice versa. Hence, changes in overall group size stem solely from changes in the number of religious users. As shown in Appendix 9.1.2, this property disappears once a per-unit cost $c_B$ is introduced; a higher $c_B$ often, but not always, reduces the equilibrium demand for service $B$.

[23] For example, in Proposition 6 in Appendix 9.5.1, we show that results are robust to considering FBO leaders who value simply reaching a large audience, perhaps to increase their ideological or political influence.

### 4.1 Innovations in the cost of providing the religious good

The cost of providing the religious service, represented by $\kappa$, captures all factors influencing users' utility from service A, including location quality, the speaker's charisma, the appeal of the narrative and norms, and accessibility. Charismatic leaders, who attract large followings across religious traditions (Wessinger, 2012; Corcoran and Wellman Jr, 2016), have been especially influential in American Christianity (Worthen, 2025). Charisma – understood as authority grounded in perceived extraordinary qualities (cf. Weber, 1978; Oxford English Dictionary, 2024) – effectively lowers the cost of delivering a high-quality service in our model. The same holds for denominations offering more compelling narratives or worship styles. Pentecostal and Charismatic churches illustrate this, providing emotionally engaging services and practices that many believers find particularly attractive (Miller and Yamamori, 2007).

Accessibility also affects perceived quality, and technological innovations have repeatedly reduced the effective cost of delivering religious content. Radio and television expanded the reach of preachers and enabled consumption from home (Miller, 1935; Hadden and Shupe, 1987). Today, social media allows leaders to communicate directly with members and broadcast their message at scale, while emerging tools such as artificial intelligence let some leaders generate sermons far more efficiently.[24]

When the cost decreases, FBPs can provide the same level of quality at a lower price, making it optimal to increase the quality of the religious service. The effect on the price of the religious service is more ambiguous. The FBP faces the possibility of making relatively small improvements in quality and charging a lower price for the religious service. It can also invest a lot more in quality and charge a higher price. When networking is congested, the platform increases quality and compensates for this increase with an increase in prices. When networking is uncongested, either outcome is possible depending on the parameters. The implications for the networking service mirror this distinction. When networking is congested, a lower cost of religious quality enables the platform to attract more paying members and thus increases the quality and price of service $B$. When networking is uncongested, by contrast, the same reduction in religious-service costs lowers the average quality of the member pool and thereby reduces the quality and price of

[24] See Mannerfelt and Roitto (2025) on Swedish pastors' use of AI.

the networking service.

Turning to FBP size, the effects again depend on congestion. When networking is congested, a cost reduction leads to a decline in FBP size. Because congested FBPs are initially larger, this adjustment brings the sizes of congested and uncongested FBPs closer together. This is intuitive: the initial size difference reflects the weight of the networking service in the platform's objective, and lowering the cost of religious provision reduces the relative importance of networking, thereby narrowing the gap between the two types. When networking is uncongested, a cost reduction can increase FBP size for certain parameters.

### 4.2 An increase in religiosity

An increase in $\alpha$, the weight individuals place on the religious service, captures situations in which communities become more religious on average. While these changes might increase the value of the religious service, they do not make people better network partners, since the distribution of $\theta$ remains fixed. They may occur when secular alternatives are limited (Gruber and Hungerman, 2008), or in response to shocks that heighten demand for spiritual comfort, such as natural disasters (Belloc et al., 2016; Bentzen, 2018; Dube et al., 2022), pandemics (Bentzen, 2021; Boguszewski et al., 2020), or conflict (Cesur et al., 2020; Mill et al., 2024). In the model, a higher $\alpha$ raises the optimal quality of the religious service and, as quality increases, also leads to a higher price for service $A$.

When networking is congested, the price increase for service $A$ dominates its quality increase, leading to fewer religious users; when networking is uncongested, the reverse holds and religious membership expands. Yet, in both cases, the quality of the networking service decreases, and so do the prices for it. Intuitively, the FBP puts more focus on (and obtains more profits from) the religious service, overall obtaining higher profits.

### 4.3 An increase in the value of faith-based networking

An increase in $\beta$, the value individuals attach to faith-based networking, reflects environments in which the demand for screened or trustworthy partners is higher. For example, we find that urban residents are significantly more likely to report that religion helps people make friends (see Table 2), even though their beliefs about the comforting role of religion do not differ. This pattern is

Table 2: What does religion do in big cities?

| | Probability respondent agrees that religion helps to... | | | | | |
|---|---|---|---|---|---|---|
| | 'make friends' | | | 'find comfort' | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Lives in a big city | 0.0562* | 0.0531** | 0.0233** | 0.0199 | 0.0112 | 0.0082 |
| | (0.0316) | (0.0206) | (0.0088) | (0.0164) | (0.0112) | (0.0065) |
| Constant | 0.6039*** | 0.5715*** | | 0.8206*** | 0.5427*** | |
| | (0.0396) | (0.0583) | | (0.0206) | (0.0507) | |
| Dependent variable mean | | | 0.592 | | | 0.780 |
| $R^2$ | 0.00601 | 0.05644 | 0.14361 | 0.00663 | 0.07135 | 0.11467 |
| Observations | 71,816 | 71,816 | 71,816 | 71,816 | 71,816 | 71,816 |
| Demographic controls | No | Yes | Yes | No | Yes | Yes |
| Country fixed effects | No | No | Yes | No | No | Yes |

*Notes:* Standard errors clustered at the country level. Data from 27 countries included in the cumulated International Social Survey Programme's 2008 and 2018 Religion modules. Dependent variables coded as True if the respondent 'agreed' or 'strongly agreed' with the statement 'practicing religion helps people...'. 'Lives in big city' coded as True if respondent selected 'A big city' out of options that include 'The suburbs or outskirts of a big city', 'A town or a small city' 'A country village', 'A farm or home in the country'. Demographic variables include age, gender, years of education, highest degree marital status, number of children in the household membership in one of 3 harmonized income categories (low, medium, high), employment status, a self-ranking into the 'top' or 'bottom' of society, and a categorical variable indicating which religious group the respondent says they belongs to. See Appendix for a full list of countries and links to specific wording of survey questions.

consistent with the interpretation that network characteristics are more transparent, and monitoring more effective, in small, close-knit communities than in large, anonymous urban settings. Therefore, the screening and monitoring functions of faith-based networks may be more valuable in cities. In general, the demand for faith-based networking can rise when anonymous markets function poorly, contract enforcement is costly, or social and economic instability makes informal insurance more valuable. Consistent with this interpretation, agricultural shocks (Ager and Ciccone, 2016) and financial hardship (Chen, 2010) have been shown to increase involvement in faith-based communities that help insure risk through screened relationships.

In the model, an increase in $\beta$ shifts the FBP's focus toward the networking service and raises its quality. This occurs either through higher quality and a higher price for the religious service with more religious members in the uncongested case, or through lower quality, a lower price and fewer religious members in the congested case. In both situations, the platform charges higher prices for the networking service and increases overall profits. Furthermore, when the networking service has a positive marginal cost $c_B$, the same qualitative effects hold, but the number of networking users is no longer fixed. Instead, it rises with $\beta$, so that (subject to a regularity condition on demand) for any given $c_B$, a stronger demand for networking increases the number of networking users, as shown in Appendix 9.1.2. With this extension, the overall FBP size may increase with $\beta$ independent of congestion.

### 4.4 Changes in the type of connections the FBP fosters

The size of the FPB, its price bundle, the quality of the religious service, and the profits it can make depend on whether the networking service is congested or uncongested. The main factor for this is $\nu$, the number of connections a religious user can make with a network user. In the example where FBPs primarily help members find a spouse $\nu$ is low, so the FBP will be large with a low price for the religious service. Conversely, if the FBP primarily helps foster friendship groups or insurance networks, $\nu$ can be higher, so FBPs will be smaller and charge higher prices. In our model, $\nu$ is exogenously given and can be interpreted as reflecting the demand for the predominant type of connection network users are looking for. This can vary with the available alternative offers from secular networks, economic development, or demographic change.

A defining demographic shift of the twenty-first century is population aging, which alters the balance between young, unmarried individuals and older, predominantly partnered generations. In the ISSP data, 57% of respondents strongly agree that religion helps people make friends, with significantly higher rates among those above age 60 who are not living with a partner (see Table 5), while beliefs about religion as a source of comfort do not vary accordingly. This suggests that the value of faith-based networks as providers of trustworthy friendships may rise with age and with the prevalence of individuals living alone, even without changes in the spiritual value of religion. In our model, an FBP that primarily facilitates friendships corresponds to a higher value of $\nu$, and would consequently be smaller and charge higher prices. Evidence from both the ISSP (columns (3) and (4) of Appendix Table 5) and the US National Congregations Survey aligns with this prediction: congregations with a higher share of members above 60 tend to be smaller, feature higher donations per member, and include fewer individuals in family-formation stages. Thus, declines in FBP size in aging communities should not be necessarily viewed as reduced relevance, but could also imply adaptation toward supporting different forms of social connection.

Alternative (secular) platforms can also change the type of connection demanded at an FBP. One example is partner matching: historically, many couples met through their religious community,[25] but the rise of online dating platforms that allow users to filter by religious affiliation or shared beliefs may have reduced the demand for such matching within FBPs.[26] In the United States, meeting a spouse at church has become increasingly uncommon, with a pronounced decline during the 2000s coinciding with the expansion of online dating (Rosenfeld et al., 2019), whereas in contexts such as Pentecostal churches in Ghana, FBOs remain deeply involved in partner selection (Auriol et al., 2020b).

Economic development also shifts the connections people look for. In agricultural settings, respondents often value religious communities as places to "meet the right people" for informal insurance or information sharing (Ager and Ciccone, 2016; Murphy et al., 2022). In more urban or service-based economies, the relevant contacts may instead be clients, investors, or business partners. Among members of a Pentecostal church in urban Ghana, for example, many (around 45% each) prefer both their coworkers and clients to be from the same church (Auriol et al., 2020b), reflecting how FBPs adapt by facilitating the types of connections that are most valuable in a given environment.[27]

## 5 MegaFBPs

Over the past few decades, some FBOs have grown to extraordinary sizes. Although large congregations have existed throughout history, a distinct phenomenon began to emerge in the 1960s and 1970s: single congregations attracting thousands—and sometimes tens or even hundreds of thousands—of worshipers to one site. Even in faith traditions that historically favored small congregations, individuals who attend religious services today are disproportionately likely to do so in large ones (Chaves, 2006).

[25] In the representative U.S. survey *How Couples Meet and Stay Together* (HCMST), "met at church" is listed as one of the possible meeting venues (Rosenfeld et al., 2024). Before 1950, more than 10% of couples reported meeting their spouse at church.

[26] While FBPs may offer better screening, secular online dating platforms can be competitive by providing access to a larger and less congested pool of potential partners.

[27] This relates to the discussion about the connection between entrepreneurship and religion. While overall there seems to be only a small positive correlation between religious affiliation and entrepreneurship (Lehmann and Weiße, 2025), religious practice – contrary to religious beliefs – can be positively correlated with being an entrepreneur (Klein et al., 2023). In survey data in the US, Dougherty et al. (2013) find that religious attendance is not correlated with entrepreneurship, but entrepreneurs are more likely to attend "a place of worship that encourages business activity". Rather than affecting their entrepreneurial spirit, some (but not all) FBPs might provide their users with the "right people" for their business.

This organizational style was first systematically documented in the United States, where scholars introduced the term *megachurch* to describe Protestant congregations with more than 2,000 regular weekly attendees (Thumma, 2024). Since then, similar developments have appeared across the world and in other religious traditions. Figure 6 shows that the phenomenon is both global and recent: we identify megachurches (defined as congregations with at least 2,000 regular attendees) in at least 72 countries—nearly 60% of Christian-majority countries outside Europe. They are found on every continent and across regions with diverse religious histories. While 20% were founded between 1900 and 1960, roughly 62% were established in the past 40 years. Growth in this organizational form is not confined to Christianity. Bagby (2020) documents a similar trend among U.S. mosques: in 2010, only 2% reported more than 2,000 attendees at Friday Jum'ah prayers, a share that doubled to 4% by 2020.

In many ways, the shift toward very large congregations in urban and suburban areas with rising incomes is puzzling. Globally, while religion remains socially and politically salient, overall rates of attendance at religious services are declining (Seabright, 2024). At the same time, participation patterns in other cultural and social domains appear to be fragmenting rather than concentrating: individuals increasingly seek niche, personalized forms of entertainment (Benner and Waldfogel, 2023; Holtz et al., 2020; Waldfogel, 2017) and leisure (Lizana Maldonado et al., 2021). Moreover, urbanization and economic development are typically associated with secularization (Barro and McCleary, 2003).

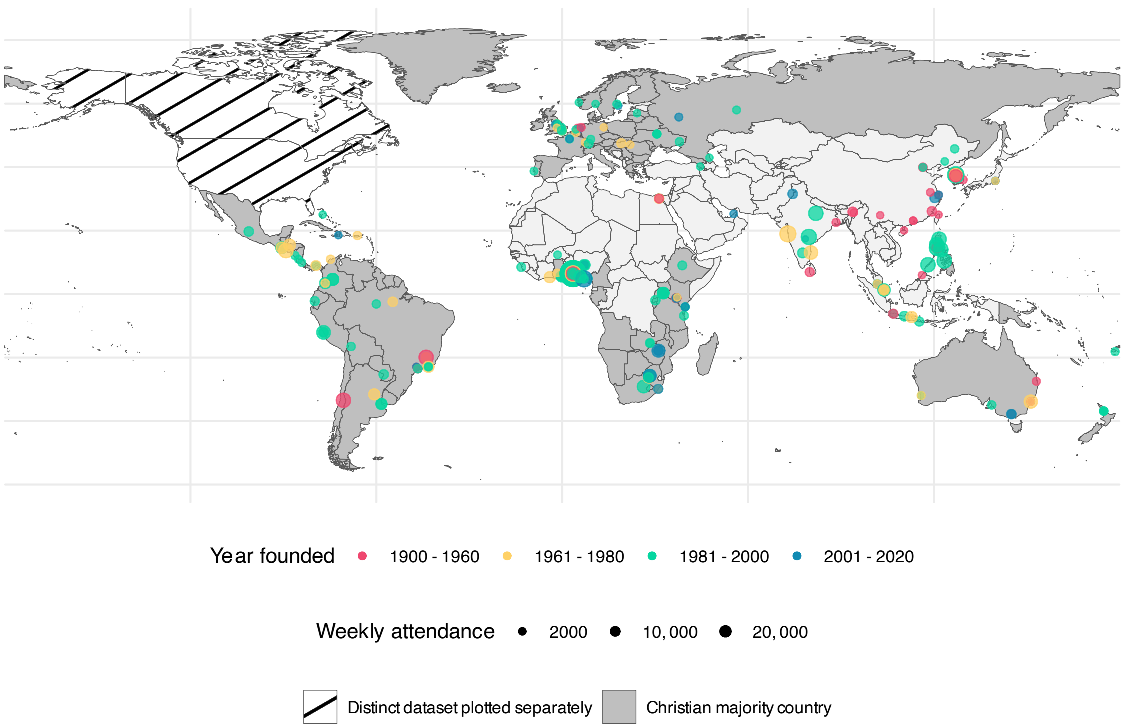
Understanding this phenomenon matters not only for the study of religious organizations but also for broader questions of social and political organization. As more individuals concentrate in a single FBO, the organization becomes a more attractive target for political influence and capture,[28] and their scale enables them to exert substantial cultural and economic influence within their communities.[29] Together, these features imply that the rise of megaFBOs affects not only religious life but also local governance, economic development, and urban landscapes.

Despite considerable denominational and cultural diversity, many share a set of organizational traits that our model can explain and link to size. They offer a rich mix of networking activities

[28]Megachurches frequently engage in electoral and partisan politics, for example by mobilizing voters, endorsing candidates, or fielding pastors for public office; see Adogame et al. (2024).

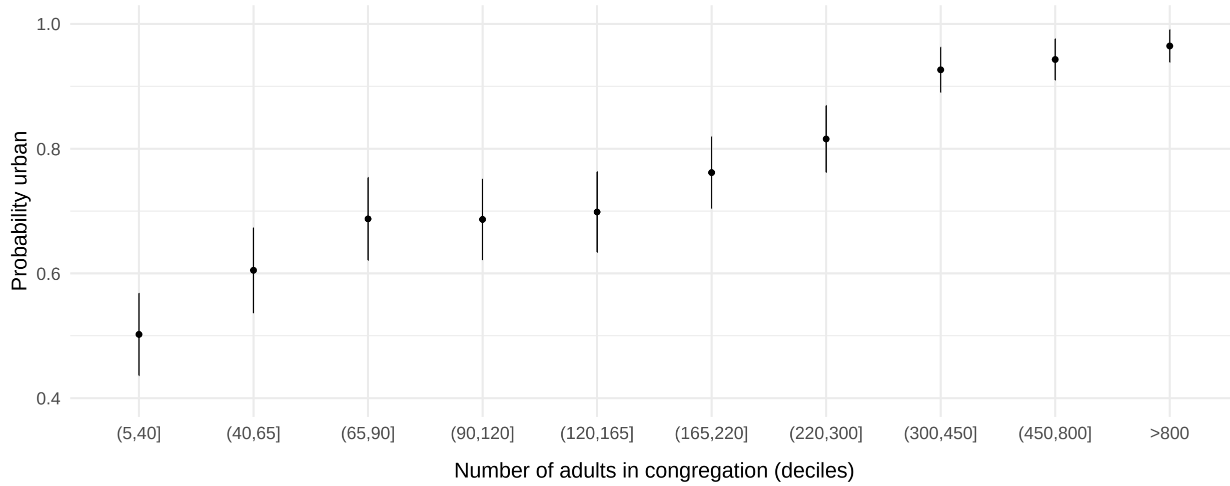
[29]For example, Black megachurches in the United States often invest in local economic development and workforce training, while White megachurches tend to pursue commercial or property development initiatives; see Goh (2024).

Figure 6: Map of Global Megachurches




*Note:* This figure plots the location, size and founding years of megachurches documented in a database maintained by Dr Warren Bird, a leading scholar of church growth and organization. The data can be accessed at `https://exponential.org/world`. While the database is knowingly incomplete, it nonetheless points to the global and recent development of this church style. Data on American and Canadian megachurches is collected and maintained with a different methodology, and we plot these separately. A Christian majority country is defined as one where more than 50% of the population is Christian according to the World Religion Database.

Figure 7: FBO size and probability of being in an urban location




*Notes:* The figure shows point estimates for probability of being in an urban location and 95% confidence intervals plotted for each size decile for 2083 Protestant Christian congregations appearing in the USA National Congregations Survey waves I to IV.

alongside their spiritual message; are typically located in urban or suburban areas; led by highly charismatic, entrepreneurial leaders who make extensive use of new technologies; and, despite their scale, tend to be highly profitable per capita. We examine each of these characteristics in turn.

A defining characteristic of megaFBPs is the unusually rich set of networking activities they provide, extending far beyond traditional religious programming. Thumma and Travis (2007) argue that a distinctive organizational mode of megachurches is their systematic emphasis on "organizing members' interactions", documenting how these churches institutionalize regular social engagement both between services and throughout the week.[30] This emphasis is accompanied by the development of extensive infrastructures for social life. Hunt (2020) offer striking examples of the kinds of facilities and programs commonly found in megachurches:[31] many operate large campus-like complexes offering recreational, educational, counseling, and even commercial services. Such infrastructures transform megachurches into hubs for continuous interaction and for cultivating dense social networks among members.

These features map directly onto the networking service $B$ in our model. MegaFBPs do not

[30] They describe this as the intentional organization of "the interaction and fellowship of participants with each other during social times between services and week to week."

[31] They note that megachurches often include "gymnasiums, schools, divorce centres, aerobics studios, computer centres, shopping arcades, banquet halls (including in one case, a McDonald's restaurant)... Virtually all aspects of life are catered to at megachurches; they are not just Sunday 'religious' experiences."

merely provide religious content; they create structured environments that generate repeated, predictable opportunities for social connection. In settings where individuals seek community, support, or embeddedness, the value of $B$ becomes central to the organization's appeal. The model captures how adding networking activities, attracting both religious and networking members, is key to expanding in scale and increasing profits.

MegaFBOs are overwhelmingly an urban phenomenon. In the United States, almost all (97%) congregations with more than 800 members are located in urban areas, compared to about 60% among congregations with 90 or fewer members (Figure 7). Globally, nearly every megachurch in Figure 6 is situated in an urban or suburban region. Part of this pattern reflects simple population density: larger potential pools of adherents make it easier for a single FBO to assemble thousands of attendees, and urban congregations are not constrained by the travel costs that limit rural ones. Yet, scholars also point to distinct features of urban life that make large FBOs more attractive—from providing community for individuals experiencing social dislocation in rapidly changing cities (Thumma and Bird, 2014) to filling gaps in state service provision (Shanahan, 2019).

Connecting this to the model suggests that $\beta$, the demand for network connections, might be much higher in growing cities. Migrants arriving as young adults often lack established support networks and therefore seek environments that offer guidance, social ties, and security for themselves and their families. This pattern aligns with evidence from Latin America, where Protestant growth accompanied large-scale rural–urban migration (Cleary, 2018) and from Sub-Saharan Africa, where Pentecostal churches serve as welfare and network hubs for new urban migrants (Hersey, 2024; Ibrahim, 2013). It is also consistent with survey evidence from 26 countries (Table 2), which shows higher agreement among urban residents that religion helps make friends, even though intrinsic religiosity ($\alpha$) is not higher in cities. Higher $\beta$ increases the number of networking members when offering a networking service comes with a marginal cost (and, under congestion, religious members as well), making large-scale organizations more viable. Given that urban areas exhibit both higher density and, in many settings, higher $\beta$, it is unsurprising that megaFBPs flourish disproportionately in urban contexts – a tendency amplified in low-income countries with exceptionally high urban densities (UN-Habitat, 2022).

MegaFBOs are typically centered around entrepreneurial, charismatic leaders who innovate in religious form and style. Thumma and Bird (2014) describe how megachurch sermons commonly take the form of practical, biblically based messages tailored to everyday life.[32] These leaders also make extensive use of technology. Hillsong, a leading Australian megachurch brand known for its contemporary worship music, illustrates this pattern: Bauman (2022) argue that its media innovations helped shift sermons from local, embodied performances to video-recorded "sermonic events" that can be reproduced across time and place.[33] This path-breaking use of technology is an example of how charismatic religious entrepreneurs can increase the appeal of large congregations (Thumma and Bird, 2014).

In the model, $\kappa$, the cost of providing religious services, captures leader charisma, the appeal and delivery of the religious narrative, and the use of technology. A defining feature of megaFBPs can therefore be understood as a low $\kappa$, which enables them to offer high-quality religious services to very large numbers of members. As $\kappa$ falls, FBPs optimally raise service quality, increase per-capita profitability, and are able to expand in size while maintaining viable price levels.

Despite uniting large and heterogeneous memberships, many megaFBOs remain highly profitable, even on a per-capita basis. Their emphasis on prosperity, efficiency, and organizational success is often reflected in the outward image they project and the way they structure themselves internally. Yip and Ainsworth (2015) show that megachurches in Singapore adopt corporate and entrepreneurial logics in their leadership style, governance structures, and use of space, effectively "spectacularizing" consumption and managing their organizations much like businesses. Consistent with this, Adogame et al. (2024) note that "whereas megachurches leaders once looked to business executives for inspiration, the latter now periodically also study the former." Empirically, Figure 2 shows that income per member does not systematically decline with size and, for some denominations, even increases as congregations grow.

The model helps explain why FBPs offering networking services are more profitable than standalone FBOs and why megaFBPs, in particular, achieve very high per-capita profitability. Even though lowering the price of the religious service to attract more members might suggest declining contributions with size, both stronger demand for networking ($\beta$) and lower costs of providing religious services ($\kappa$) raise per-capita profits. FBPs that supply networking activities thus outperform similar FBOs that do not, and megaFBPs – with especially high $\beta$ and low $\kappa$ – can be more prof-

[32] For example, they describe sermons in which pastors offer personally revealing illustrations of how biblical teachings have transformed their own weaknesses into "faithful, victorious living."

[33] Bauman (2022) describe this shift as enabling sermons to be "reproduced across limits of time, place and context."

itable per capita than smaller FBPs. Moreover, because the model assumes a profit-maximizing principal, it aligns closely with the organizational reality of these large, entrepreneurially structured FBOs.

# 6 Conclusion

This paper develops a model of FBOs as multi-sided platforms supplying both a religious and a networking service. By allowing for heterogeneity in member motives and an endogenous choice of quality, the framework links pricing, quality, and community size within a single structure. A key insight is that demand for the religious service not only generates revenue but also screens for members with desirable traits, raising the value of the networking service. This complementarity allows FBPs to earn rents even under strong competitive pressure.

The platform framework can explain why, in some contexts, communal gatherings are at the heart of the community, while other FBOs concentrate on providing a space for individual religious rituals. It can account for empirical patterns that are difficult to reconcile with standard club-good models, such as the coexistence of small, low-contribution congregations alongside very large, high-contribution organizations like megachurches. It provides a flexible framework to explore how shocks to demand for religious and networking services affect profits, prices, quality and size.

In practice, many social and economic phenomena affect multiple parameters at once. For example, increases in perceived risk or uncertainty may heighten demand for spiritual guidance and comfort, while simultaneously increasing the value of community-based risk-sharing, thereby strengthening demand for the networking service. Economic development may come with better institutions (which decreases the demand for religious networks), but also with improved technology (which decreases the cost of providing the religious service) and greater urbanization (which increases the demand for religious networks, and - through higher population density - increases the potential pool of members for each FBP). Our model provides a simple structure for thinking separately about these channels and clarifying their potential combined effects.

Future empirical work could build on our model by distinguishing between religious and network-based motivations for membership in FBOs. This would require detailed data on participation across different activities and engagement modes (e.g., prayer or counselling in communal or individual settings) as well as data on relational ties with leaders and other members. Such data would make it possible to isolate the mechanisms we highlight and to test the model's predictions in practice.

Overall, viewing religious organizations as platforms highlights how they are sophisticated intermediaries that adapt and innovate. Their resilience reflects not only doctrinal appeal but organizational strategy. Understanding religion through the lens of platforms, therefore, offers a unified explanation for the economic behavior of FBOs and opens new directions for empirical work at the intersection of religion, organization, and market structure.

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## 8 Appendix A: Strategic interactions with preferences for quality partners: A model of "spatial" competition

We develop a model to illustrate how the composition of its adherents might affect the"quality" of an FBO as a platform for meeting (marriage, business) partners. It is an adaptation of a well known model of spatial competition due to Hotelling and is much used to represents horizontally differentiated products or services. It captures the idea that users/consumers have heterogeneous preferences on the ideal location of the firm on a (real or metaphorical) space.

The standard, simplest model of Hotelling competition has two firms, identified as 0 and 1, located at either end of a unit line. They have products with intrinsic qualities $\theta_0$ and $\theta_1$ (which may differ between firms), and set prices $p_0$ and $p_1$. We ignore marginal costs, normalizing them to zero. Consumers are represented as points located along this line (usually with a uniform density function). The closer they are to one end of the line the more closely their tastes correspond to what the firm has to offer, an effect which is captured by the idea that a consumer located at point $i$ has to pay a "transport cost" equal to $t$ times $i$ in order to consume the product of firm 0, and a cost equal to $t$ times $(1-i)$ to consume the product of firm 1.

If the market is fully covered - that is, if all consumers buy from either firm 0 or firm 1, the marginal consumer is the one for whom the value of the two products, net of prices and transport costs, equals, yielding the equation:

$$\theta_0 - p_0 - t.i = \theta_1 - p_1 - t(1-i) \tag{A8.16}$$

from which we can derive the marginal consumer $i*$ as the one for whom

$$i* = \frac{1}{2} + \frac{(\theta_0 - \theta_1) - (p_0 - p_1)}{2t} \tag{A8.17}$$

To simplify notation we define the variable $\theta = \theta_0 - \theta_1$ as the amount by which the quality of firm 0's product exceeds that of firm 1. Then, if firm 0 sets its price $p_0$ to maximize its profit $\Pi_0 = p_0.i$, and firm 1 does the equivalent, the solution that represents a Nash equilibrium in prices yields:

$$p_0 = t + \frac{\theta}{3} \tag{A8.18}$$

and

$$p_1 = t - \frac{\theta}{3} \tag{A8.19}$$

Simple as it is, this solution shows us some important things:

- The higher the "transport cost" (which represents the extent to which the firm's products are horizontally differentiated), the higher the prices that both firms can set. If transport costs were zero, the firms would make zero profits, because any positive amount of profit could be competed away by a rival setting a price fractionally lower to attract away all the consumers.

- A firm whose quality is higher than that of its rival can set a higher price and make a higher profit. However, if both firms raise the quality of their products by the same amount without changing the difference in quality between them, this has no effect on prices, since all the benefits are passed on to consumers. In this sense, rivalry between firms competes away all the benefits from quality improvement that is industry-wide.

- Competition will constrain the ability of a firm to offer a lower quality product than its rival. We can precisely measure the extent to which a firm can offer a product of lower quality than that of its rival and still stay in business, namely that it must satisfy the inequality $\theta \leq 3t$. The lower the transport cost, the lower the quality differentials that can persist in equilibrium.

We can now adapt the model to take into account some of the features of the platform model of religious competition. The simplest feature (which is also present in some versions of the theory of clubs) is that the quality of the products is a function of the quality of the members who buy them. We can represent this formally by saying that the quality of the product offered by firm 0 is

$$\theta_0 = \phi_0 + q(1 - \frac{i}{2}) \tag{A8.20}$$

It consists of a fixed component $\phi_0$ plus a component that measures the average distance from 0 of the set of consumers who buy the product, multiplied by a parameter $q$ which represents how important it is for each consumer that the other consumers be close to the optimum point for the product. In the context of religious competition we can understand this as meaning that each member of a religious organization (say a church) benefits from the other members' being authentic worshippers who really share the church's mission. We can call this the "authenticity" component of religious service quality. It will evidently be always weakly positive, given that $i$ lies between zero and one. However, it will decline in value as the church attracts members who are further from sharing its core mission.

It can readily be seen that this set-up has the effect of adding to the impact of transport costs on price-setting. In the simple model, firms that wish to attract more distant customers must lower prices to compensate those customers for their greater transport costs. In this version of the model, they must lower prices still further to compensate for the fact that in attracting more distant customers they are also diluting the authenticity of their membership base. Defining the variable $\phi = \phi_0 - \phi_1$, it will therefore not be surprising that the Nash equilibrium solution yields:

$$p_0 = t + \frac{q}{2} + \frac{\phi}{3} \tag{A8.21}$$

and

$$p_1 = t + \frac{q}{2} - \frac{\phi}{3} \tag{A8.22}$$

Compared to the simple model this shows us that:

- Even if the transport cost goes to zero the price (and therefore the profit) does not go to zero. Even if there is no other form of differentiation, the mere fact that members of a church value the authenticity of other members means that prices can be positive, and proportionate to $q$, the cost of inauthenticity.

- Even when members can switch costlessly from one church to another, a firm can offer a service that is lower in absolute quality than its rival and still make a non-negative profit, so long as it satisfies the inequality $\phi \leq \frac{3q}{2}$.

The extent to which the quality of services differs between churches can therefore be informative about the extent to which competition between them is constrained, either by horizontal differentiation or by the extent to which members demand authenticity.

# 9 Appendix B: Proofs and derivations related to the general model and uniform-quadratic case

## 9.1 The general model

### 9.1.1 Proof of Proposition 1

We consider how the FBO sets its prices $p_A$, $p_B$ and the quality $q_A$ of service $A$. It solves:

$$\begin{aligned} \max_{p_A, p_B, q_A} \quad & \Pi = n^*[p_A - C(q_A)] + p_B m^* \\ s.c. \quad & n^* = 1 - F\left(\frac{p_A}{\alpha q_A}\right) \\ & m^* = 1 - G\left(\frac{p_B}{\beta q_B}\right) \end{aligned} \tag{B9.23}$$

where $q_B = q_B^u$ if the system is uncongested and $q_B = q_B^c$ if it is subject to congestion (i.e., if $\nu n^* < m^*$). This yields the following First Order Conditions:

$$\frac{\partial \Pi}{\partial p_B} = m^* + \frac{\partial m^*}{\partial p_B} p_B = 0 \tag{B9.24}$$

$$\frac{\partial \Pi}{\partial p_A} = n^* + \frac{\partial n^*}{\partial p_A}[p_A - C(q_A)] + p_B \frac{\partial m^*}{\partial p_A} = 0 \tag{B9.25}$$

$$\frac{\partial \Pi}{\partial q_A} = -n^* C'(q_A) + \frac{\partial n^*}{\partial q_A}[p_A - C(q_A)] + p_B \frac{\partial m^*}{\partial q_A} = 0 \tag{B9.26}$$

Computing the partial derivative of $m^*$ with respect to $p_B$ yields:

$$\frac{\partial m^*}{\partial p_B} = -g\left(\frac{p_B}{\beta q_B}\right) \frac{1}{\beta q_B} \tag{B9.27}$$

Substituting this value and the value of $m^*$ in (B9.24) yields equation (11).

Now let $\varepsilon_{n^*, p_A} = -\frac{\partial n^*}{\partial p_A} \frac{p_A}{n^*}$ be the price elasticity of the demand for service $A$ for a given quality

$q_A$. Dividing equation (B9.25) by $\frac{\partial n^*}{\partial p_A} p_A$ and isolating on the LHS the Lerner index, $\frac{p_A - C(q_A)}{p_A}$, and the other terms on the RHS, yields equation (9). The RHS is composed of two terms, first the standard ratio of 1 over the price elasticity of demand, and second a distortion equals to $-\frac{p_B}{p_A}\left(\frac{\partial m^*}{\partial p_A} / \frac{\partial n^*}{\partial p_A}\right)$, where

$$\frac{\partial n^*}{\partial p_A} = -f\left(\frac{p_A}{\alpha q_A}\right)\frac{1}{\alpha q_A} < 0, \tag{B9.28}$$

and

$$\frac{\partial m^*}{\partial p_A} = g\left(\frac{p_B}{\beta q_B}\right)\frac{p_B}{\beta q_B^2}\frac{dq_B}{dp_A}. \tag{B9.29}$$

The distortion is positive when $\frac{\partial m^*}{\partial p_A} > 0$ and negative when $\frac{\partial m^*}{\partial p_A} < 0$, which depends on the sign of $\frac{dq_B}{dp_A}$. Everything else being equal, the price of service $A$ is higher if access to member is uncongested (i.e., if $\frac{dq_B}{dp_A} > 0$), and lower if it is congested (i.e., if $\frac{dq_B}{dp_A} < 0$).

Finally equation (B9.26), is the standard result that marginal cost of increasing quality, $n^* C'(q_A)$, should be equal to its marginal benefit, which includes the direct effect on sales of spiritual service $A$, $\frac{\partial n^*}{\partial q_A}[p_A - C(q_A)]$, plus the impact of raising marginally the quality of service $A$, and thus changing the quality of pool of users of religious services, on sales of service $B$, $p_B \frac{dm^*}{dq_A}$. Note that $\frac{\partial n^*}{\partial q_A} = -\frac{p_A}{q_A}\frac{\partial n^*}{\partial p_A}$. Substituting this value in (B9.26), and using the FOC (B9.25), yields:

$$C'(q_A)q_A = p_A + \frac{p_B}{n^*}\left(p_A \frac{\partial m^*}{\partial p_A} + q_A \frac{\partial m^*}{\partial q_A}\right) \tag{B9.30}$$

Computing the partial derivative of $m^*$ with respect to $q_A$ yields:

$$\frac{\partial m^*}{\partial q_A} = g\left(\frac{p_B}{\beta q_B}\right)\frac{p_B}{\beta q_B^2}\frac{dq_B}{dq_A} \tag{B9.31}$$

Substituting the partial derivatives of $m^*$ by their values from (B9.29) and (B9.31) yields:

$$C'(q_A)q_A = p_A + g\left(\frac{p_B}{\beta q_B}\right)\left(\frac{p_B}{\beta q_B}\right)^2 \frac{\beta}{n^*}\left(p_A \frac{dq_B}{dp_A} + q_A \frac{dq_B}{dq_A}\right) \tag{B9.32}$$

The distortion is proportional to $p_A \frac{dq_B}{dp_A} + q_A \frac{dq_B}{dq_A}$. Since $\frac{dq_B^u}{dq_A} = -\frac{p_A}{q_A}\frac{dq_B^u}{dp_A}$, the distortion is therefore $p_A \frac{dq_B^u}{dp_A} + q_A\left(-\frac{p_A}{q_A}\frac{dq_B^u}{dp_A}\right) = 0$ in uncongested cases. Similarly, since $\frac{dq_B^c}{dq_A} = -\frac{p_A}{q_A}\frac{dq_B^c}{dp_A} > 0$, it is also equal to 0 in congested cases. We deduce Proposition 1. QED

### 9.1.2 Positive marginal cost of service B

Here we characterize how the profit maximizing number of users of the networking service responds to $\beta$ when providing service $B$ entails a constant marginal cost $c_B > 0$ per user. Fix $(q_A, q_B)$ and suppose demand for service $B$ is

$$m(p_B;\beta,q_B) = 1 - G(\Phi_B)\,, \qquad \Phi_B \equiv \frac{p_B}{\beta q_B},$$

where $G$ is continuously differentiable with density $g > 0$ on the relevant support. The platform chooses $p_B$ to maximize

$$\Pi_B(p_B) = (p_B - c_B)\, m(p_B;\beta,q_B),$$

and we restrict attention to interior solutions, so that $0 < m^* < 1$.

The first-order condition for an interior optimum is

$$\Phi_B - \frac{1-G(\Phi_B)}{g(\Phi_B)} = \frac{c_B}{\beta q_B}. \tag{B9.33}$$

To see this, note that

$$\frac{\partial m}{\partial p_B} = -g\left(\frac{p_B}{\beta q_B}\right)\cdot\frac{1}{\beta q_B} = -\frac{g(\Phi_B)}{\beta q_B},$$

so that

$$0 = \frac{d\Pi_B}{dp_B} = \Big[1 - G(\Phi_B)\Big] - (p_B - c_B)\frac{g(\Phi_B)}{\beta q_B}.$$

Define the inverse hazard (Mills ratio) of $G$ by

$$H(\Phi) \equiv \frac{1-G(\Phi)}{g(\Phi)},$$

and let

$$F(\Phi) \equiv \Phi - H(\Phi).$$

Assume that $H$ is differentiable and that

$$F'(\Phi) = 1 - H'(\Phi) > 0 \quad \text{for all } \Phi \text{ in the relevant domain.} \tag{B9.34}$$

This condition ensures that (B9.33) pins down a unique optimal $\Phi_B$ and allows the use of the implicit function theorem.[34]

Rewriting (B9.33) as

$$F(\Phi_B^*) = \frac{c_B}{\beta q_B},$$

and differentiating with respect to $\beta$ yields

$$F'(\Phi_B^*) \frac{d\Phi_B^*}{d\beta} = -\frac{c_B}{\beta^2 q_B^2}\Big(q_B + \beta \frac{dq_B}{d\beta}\Big),$$

so that

$$\frac{d\Phi_B^*}{d\beta} = -\frac{c_B}{\beta^2 q_B^2} \frac{q_B + \beta \frac{dq_B}{d\beta}}{F'(\Phi_B^*)}. \tag{B9.35}$$

Since $F'(\Phi_B^*) > 0$, we obtain

$$\frac{d\Phi_B^*}{d\beta} < 0 \quad \Longleftrightarrow \quad q_B + \beta \frac{dq_B}{d\beta} > 0.$$

Finally, since $m^* = 1 - G(\Phi_B^*)$ and $g > 0$,

$$\frac{dm^*}{d\beta} = -g(\Phi_B^*) \frac{d\Phi_B^*}{d\beta},$$

so that

$$\frac{dm^*}{d\beta} > 0 \quad \Longleftrightarrow \quad q_B + \beta \frac{dq_B}{d\beta} > 0.$$

We can note also the special case of uniform demand (which is the subject of Proposition 3. If $\phi \sim U[0,1]$, then $G(\Phi) = \Phi$ and $g(\Phi) = 1$, so $F(\Phi) = 2\Phi - 1$ and $F'(\Phi) \equiv 2 > 0$. Equation (B9.33) implies

$$\Phi_B^* = \frac{1}{2} + \frac{c_B}{2\beta q_B}, \qquad m^* = \frac{1}{2} - \frac{c_B}{2\beta q_B}.$$

[34] For example, (B9.34) holds whenever $H$ is non-increasing, which is implied by many standard regularity conditions on demand (e.g. log-concavity of $1 - G$ or increasing hazard rate).

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### 9.1.3 Proof of Proposition 2

Let $m^* = 1 - G\left(\frac{p_B}{\beta q_B}\right) = \bar{m}$ and $n^* = 1 - F\left(\frac{p_A}{\alpha q_A}\right) = 1 - F\left(\frac{C'(q_A)}{\alpha}\right)$, while $n^0 = 1 - F\left(\frac{p_A^0}{\alpha q_A^0}\right) = 1 - F\left(\frac{C'(q_A^0)}{\alpha}\right)$. The size of the FBP is $n^* + m^*(1-n^*) = m^* + n^*(1-m^*)$. It is equal to the sum of those who buy only service $A$, those who buy only service $B$ and those who buy both. The size of the stand-alone FBO is $n^0$ and include only buyers of service $A$. The size of the FBP is larger than the stand-alone FBO, if and only if $n^* + m^*(1-n^*) = m^* + n^*(1-m^*) > n^0$. We establish sufficient conditions under which this inequality holds. It is for instance true when either $n^* \geq n^0$ or $m^* \geq n^0$:

- $n^* \geq n^0$ is true when the networking service is congested. Indeed in this case $q_A^0 > q_A^c$, which implies $n^* = 1 - F\left(\frac{C'(q_A^c)}{\alpha}\right) > n^0 = 1 - F\left(\frac{C'(q_A^0)}{\alpha}\right)$ since $C(q_A)$ is convex.[35]

- $m^* \geq n^0$ is true whenever $G$ hazard-rate dominates $F$: $h_G(x) = \frac{g(x)}{1-G(x)} \geq \frac{f(x)}{1-F(x)} = h_F(x)$. Indeed $m^* = 1 - G(\Phi^*)$, where $\Phi^*$ is so that

$$\frac{1}{h_G(\Phi)} = \Phi. \tag{B9.36}$$

  By contrast, $n^0 = 1 - F(\Phi^0)$, where $\Phi^0 = \frac{C'(q_A^0)}{\alpha}$ is so that

$$\frac{1}{h_F(\Phi)} = \Phi - \frac{C(q_A^0)}{\alpha q_A^0} \tag{B9.37}$$

  The RHS of equation (B9.36) is larger than the RHS of equation (B9.37) for all $\Phi \geq 0$, while the LHS is smaller for all $\Phi$ whenever $F$ hazard-rate dominates $G$. We deduce that in this case $\Phi^* < \Phi^0$, so that $m^* > n^0$.

The FBP is weakly more profitable than the stand-alone FBO: $\Pi^* > \Pi^0$, and strictly so if $\beta > 0$. The FBP always has the possibility to choose the same price and quality for service $A$ as the stand-alone FBO. If $\beta > 0$, since it can set a price close to, but strictly below 1, and thereby enrol a strictly positive number of users of the networking service to yield an increase in profit. If

[35] By contrast when the networking service is uncongested we have $q_A^0 < q_A^u$ so that $n^* < n^0$.

it chooses a different price it is because its profit is larger with the optimal quality/prices strategy described in Proposition 1, which includes providing the networking service $B$. Thus, the optimal profit of the FBP must satisfy $\Pi^* > \Pi^0$.

## 9.2 The uniform-quadratic case

### 9.2.1 Proof of Proposition 3

*Proof.* Throughout let $\Phi_A \equiv p_A/(\alpha q_A)$ and $\Phi_B \equiv p_B/(\beta q_B)$. Under $\theta, \phi \sim U[0,1]$ we have

$$n = 1 - \Phi_A = 1 - \frac{p_A}{\alpha q_A}, \qquad m = 1 - \Phi_B = 1 - \frac{p_B}{\beta q_B}.$$

**Step 1: Optimal pricing on $B$.** Given $(q_A, q_B)$, the platform's revenue from $B$ is $p_B m = p_B\big(1 - \frac{p_B}{\beta q_B}\big)$. Maximizing over $p_B \in [0, \beta q_B]$ yields

$$p_B^* = \frac{\beta q_B}{2}, \qquad m^* = \frac{1}{2}.$$

**Step 2: Optimal pricing on $A$ given $q_A$.** Given $q_A$, profit from $A$ is

$$\Pi_A(p_A \mid q_A) = n\Big(p_A - \frac{\kappa q_A^2}{2}\Big) = \Big(1 - \frac{p_A}{\alpha q_A}\Big)\Big(p_A - \frac{\kappa q_A^2}{2}\Big).$$

The first-order condition in $p_A$ gives

$$\frac{\partial \Pi_A}{\partial p_A} = \Big(1 - \frac{p_A}{\alpha q_A}\Big) - \frac{1}{\alpha q_A}\Big(p_A - \frac{\kappa q_A^2}{2}\Big) = 0 \quad \Longrightarrow \quad p_A^* = \kappa q_A^2,$$

and hence

$$n^* = 1 - \frac{p_A^*}{\alpha q_A} = 1 - \frac{\kappa}{\alpha} q_A.$$

The maintained restriction $\beta\kappa < 4\alpha^2$ ensures the interiority of the relevant solutions below.

**Step 3: Reduce the problem to a one-dimensional choice of $q_A$.** With $p_A^* = \kappa q_A^2$ and $p_B^* = \beta q_B/2$, total profit is

$$\Pi(q_A) = n^* \cdot \frac{\kappa q_A^2}{2} + \frac{\beta q_B(q_A)}{4}, \qquad n^* = 1 - \frac{\kappa}{\alpha} q_A, \tag{B9.38}$$

where $q_B(\cdot)$ depends on whether service $B$ is congested.

**Step 4: Uncongested $B$.** In the uncongested regime, the match-quality term is

$$q_B^u(q_A) = \frac{1}{2}\Big(1 + \frac{\kappa}{\alpha} q_A\Big),$$

so (B9.38) becomes a strictly concave function of $q_A$ on the admissible domain, and the FOC $\frac{d\Pi}{dq_A} = 0$ yields

$$q_A^{u*} = \frac{\alpha + \sqrt{\alpha^2 + \frac{3}{4}\beta\kappa}}{3\kappa}, \qquad q_B^{u*} = \frac{1}{2}\Big(1 + \frac{\kappa}{\alpha} q_A^{u*}\Big),$$

**Step 5: Congested $B$.** In the congested regime, the match-quality term is

$$q_B^c(q_A) = \nu\Big(1 - \Big(\frac{\kappa}{\alpha} q_A\Big)^2\Big),$$

so (B9.38) is again strictly concave in $q_A$ on the admissible domain and the FOC $\frac{d\Pi}{dq_A} = 0$ yields

$$q_A^{c*} = \frac{4\alpha^2 - \beta\kappa\nu}{6\kappa\alpha}, \qquad q_B^{c*} = \nu\Big(1 - \Big(\frac{\kappa}{\alpha} q_A^{c*}\Big)^2\Big),$$

Finally, the congested regime applies precisely when the congestion constraint holds, which (after substituting $m^* = 1/2$ and $n^* = 1 - \frac{\kappa}{\alpha} q_A^{c*}$) is equivalent to

$$\beta\kappa < \frac{3 - 2\nu}{\nu^2}\alpha^2.$$

This completes the proof. □

### 9.2.2 Proof of Proposition 4

*Proof.* **Size of the platform.** With the uniform distribution, the proportion of religious users joining the platform is $n^* = 1 - \frac{\kappa}{\alpha} q_A$.

In the congested case, $q_A^c = \frac{4\alpha^2 - \beta\kappa\nu}{6\kappa\alpha}$ so that $n^{c*} = 1 - \frac{4\alpha^2 - \beta\kappa\nu}{6\alpha^2} = \frac{2\alpha^2 + \beta\kappa\nu}{6\alpha^2} = \frac{1}{3} + \beta\frac{\kappa\nu}{6\alpha^2}$.

In the uncongested case, $q_A^u = \frac{\alpha + \sqrt{\alpha^2 + \frac{3}{4}\beta\kappa}}{3\kappa}$ so that $n^{u*} = 1 - \frac{\alpha + \sqrt{\alpha^2 + \frac{3}{4}\beta\kappa}}{3\alpha} = \frac{2 - \sqrt{1 + \frac{3\beta\kappa}{4\alpha^2}}}{3}$.

Now, since $p_B = \frac{\beta q_B}{2}$ it implies that $\frac{p_B}{\beta q_B} = \frac{1}{2}$, and independently of whether the service $B$ is congested or not, $m^* = 1 - G\left(\frac{p_B}{\beta q_B}\right) = 1 - \frac{p_B}{\beta q_B} = \frac{1}{2}$.

**Stand-alone per-capita profit** With $\theta \sim U[0,1]$ and $C(q_A) = \kappa q_A^2/2$, the stand-alone FBO chooses $(p_A, q_A)$ to maximize $\Pi^0 = n(p_A - \kappa q_A^2/2)$ with $n = 1 - p_A/(\alpha q_A)$. The standard monopoly FOCs imply $p_A^0 = \kappa(q_A^0)^2$ and $q_A^0 = 2\alpha/(3\kappa)$, hence

$$\pi^0 = p_A^0 - C(q_A^0) = \frac{\kappa(q_A^0)^2}{2} = \frac{2\alpha^2}{9\kappa}.$$

**FBP per-capita profit.** With $c_B = 0$ and $\phi \sim U[0,1]$, monopoly pricing on $B$ yields $p_B = \beta q_B/2$ and therefore $m^* = 1/2$. Total headcount equals $n^* + m^*(1-n^*) = (1+n^*)/2$. Total profit is

$$\Pi^* = n^* \frac{\kappa(q_A^*)^2}{2} + m^* \frac{\beta q_B^*}{2},$$

so per-capita profit is

$$\pi^* = \frac{2\Pi^*}{1+n^*} = \kappa \frac{n^*}{1+n^*}(q_A^*)^2 + \frac{\beta}{2(1+n^*)} q_B^*.$$

**(i) Uncongested regime.** Let $X_u \equiv \sqrt{1 + \frac{3\beta\kappa}{4\alpha^2}}$. In the uncongested case the equilibrium values are

$$n^{u*} = \frac{2 - X_u}{3}, \qquad q_A^{u*} = \frac{\alpha}{3\kappa}(1 + X_u), \qquad q_B^{u*} = \frac{1 + q_A^{u*}}{2}.$$

Substituting into the expression for $\pi^*$ yields $\pi^{u*}$ as an explicit function of $X_u$. The inequality $\pi^{u*} > \pi^0$ is equivalent (after simplification) to

$$\left(5 + \frac{9\beta}{4\alpha}\right) X_u - X_u^3 + \frac{27\beta\kappa}{4\alpha^2} + \frac{9\beta}{4\alpha} - 8 > 0.$$

Under the maintained restriction $\beta\kappa < 4\alpha^2$ we have $X_u < 2$, which implies $\left(5 + \frac{9\beta}{4\alpha}\right) X_u - X_u^3 > 0$. Hence a sufficient condition for $\pi^{u*} > \pi^0$ is

$$\frac{27\beta\kappa}{4\alpha^2} + \frac{9\beta}{4\alpha} - 8 > 0.$$

In particular, since $\beta/(4\alpha) > 0$, the simpler sufficient condition

$$\frac{8}{27} \le \frac{\beta\kappa}{4\alpha^2} < 1$$

implies $\pi^{u*} > \pi^0$.

**(ii) Congested regime.** Let $X_c \equiv \frac{\beta\kappa\nu}{\alpha^2}$. In the congested case the equilibrium values are

$$q_A^{c*} = \frac{4\alpha^2 - \beta\kappa\nu}{6\kappa\alpha}, \qquad n^{c*} = 1 - \frac{\kappa}{\alpha} q_A^{c*} = \frac{1}{3} + \frac{\beta\kappa\nu}{6\alpha^2}, \qquad q_B^{c*} = \nu\Big(1 - \big(\tfrac{\kappa}{\alpha} q_A^{c*}\big)^2\Big).$$

Substituting these expressions into $\pi^*$ and rearranging shows that a sufficient condition for $\pi^{c*} \geq \pi^0$ is

$$1 + X_c \;\geq\; \frac{3}{1 + X_c/2},$$

which is equivalent to

$$X_c^2 + 3X_c - 4 \geq 0.$$

Since $X_c \geq 0$, this holds whenever $X_c \geq 1$. Finally, the congested regime condition $\nu n^{c*} < m^* = 1/2$ is equivalent to $\frac{\beta\kappa}{\alpha^2} \leq \frac{3-2\nu}{\nu^2}$, and interiority requires $\frac{\beta\kappa}{\alpha^2} < 4$. Combining these with $X_c \geq 1$ yields

$$\frac{1}{\nu} \leq \frac{\beta\kappa}{\alpha^2} \leq \min\left\{4, \frac{3-2\nu}{\nu^2}\right\},$$

which in particular requires $1/4 < \nu < 1$. Under these conditions, $\pi^{c*} > \pi^0$. □

## 9.3 Proof of Proposition 5

Write the objective function as

$$V = \gamma\Big(n^*[p_A - C(q_A)] + m^* p_B\Big) + (1-\gamma)n^*,$$

so that

$$V = n^*\big[(1-\gamma) + \gamma p_A - \gamma C(q_A)\big] + \gamma p_B m^*.$$

**FOC in $p_A$.** Differentiating $V$ with respect to $p_A$ gives

$$0 = \frac{\partial V}{\partial p_A} = \gamma n^* + \frac{\partial n^*}{\partial p_A}\big[1 - \gamma + \gamma p_A - \gamma C(q_A)\big] + \frac{\partial m^*}{\partial p_A}\big[\gamma p_B\big].$$

Divide by $p_A(\partial n^*/\partial p_A)$ and use $\varepsilon_{n^*,p_A} = -\left(\partial n^*/\partial p_A\right)(p_A/n^*)$ to obtain (13).

**FOC in $q_A$.** Differentiating $V$ with respect to $q_A$ yields

$$0 = \frac{\partial V}{\partial q_A} = -\gamma n^* C'(q_A) + \frac{\partial n^*}{\partial q_A}\big[1-\gamma+\gamma p_A - \gamma C(q_A)\big] + \frac{\partial m^*}{\partial q_A}\big[\gamma p_B\big].$$

Since $n^* = 1 - F(p_A/(\alpha q_A))$, we have $\frac{\partial n^*}{\partial q_A} = -(p_A/q_A)\frac{\partial n^*}{\partial p_A}$. Moreover, $m^* = 1 - G(p_B/(\beta q_B))$ implies $\frac{\partial m^*}{\partial q_A} = -(p_A/q_A)\frac{\partial m^*}{\partial p_A}$ because $q_B$ depends on $(p_A, q_A)$ only through the ratio $p_A/q_A$. Substituting these identities into the $q_A$–FOC and using the $p_A$–FOC to eliminate the bracketed terms, all terms involving $\partial n^*$ and $\partial m^*$ cancel, leaving $C'(q_A)q_A = p_A$, which is (14).

**FOC in $p_B$.** Since $n^*$ does not depend on $p_B$,

$$\frac{\partial V}{\partial p_B} = \gamma m^* + \frac{\partial m^*}{\partial p_B}\gamma p_B = 0.$$

Using $\frac{\partial m^*}{\partial p_B} = -g\Big(\frac{p_B}{\beta q_B}\Big)\frac{1}{\beta q_B}$ and $m^* = 1 - G(\frac{p_B}{\beta q_B})$, rearranging yields (15). QED

## 9.4 Illustrating the profit functions

To illustrate how profit varies with the price of service $A$ and its quality in the congested and uncongested case, we first draw the profit function for service $A$ and service $B$ separately and then add them to get the total profit. We do this first as a function of $q_A$, keeping in mind the strictly increasing relationship between price and quality $p_A = \kappa q_A^2$.

We have $\pi_A(q_A) = n^*\Big(p_A - C(q_A)\Big)$, which yields

$$\pi_A(q_A) = \left(1 - \frac{\kappa}{\alpha}q_A\right)\frac{\kappa}{2}q_A^2 \tag{B9.39}$$

which is a nice bell-shaped function. For $\pi_A(p_A)$, we substitute $p_A = \left(\frac{q_A}{\kappa}\right)^{\frac{1}{2}}$.

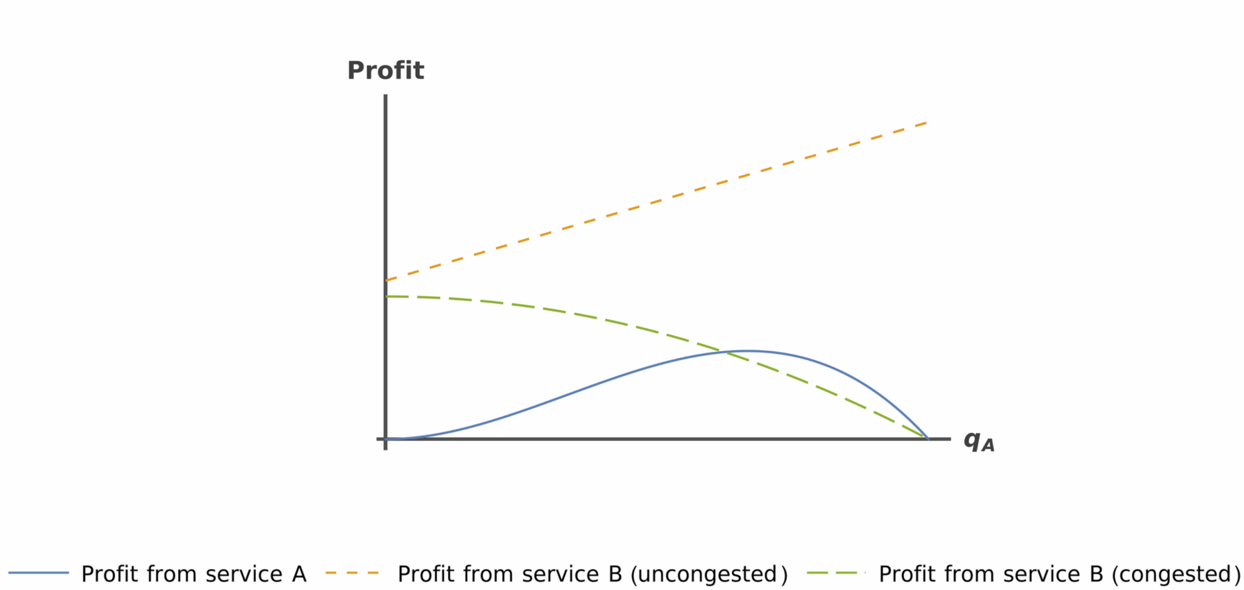
For profit on service $B$, $\pi_B = m^* p_B = \frac{1}{2}\frac{\beta q_B}{2}$, it depends on whether the service is congested or not. For the uncongested case, substituting $q_b^u$ by its value from proposition 2, yields:

$$\pi_B^u(q_A) = \frac{\beta}{8}\left(1 + \frac{\kappa}{\alpha}q_A\right) \tag{B9.40}$$

For the congested case it yields:

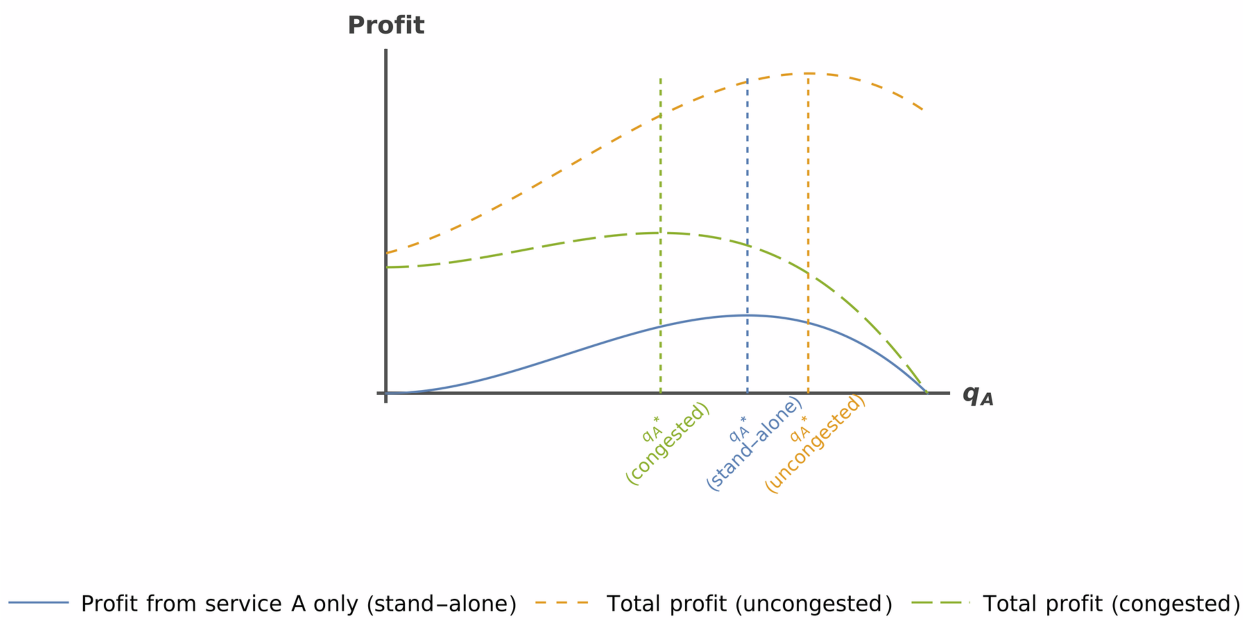
$$\pi_B^c(q_A) = \frac{\beta}{4}\nu\left(1 - \left(\frac{\kappa}{\alpha}q_A\right)^2\right) \tag{B9.41}$$

Figure 8: Profits from service $A$ and service $B$ users as a function of $q_A$




Note: Numerical example using the uniform type distributions and quadratic costs as in section 3.4. The functional forms can be found in Appendix Section 9.4.

Figure 9: Total profits from service $A$ and service $B$, and from service $A$ only as a function of $q_A$




Note: Numerical example using the uniform type distributions and quadratic costs as in section 3.4. The functional forms can be found in Appendix Section 9.4.

## 9.5 Alternatives to profit maximization

### 9.5.1 Extension to leaders who care about total audience size

FBO leaders may value reaching a large audience, increasing their ideological influence, or retaining members to strengthen long-term cohesion. To capture such motives, we can extend the model by assuming that platforms maximize $V$, a weighted sum of profits and total membership. Specifically, $\gamma < 1$ denotes the weight placed on profits and $1-\gamma$ the weight placed on membership. The FBP objective function becomes: $V = \gamma\Pi + (1-\gamma)\big[n^* + m^*(1-n^*)\big]$.

The counterpart to Proposition 1 is now:

**Proposition 6.** *Let the platform maximize*

$$V \;=\; \gamma\Pi \;+\; (1-\gamma)\Big[n^* + m^*(1-n^*)\Big], \qquad \gamma \in (0,1),$$

*where profits are* $\Pi = n^*[p_A - C(q_A)] + m^* p_B$*, and demands are*

$$n^* = 1 - F\left(\frac{p_A}{\alpha q_A}\right), \qquad m^* = 1 - G\left(\frac{p_B}{\beta q_B}\right).$$

*Assume* $F$ *and* $G$ *are differentiable with densities* $f, g > 0$ *on the relevant domain and consider an interior solution (which requires* $\gamma$ *sufficiently close to* 1*). Then the platform's optimal choices* $(p_A^\gamma, p_B^\gamma, q_A^\gamma)$ *satisfy:*

$$\frac{p_A - C(q_A)}{p_A} = \frac{1}{\varepsilon_{n^*,p_A}} - \frac{p_B}{p_A}\frac{\partial m^*/\partial p_A}{\partial n^*/\partial p_A} - \frac{1-\gamma}{\gamma p_A}\left[1 - m^* + (1-n^*)\frac{\partial m^*/\partial p_A}{\partial n^*/\partial p_A}\right], \tag{B9.42}$$

$$C'(q_A) q_A = p_A, \tag{B9.43}$$

$$\frac{p_B}{\beta q_B} = \frac{1 - G\left(\frac{p_B}{\beta q_B}\right)}{g\left(\frac{p_B}{\beta q_B}\right)} - \frac{1-\gamma}{\gamma}\frac{1-n^*}{\beta q_B}, \tag{B9.44}$$

*where* $\varepsilon_{n^*,p_A} \equiv -\left(\partial n^*/\partial p_A\right)\left(p_A/n^*\right)$ *is the price elasticity of demand for service A.*

*Proof.* Write the objective function as

$$V = \gamma\Big(n^*[p_A - C(q_A)] + m^* p_B\Big) + (1-\gamma)\big(n^* + m^* - n^* m^*\big),$$

so that

$$V = n^*\big[(1-\gamma) + \gamma p_A - \gamma C(q_A)\big] + m^*\big[(1-\gamma) + \gamma p_B\big] - (1-\gamma) n^* m^*.$$

**FOC in $p_B$.** Since $n^*$ does not depend on $p_B$,

$$\frac{\partial V}{\partial p_B} = \gamma m^* + \frac{\partial m^*}{\partial p_B}\big[(1-\gamma)(1-n^*) + \gamma p_B\big] = 0.$$

Using $\frac{\partial m^*}{\partial p_B} = -g\left(\frac{p_B}{\beta q_B}\right)\frac{1}{\beta q_B}$ and $m^* = 1 - G(\frac{p_B}{\beta q_B})$, rearranging yields (B9.44).

**FOC in $p_A$.** Differentiating $V$ with respect to $p_A$ gives

$$0 = \frac{\partial V}{\partial p_A} = \gamma n^* + \frac{\partial n^*}{\partial p_A}\big[(1-\gamma)(1-m^*) + \gamma p_A - \gamma C(q_A)\big] + \frac{\partial m^*}{\partial p_A}\big[(1-\gamma)(1-n^*) + \gamma p_B\big].$$

Divide by $p_A(\partial n^*/\partial p_A)$ and use $\varepsilon_{n^*,p_A} = -\left(\partial n^*/\partial p_A\right)\left(p_A/n^*\right)$ to obtain (B9.42).

**FOC in $q_A$.** Differentiating $V$ with respect to $q_A$ yields

$$0 = \frac{\partial V}{\partial q_A} = -\gamma n^* C'(q_A) + \frac{\partial n^*}{\partial q_A}\big[(1-\gamma)(1-m^*) + \gamma p_A - \gamma C(q_A)\big] + \frac{\partial m^*}{\partial q_A}\big[(1-\gamma)(1-n^*) + \gamma p_B\big].$$

Since $n^* = 1 - F(p_A/(\alpha q_A))$, we have $\frac{\partial n^*}{\partial q_A} = -(p_A/q_A)\frac{\partial n^*}{\partial p_A}$. Moreover, $m^* = 1 - G(p_B/(\beta q_B))$ implies $\frac{\partial m^*}{\partial q_A} = -(p_A/q_A)\frac{\partial m^*}{\partial p_A}$ because $q_B$ depends on $(p_A, q_A)$ only through the ratio $p_A/q_A$. Substituting these identities into the $q_A$–FOC and using the $p_A$–FOC to eliminate the bracketed terms, all terms involving $\partial n^*$ and $\partial m^*$ cancel, leaving $C'(q_A)q_A = p_A$, which is (B9.43). $\square$

The condition $\frac{1-\gamma}{\gamma} \leq \frac{1-G(0)}{g(0)}$ ensures that equation (B9.44) admits an interior solution. It requires that $\gamma$ is not too small $\left(\text{i.e., } \gamma \geq \frac{g(0)}{1-G(0)+g(0)}\right)$. If the weight put on profit is smaller than this, then we no longer have an interior solution and the FBP chooses a price for service $B$ equal to 0.

Comparing this with equation 9 shows that when $\gamma < 1$, leaders are willing to charge prices closer to cost than in the baseline profit-maximizing case. The reduction in the markup is larger the more sensitive $m^*$ (the number of service $B$ users) is to changes in $n^*$ (the number of service $A$ users). In other words, when leaders care about reach and influence as well as profits, they deliberately set lower prices for the religious service in order to expand $n^*$ and, indirectly, $m^*$. Pricing of network services, however, will be unaffected.

# 10 Appendix C: Derivations of comparative statics

It is useful to begin with a reminder of Proposition 3, which gives the solution to the uniform quadratic case:

- $p_B = \frac{\beta q_B}{2}$ and $p_A = \kappa q_A^2$.
- $q_A$ depends on the state of congestion as follows:

$$\begin{cases} q_A^c = \frac{4\alpha^2 - \beta\kappa\nu}{6\kappa\alpha} \text{ so that } \; q_B^c = \nu\left(1 - \left(\frac{\kappa}{\alpha}q_A^c\right)^2\right) & \text{if } \beta\kappa < \frac{3-2\nu}{\nu^2}\alpha^2 \\ q_A^u = \frac{\alpha + \sqrt{\alpha^2 + \frac{3}{4}\beta\kappa}}{3\kappa} \text{ so that } \; q_B^u = \frac{1}{2}\left(1 + \frac{\kappa}{\alpha}q_A^u\right) & \text{otherwise} \end{cases}$$

- $m^* = \frac{1}{2}$ and $n^* = 1 - \frac{\kappa}{\alpha} q_A$ such that

$$\begin{cases} n^{c*} = \frac{1}{3} + \beta \frac{\kappa\nu}{6\alpha^2} \in [\frac{1}{3}, 1] & \text{if } \beta\kappa < \frac{3-2\nu}{\nu^2}\alpha^2 \\ n^{u*} = \frac{2-\sqrt{1+\frac{3\beta\kappa}{4\alpha^2}}}{3} \in [0, \frac{1}{3}] & \text{otherwise} \end{cases}$$

## 10.1 Effect of innovations in providing the religious good

*Quality of the religious service, $q_A$.*

$q_A^c$ : $\frac{dq_A^c}{d\kappa} = -\frac{2\alpha}{3\kappa^2} < 0$

$q_A^u$ : $\frac{dq_A^u}{d\kappa} = \frac{1}{9\kappa^2}\left(\frac{9\kappa\beta}{8\sqrt{\alpha^2+\frac{3}{4}\beta\kappa}} - 3\alpha - 3\sqrt{\alpha^2+\frac{3}{4}\beta\kappa}\right)$ which is $< 0$ if $\beta\kappa < 4\alpha^2$.

Both $\frac{dq_A^c}{d\kappa}$ and $\frac{dq_A^u}{d\kappa} < 0$. After a fall in $\kappa$, it is optimal to increase the quality of the religious service.

*Price of the religious service, $p_A$.*

The price of service $A$ is $p_A = \kappa q_A^2$ so that $\frac{dp_A}{d\kappa} = q_A\left(q_A + 2\kappa\frac{dq_A}{d\kappa}\right)$.

$p_A^c$ : Substituting $\frac{dq_A^c}{d\kappa}$ in $\frac{dp_A}{d\kappa}$ yields: $\frac{dp_A^c}{d\kappa} = -q_A^c\left(\frac{\beta\nu}{6\alpha} + \frac{2\alpha}{3\kappa}\right) < 0$.

$p_A^u$ : $\frac{dp_A^u}{d\kappa} = q_A^u\left(q_A^u + \frac{2}{9\kappa}\left(\frac{9\kappa\beta}{8\sqrt{\alpha^2+\frac{3}{4}\beta\kappa}} - 3\alpha - 3\sqrt{\alpha^2+\frac{3}{4}\beta\kappa}\right)\right)$ which is of indeterminate sign.

*Quality of the network service.*

$q_B^c$ : $\frac{dq_B^c}{d\kappa} = -\nu \cdot \frac{2\kappa}{\alpha^2} \cdot q_A^c\left(q_A^c - \frac{2\alpha}{3\kappa}\right) < 0$ if $\beta\kappa < 4\alpha^2$

$q_B^u$ : Since $q_B^u = \frac{4+\sqrt{1+\frac{3\beta\kappa}{4\alpha^2}}}{6}$, $\frac{dq_B^u}{d\kappa} > 0$..

*Price of the network service.*

Since $p_B = \frac{\beta q_B}{2}$, the sign of the price derivative is the same as the sign of the quality derivative.

$p_B^c$ : $\frac{dp_B^c}{d\kappa} < 0$

$p_B^u$ : $\frac{dp_B^u}{d\kappa} > 0$

*Size of the FBO*

By Corollary **??**, $n^* = 1 - \frac{\kappa}{\alpha} q_A$. Substituting in the values in the congested and uncongested cases yields:

$n^{c*}: \frac{dn^{c*}}{d\kappa} = \frac{\beta\nu}{6\alpha^2} > 0$

$n^{u*}: \frac{dn^{u*}}{d\kappa} = -\frac{1}{\alpha} q_A^u - \frac{1}{9\kappa\alpha}\left(\frac{9\kappa\beta}{8\sqrt{\alpha^2+\frac{3}{4}\beta\kappa}} - 3\alpha - 3\sqrt{\alpha^2 + \frac{3}{4}\beta\kappa}\right)$, which is of indeterminate sign.

## 10.2 Effect of an increase in religiosity

*Quality of the religious service, $q_A$.*

$q_A^c: \frac{dq_A^c}{d\alpha} = \frac{4\alpha^2+\beta\nu\kappa}{6\kappa\alpha^2} > 0$

$q_A^u: \frac{dq_A^u}{d\alpha} = \frac{1+\alpha\left(\alpha^2+\frac{3}{4}\beta\kappa\right)^{0.5}}{3\kappa} > 0$

*Price of the religious service, $p_A$.*

$p_A^c: \frac{dp_A^c}{d\alpha} = 2\kappa q_A^c \frac{dq_A^c}{d\alpha} > 0.$

$p_A^u: \frac{dp_A^u}{d\alpha} = 2\kappa q_A^u \frac{dq_A^u}{d\alpha} > 0.$

*Quality of the network service, $q_B$*

$q_B^c: \frac{dq_B^c}{d\alpha} = -\frac{2\beta\kappa^2\nu^2}{3\alpha^4} q_A^c < 0$

$q_B^u:$ Since $q_B^u = \frac{4+\sqrt{1+\frac{3\beta\kappa}{4\alpha^2}}}{6}$, $\frac{dq_B^u}{d\alpha} < 0..$

*Price of the network service, $p_B$*

$p_B^c: \frac{dp_B^c}{d\alpha} = \frac{\beta}{2}\frac{dq_B^c}{d\alpha} < 0$

$p_B^u: \frac{dp_B^u}{d\alpha} = \frac{\beta}{2}\frac{dq_B^u}{d\alpha} < 0$

*Size of the FBO, $n*$*

$n^{c*}: n^{c*} = 1 - \frac{\kappa}{\alpha} q_A^c$ so $\frac{dn^{c*}}{d\alpha} = -\frac{\beta\kappa\nu}{3\alpha^3} < 0$

$n^{u*}: \frac{dn^{u*}}{d\alpha} = \frac{\beta\kappa}{4\alpha^2\sqrt{\alpha^2+\frac{3}{4}\beta\kappa}} > 0$

### 10.3 Effect of an increase in the value of a religious network

*Quality of the religious service, $q_A$.*

$q_A^c : \frac{dq_A^c}{d\beta} = -\frac{\nu}{6\alpha} < 0$

$q_A^u : \frac{dq_A^u}{d\beta} = \frac{1}{8\sqrt{\alpha^2+\frac{3}{4}\beta\kappa}} > 0$

*Price of the religious service, $p_A$.*

$p_A^c : \frac{dp_A^c}{d\beta} = 2\kappa q_A^c \frac{dq_A^c}{d\beta} < 0.$

$p_A^u : \frac{dp_A^u}{d\beta} = 2\kappa q_A^u \frac{dq_A^u}{d\beta} > 0.$

*Quality of the network service, $q_B$*

$q_B^c : \frac{dq_B^c}{d\beta} = \frac{\kappa^2\nu^2}{3\alpha^3} q_A^c > 0$

$q_B^u :$ Since $q_B^u = \frac{4+\sqrt{1+\frac{3\beta\kappa}{4\alpha^2}}}{6}$, $\frac{dq_B^u}{d\beta} > 0.$

*Price of the network service, $p_B$*

$p_B^c : \frac{dp_B^c}{d\beta} = \frac{1}{2}\left(q_B^c + \beta \cdot \frac{dq_B^c}{d\beta}\right) > 0$

$p_B^u : \frac{dp_B^u}{d\beta} = \frac{1}{2}\left(q_B^u + \beta \cdot \frac{dq_B^u}{d\beta}\right) > 0$

*Size of the FBO, $n^*$*

$n^{c*} : \frac{dn^{c*}}{d\beta} = -\frac{\kappa}{\alpha}\frac{dq_A^c}{d\beta} = \frac{\kappa\nu}{6\alpha^2} > 0.$

$n^{u*} : \frac{dn^{u*}}{d\beta} = -\frac{\kappa}{\alpha}\frac{dq_A^u}{d\beta} < 0.$

Table 3: How do shocks to technology, religiosity or networking affect FBOs?

| | Congested | | | | | Uncongested | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $q_A$ | $p_A$ | $q_B$ | $p_B$ | $n^*$ | $q_A$ | $p_A$ | $q_B$ | $p_B$ | $n^*$ |
| The cost $\kappa$ of religious service quality falls | $\uparrow$ | $\uparrow$ | $\uparrow$ | $\uparrow$ | $\downarrow$ | $\uparrow$ | ? | $\downarrow$ | $\downarrow$ | ? |
| Religiosity $\alpha$ goes up | $\uparrow$ | $\uparrow$ | $\downarrow$ | $\downarrow$ | $\downarrow$ | $\uparrow$ | $\uparrow$ | $\downarrow$ | $\downarrow$ | $\uparrow$ |
| Demand $\beta$ for networking goes up | $\downarrow$ | $\downarrow$ | $\uparrow$ | $\uparrow$ | $\uparrow$ | $\uparrow$ | $\uparrow$ | $\uparrow$ | $\uparrow$ | $\downarrow$ |

*Note*: Summary of comparative statics with respect to stated changes in $\kappa$, $\alpha$ and $\beta$. We consider effects on the quality and price of the religious service, $q_A$ and $p_A$; quality and price of the networking service, $q_B$ and $p_B$; and number of members demanding religious services $n^*$. Derivations are shown in Appendix 10.

# 11 Appendix D: Further data descriptions

## 11.1 The International Social Survey Programme

The International Social Survey Programme (ISSP Research Group, 2025) is a cross-national collaboration between universities, survey agencies and other academic institutions across almost 50 countries. Members of the programme agree on a shared set of principles and questionnaires then individually conduct annual surveys on topics related to the social sciences. Each year, ISSP surveys focus on a specific module. These may be implemented as standalone modules or conducted as part of a general social survey. Religion was the focus in 1991, 1998, 2008 and 2018. We analyse data from the 2008 and 2018 waves, restriction our analysis to countries with data that appear in both waves. Sampling in most countries is based on a simple or a stratified probability sample of individuals aged 18 and older. Table 4 summarizes some of the key variables used in our analysis.

## 11.2 The National Congregations Dataset

The National Congregations Study is a repeated cross-section of a nationally representative sample of religious congregations in the USA. It has been conducted in four waves in 1998, 2006, 2012 and 2018. A subset of the 2006 and 2018 samples are deliberate re-samplings of congregations that appeared in 1998 and 2012 respectively. We do not exploit this panel dimension. We restrict our analysis to protestant Christian groups that belong to a denominational tradition, using their self-reported categorizations.

Table 4: Country and summary statistics of the International Social Survey Program data

| | Country | N | Modal religion | Lives in big city | Agree religion helps make friends | find comfort |
|---|---|---|---|---|---|---|
| 1 | South Africa | 5654 | Protestant | 0.65 | 0.77 | 0.84 |
| 2 | Israel | 2162 | Jewish | 0.52 | 0.44 | 0.80 |
| 3 | Chile | 2628 | Roman Catholic | 0.52 | 0.71 | 0.81 |
| 4 | United States | 2460 | Protestant | 0.44 | 0.79 | 0.94 |
| 5 | Turkey | 2691 | Islam | 0.41 | 0.40 | 0.79 |
| 6 | Hungary | 1903 | Roman Catholic | 0.37 | 0.41 | 0.56 |
| 7 | Philippines | 2358 | Roman Catholic | 0.34 | 0.86 | 0.83 |
| 8 | Czechia | 2656 | No religion | 0.29 | 0.47 | 0.68 |
| 9 | South Korea | 2396 | No religion | 0.28 | 0.64 | 0.83 |
| 10 | Austria | 2077 | Roman Catholic | 0.27 | 0.43 | 0.70 |
| 11 | Norway | 2036 | Protestant | 0.27 | 0.55 | 0.82 |
| 12 | Kenya | 2103 | Protestant | 0.27 | 0.88 | 0.95 |
| 13 | Taiwan | 3701 | Other Eastern/Asian | 0.26 | 0.75 | 0.86 |
| 14 | Denmark | 3281 | Protestant | 0.26 | 0.49 | 0.82 |
| 15 | Sweden | 2706 | Protestant | 0.25 | 0.53 | 0.77 |
| 16 | New Zealand | 2037 | No religion | 0.24 | 0.74 | 0.85 |
| 17 | Spain | 3885 | Roman Catholic | 0.21 | 0.53 | 0.76 |
| 18 | Germany | 3162 | No religion | 0.20 | 0.46 | 0.78 |
| 19 | Italy | 2175 | Roman Catholic | 0.19 | 0.57 | 0.79 |
| 20 | France | 2806 | Roman Catholic | 0.17 | 0.34 | 0.76 |
| 21 | Slovenia | 1988 | Roman Catholic | 0.17 | 0.61 | 0.84 |
| 22 | Switzerland | 3205 | Roman Catholic | 0.14 | 0.65 | 0.88 |
| 23 | Finland | 2164 | Protestant | 0.12 | 0.47 | 0.78 |
| 24 | United Kingdom | 1981 | No religion | 0.11 | 0.66 | 0.81 |
| 25 | Slovakia | 2317 | Roman Catholic | 0.11 | 0.48 | 0.70 |
| 26 | Indonesia | 2969 | Islam | 0.11 | 0.90 | 0.96 |
| 27 | Japan | 2315 | No religion | 0.10 | 0.17 | 0.42 |

*Notes:* Summary statistics of International Social Survey Program data used to estimate regressions presented in Table x. Rows ordered according to proportion of country sample that lives in a big city. 'Lives in big city' coded as True if respondent selected 'A big city' out of options that include 'The suburbs or outskirts of a big city', 'A town or a small city' 'A country village', 'A farm or home in the country'. 'Agrees religion helps...' variables coded as True if the respondent 'agreed' or 'strongly agreed' with the statement 'practicing religion helps people... .

Table 5: Correlations between age, organizational structure and religious attitudes

| | Probability individual agrees that religion helps | | Percent of congregation | |
|---|---|---|---|---|
| | 'make friends' | 'find comfort' | $\geq$ 60 years | $\leq$ 35 years |
| | (1) | (2) | (3) | (4) |
| Older than 60 $\times$ in a partnership | -0.0340*** | -0.0123 | | |
| | (0.0097) | (0.0089) | | |
| Older than 60 | 0.0242** | 0.0033 | | |
| | (0.0109) | (0.0108) | | |
| Younger than 35 $\times$ in a partnership | 0.0022 | 0.0076 | | |
| | (0.0087) | (0.0069) | | |
| Younger than 35 | -0.0067 | -0.0112* | | |
| | (0.0079) | (0.0055) | | |
| In a partnership | 0.0107 | 0.0073 | | |
| | (0.0064) | (0.0054) | | |
| Congregation number of adult members | | | -0.0040*** | 0.0021*** |
| | | | (0.0005) | (0.0004) |
| Congregation income per member | | | 0.000417** | -0.000651*** |
| | | | (0.0002) | (0.0002) |
| Constant | | | 41.56*** | 21.93*** |
| | | | (1.301) | (1.030) |
| $R^2$ | 0.14331 | 0.11452 | 0.25819 | 0.18557 |
| Observations | 71,816 | 71,816 | 2,641 | 2,636 |

*Notes:* Columns 1 and 2 show how age and partnership status are correlated with whether an individual believes religion helps people make friends or find comfort. Data for these variables come from 27 countries included in the cumulated International Social Survey Programme's 2008 and 2018 Religion modules. The dependent variables are coded as True if the respondent 'agreed' or 'strongly agreed' with the statement 'practicing religion helps people... . The full regression specification includes controls for the following demographic variables: age, gender, years of education, highest degree, number of children in the household, membership in one of 3 harmonized income categories (low, medium, high), employment status, a self-ranking into the 'top' or 'bottom' of society, a categorical variable indicating which religious group the respondent says they belongs to; and country fixed effects. Columns 4 and 5 show correlations between the percent of a congregation that is older than 65 years or younger than 35 years. These data come from 2, 636 Christian congregations surveyed as part of the American National Congregations Survey waves I-IV. See the Appendix for more details on both datasets.