Essays on Religion as an Industry

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Abstract

This dissertation is comprised of two chapters. The first chapter is titled "Estimating a Strategic Entry Model for Churches." This chapter treats the entry decisions of churches as if they were profit-maximizing firms and uses recent developments in the strategic entry industrial organization literature to study these decisions. A central theme in the entry literature is the potential for excess entry because the entrant fails to internalize the negative impact of its entry on the revenue of existing firms. Two key facts underlying my analysis are that Catholic churches tend to be much bigger in terms of members than Protestant churches and there are also fewer Catholic churches in a typical market. As compared to relatively decentralized Protestant churches, the Catholic Church is hierarchical, with authority for entry decisions vested in a local bishop. One might expect the bishop to internalize negative impact from entry of a new church, in a way that a Protestant preacher starting a new church would not. I estimate the parameters of an entry model using data from the entry of Protestant churches in specially defined markets and then do an experiment to determine how things look different when a Catholic bishop controls entry. I find that I can explain a large amount of the differences in entry patterns between Catholic churches and Protestant churches taking this difference in entry regulation into account.

The second chapter is titled, "A Model of Church Exit." Much work has been in the fields of economics and sociology treating religion as an industry.

One significant empirical difference between churches and for-profit firms is that churches have much lower exit rates. This paper develops a model of the exit decisions of for-profit firms and religious entrepreneurs that differ in objectives, in what can be done with assets when a store or church (a unit) is shut-down and in the number of units they control. Historical data on the exit rates of churches and grocery stores support the predictions of the model.

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Chapter 1

Estimating a Strategic Entry Model for Churches

1.1 Introduction

Thinking about the entry process of a church, there are a number of similarities between the decision of whether or not to open a new church and the decision of opening a new business, such as a video store.[1] The new church will incur a fixed cost, just like a video store. In order to cover the fixed cost, the church will need revenue. A church will not generate revenue by renting tapes, but instead by passing the collection plate. Everything else equal, a video store's (or church's) revenue is more likely to cover its costs if the market population is larger or if there are fewer rival video stores (churches) in the market. So in these respects, the entry decision of a church is similar to the entry decision of

[1] The distinction between a "small 'c' church," which is a building for worship, and "large 'C' Church" which refers to a religion is important. I am focusing on the creation of churches in different markets, which can be thought of as plant level, not firm level.

a video store (or some other profit-maximizing retail business).

In the past 20 years much work has been done in the IO literature concerning the strategic entry of retail firms.[2] One of the seminal papers in the entry literature is Bresnahan and Reiss [1991]. They estimate a model of entry for dentists, plumbers, tire dealers, etc. in small, rural markets. There have been many methodological contributions in recent years. Seim [2001] studies video stores, Aguirregabiria and Mira [2007] study restaurants, gas stations, bookstores, etc. Though the methodologies used differ, a common thread to this work is that entry of a firm depends on market size and the firm's expectations about the number of rival firms. Also, in these models there is "excess entry" from the perspective of the firm. An entering firm does not take into account the negative effect of its entry on the revenue of other firms in the market.

This paper applies empirical methods that have been developed to study entry of retail firms to the entry of churches. I find that these methods are successful in explaining the difference in entry between Catholic and Protestant churches (section 1.2 discusses these different religious groupings). Compared to Catholics, Protestant churches seem to satisfy the standard "free-entry" condition. There is no central authority regulating the entry of Protestant churches. However, Catholics have a strict hierarchy going from priest to bishop to pope (with a number of steps between); through this hierarchy Catholics regulate entry.[3] I use methods of estimating entry games to show that the regulation of entry can explain why in a typical market there are fewer Catholic churches than Protestant churches.

[2]See Berry and Reiss [2007] for a discussion of this literature.

[3]See Mitchell [2007] and Takayama [1975] for a discussion of differences in organizational structure between different denominations.

The particulars of what I do follow. As in Bresnahan and Reiss [1991], I study entry in small, rural markets. I take advantage of advances in Geographic Information Systems (GIS) technology, so I can be more careful in my definition of markets. My methodological approach draws on various aspects of Bresnahan and Reiss [1991], Seim [2001] and Aguirregabiria and Mira [2007]. First, I estimate the structural parameters of an entry game (such as fixed costs, etc.) using only the entry behavior of Protestants. Second, I study the entry decisions of Catholic churches using the structural parameters from the Protestant estimation and feeding in Catholic demographics. If I assume Catholic churches engage in unregulated entry, I find that Catholic entry behavior looks much like Protestant entry behavior (number of churches in a given market). However, when I use Protestant parameters, Catholic demographics and assume that Catholic entry is being regulated by a planner (bishop), there is substantially less entry. I find that this difference in entry regulation accounts for essentially all of the difference in entry behavior observed in the data.

This paper specifically addresses the question: if Catholics were just like Protestants except for demographics and the presence of a Catholic planner, what would be the difference in entry behavior? There could be a number of other possible explanations for the difference in church entry behavior that this paper does not account for. In the conclusion I discuss a few possible alternative explanations that may also play a role. Taking these alternatives into account now would add substantial complications. To make progress, in this paper I focus on how far I can get explaining the difference in entry behavior just taking into account demographics and difference in entry regulation.

I find that these two factors go quite far in explaining the difference in entry behavior.

This paper contributes to two different literatures. One is the literature on free entry and regulation. In perfectly competitive markets entry regulation is thought to be detrimental. However, Mankiw and Whinston [1986] show theoretically that in an oligopoly market it is possible for free entry to result in excess entry. Berry and Waldfogel [1999] and Hsieh and Moretti [2003] empirically study welfare loss of free-entry. My paper does not model consumers, so I cannot make any statements about total welfare. (Given the topic, it could be quite dangerous to discuss the welfare of consumers.) I only focus on excess entry from the perspective of the church.

This paper also adds to the economics of religion literature. The notion of a market for religion was alluded to as long ago as Adam Smith's *Wealth of Nations*. He discusses the difference between clergy who "depend [...] upon the voluntary contributions of their hearers" and clergy who depend on "some other fund to which the law of their country may entitle them" (Smith [1776], 486). He says that government subsidized clergy fall behind in "Their exertion, their zeal and industry" compared to clergy not dependent on the government (Smith [1776], 486). Iannaccone [1998] reviews the work that has been done applying economic concepts to religion in the past 30 years. Much work has focused on individual's decisions regarding religious attendance.[4] There has also been work relating religious participation to various outcomes, such as educational attainment and income (for example, Gruber

[4]For example, Azzi and Ehrenberg [1975] study the decision of church attendance by treating it as a household utility maximization problem (with consumption of both corporeal and after-life goods) subject to a time constraint.

[2005]). There has been limited work treating churches as firms. For example Ekelund [1996] treats the Medieval Catholic Church as a monopolist. This paper is the first to treat the creation of a new church as a result of strategic entry decision.[5]

The paper proceeds as follows. Section 1.2 provides some background on thinking of religion as an industry; section 1.3 presents a simple theoretical model of church entry; section 1.4 presents the empirical model; section 1.5 discusses the estimation strategy; section 1.6 describes the data; section 1.7 looks at descriptive evidence; section 1.8 presents the results of the entry game and then looks at the effect of a Catholic planner and section 1.9 concludes.

1.2 Background on Religion as an Industry

This section deals with some particular characteristics of religion in the US that will inform modeling choices made in the paper. First I will discuss common groupings of religions used in the study of religion. Then I will discuss differences in organizational structure and the decision of starting a new church in different religious groups. Then I will give examples of fixed costs of starting a church and discuss the assumption of profit-maximization.

This paper will specifically deal with Christian religions. More specifically, Catholic and Protestant denominations. I will consider three separate religious groups. These groupings are given in table 1.1 and are based on classifications in Pew [2008] and Ammerman [2001].[6] The group Catholics are

[5]The distinction between, church and Church is important; Montgomery [1996] has a theoretical approach to the creation of new religions.

[6]The classifications in these two sources have some differences so my categories synthe-

made up solely of the Roman Catholic Church. Within each broad classification of Protestantism there are a number of denominational families. For example Mainline Protestants are made up of the denominational families Lutheran, Methodist, Congregational, etc. Some of these denominational families are made up of a number of separate denominations. For example, different denominations contained within the denominational family of Lutheran include the Evangelical Lutheran Church of America (ELCA), Lutheran Church - Missouri Synod, Lutheran Church - Wisconsin Synod. Individuals switch between all of these three groups, but switching between a Protestant denomination and Catholicism is less likely than switching between different Protestant denominations. (This is supported by Pew [2008] and Loveland [2003].)

Since the Protestant groups are made up of a number of different denominations, each Protestant group will have less centralized control than the Catholics, which is comprised of just the Roman Catholic Church. Also, the Roman Catholic Church has a particularly strict hierarchical structure. In general each Protestant denomination will have a less centralized organizational structure. [7]

Some anecdotal evidence of differences in organizational structure can be seen when looking at the process of opening a new church. From the Vatican

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size the categories in these two sources. Pew [2008] places American Baptist Churches into the Mainline Protestants, while other Baptist denominations are Evangelical Protestants. Due to limitations on the data, for this paper all Baptist denominations are counted as Evangelical Protestant.

[7]From Takayama [1975]:

> For the most part Protestants deplore the legality, hierarchy, and tradition which are found in the organizational structure of the Roman Catholic Church. They believe that their organizations can operate effectively without recourse to a well-defined line of authority.

Table 1.1: Makeup of Religious Groups

Religious Group	Denominational Family
Catholic	Roman Catholic Church
Mainline	Methodist
Protestant	Lutheran
	Presbyterian
	Anglican
	Congregational
Evangelical	Baptist
Protestant	Holiness
	Restorationist
	Pietiests
	Reformed
	Pentecostal
	Adventist
	Anabaptist

website, the *Directory for the Pastoral Ministry of Bishops* specifically details the "Planning for the Establishment of Parishes."

> [. . .]the Bishop should proceed, after consulting the diocesan presbyteral council (660), to alter territorial boundaries, to divide parishes that are too large, to merge small parishes, to establish new parishes [. . .] [anyone who] wish[es] to build churches within the territory of the diocese, they must first obtain written permission from the Bishop.

This clearly states the Bishop's responsibility for and control over planning new churches in his diocese (specific geographical region). This formal statement of policy is in stark contrast to the more eager discussion of "church planting" (the common phrase used for creating a new church) by different Protestant denominations. For example the Episcopal Church in the USA has a number of pages regarding church planting. They detail the necessary steps of the process, including "Demographic study is done before site selection" and "Other Christian communities identified."[8] Both the United Church of Christ and the United Methodists have had conferences at which Reverend Jim Griffith, president of Griffith Coaching Network has discussed planting.[9] These differences between Catholics and Protestant groups motivate modeling decisions made later in the paper regarding whether entry by a religious group is centrally or de-centrally planned.

[8] http://www.episcopalchurch.org/newchurch_4321_ENG_HTM.htm?menu=undefined accessed October 19, 2008

[9] Information found at http://www.secucc.org/development/leadtrain2.php and http://www.nccumc.org/docs/leadershipacademy/jgriffithbio.pdf on October 19, 2008.

In the model presented later there are variable profits, that depend on the size of the market and there will be a fixed cost for each church. Stonebraker [1993] discusses church costs:

> As the number of members goes up, the average cost of servicing each member goes down. Attendance at liturgies, Sunday School classes, youth groups, and Bible studies rarely approaches physical capacity. Empty pews abound and additional participants can be served at little or no extra cost.

A necessary component of a church is a clergy member. Required training for clergy can be thought of as a fixed cost of a new church. According to Lipford [1992], "the processes by which clergy qualify for employment is [...] strictly regulated in most denominations." Requirements do vary across denominations. For example, clergy in denominations such as the Roman Catholic Church, the United Methodist church and the Episcopal Church in the USA, "are subject to rigorous monitoring, examinations, and educational requirements" (Lipford [1992]). However, for clergy from the Southern Baptist Convention, though they often "attend seminaries that are supported by the denomination, the SBC sets no requirements for ministers serving in its denomination" (Lipford [1992]).

As mentioned above, the entrance of a new church incurs a fixed cost (the building itself, certain services, the necessary clergy). A church also earns revenues. This paper assumes that a potential entering church must expect revenues to be greater than costs. The clergy member starting this new church has an opportunity cost, if revenues do not cover costs, the clergy will do something else. Below I consider expected profit for a church and will impose a zero-profit condition.

1.3 Theory

This section first presents a simple theoretical model of the market for religion. Then I discuss some analytical results. This section concludes with a discussion of how the empirical model used later in the paper differs from the theoretical model.

The model presented in this section is very similar to the model in Anderson and De Palma [1992]. First consider a logit-style demand framework. Individual i has utility for church j given by:

$$u_{ij} = a - p_j + \mu\xi_{ij} \tag{1.1}$$

Where a is some constant, p_j is the price of attending church j, ξ_{ij} is a utility shock distributed by a type-1 extreme value distribution and μ represents the level of product differentiation. The probability that individual i will attend church j will be:

$$P_{ij} = \frac{\exp[(a - p_j)/\mu]}{\sum_{k=1}^{N} \exp[(a - p_k)/\mu] + \exp[V_0/\mu]} \tag{1.2}$$

V_0 is the deterministic utility of the outside option, which in this case would be non-attendance. If there were no outside good, ($V_0 \to -\infty$), it would imply that all people attend some church. If a market has population S, then church

j will have attendance $P_{ij}S$.

Now consider the supply side. There are a certain number of religious entrepreneurs who can potentially enter (create a church). An entrant incurs fixed cost γ. As mentioned above there is some price, p_j, of attending a church. Church j will earn revenues, $p_j P_{ij} S$ (price times number of attendees).

In general a church does not set a price of admission and collect it at the door. Individuals choose the amount they place in a collection plate. Consumers choosing their own price eliminates price competition. The price of every church would be the same $\bar{p}$ (one can think of $\bar{p}$ as the average contribution of all church-goers). The number of churches that will enter, $\hat{N}$, will depend on the structure of the market. I will consider two different market structures. One structure will be free-entry by religious entrepreneurs, the other will be a single monopoly religion with the number of churches determined by a planner. As expected, the number of churches in a market is larger if there is free entry than if there is a planner.

Proposition 1.3.1. *With consumer utility given in equation (1.1) and fixed price $\bar{p}$ for every church, the number of churches in market with free-entry, $\hat{N}^F$, will be greater than or equal to the number of churches chosen by a planner, $\hat{N}^P$.*

Proof. See appendix. □

The key difference between free-entry and a planner is that in free-entry each potential entrant only cares about the profit it earns. Entry will occur until per church profits are driven to zero. When a planner makes a decision to add a church, it takes into account the profits of that church but also the negative effect on the other churches in the market. If everyone attended a church, ($V_0 \to -\infty$), the number of customers per church would be $\frac{S}{N}$. In this case a planner would either choose zero churches (if $\bar{p}S < \gamma$) or just one church (if $\bar{p}S \geq \gamma$). With revenues being evenly split and each additional church incurring a fixed cost, a planner would never place more than one church in a market.

When everyone attends a church (no outside good) the effect of changes in fixed price, $\bar{p}$, level of product differentiation, μ, market size, S, and fixed cost, γ, on number of churches that will enter in free-entry, $\hat{N}^F$, is immediate.[10] In this case the pool of church revenue, $\bar{p}S$ is split evenly among the N churches in a market such that each church earns revenue $\frac{\bar{p}S}{N}$. With no outside good, the number of people who go to church is fixed, so as the fixed price, $\bar{p}$, increases, the pool of possible revenues increase. So in free-entry the number of churches will increase. With no outside good and no price competition, product differentiation, μ, will have no effect. The number of churches will grow proportionately with market size, S. The number of churches would be inversely proportional to the fixed cost, γ.

If there is an outside good these effects can be less clear.[11] With an outside good the effect of changing the price level, $\bar{p}$, has two effects. It increases the price each church-goer pays, but causes more people to choose the outside good. For small $\bar{p}$ as the price increases at first revenues will increase and then eventually start to decrease. When the total revenue increases, the number

[10] Under these conditions, profit per church, if there are N churches is given by: $\Pi_N = \frac{\bar{p}S}{N} - \gamma$

[11] Now per church profits, if there are N churches, is given by: $\Pi_N = \frac{\bar{p}S}{N + \exp[(V_0 - a + \bar{p})/\mu]} - \gamma$.

of churches that will enter will increase; as revenues decrease the number of churches that enter will decrease. The effect of a change in the level of product differentiation, μ, depends on the value of the outside good. If $V_0 - a + \bar{p} < 0$, then an increase in μ decreases revenue, thus decreasing the number of churches that will enter. On the other hand, if $V_0 - a + \bar{p} > 0$ then an increase in product differentiation, μ, will increase per church revenue, causing more churches to enter. Increasing market size, S, will cause more churches to enter, but the increase in churches will not be proportional to market size. Increasing fixed cost, γ, will decrease the number of churches, but the decrease will not be proportional.

One way to interpret more than one religious group in a certain market is to think of products $j = 1, \ldots, N$ as churches of a specific religious group, while V_0 represents utility from all other religious groups ("no religion" would be one of these other groups). A change such as lower $\bar{p}$ or higher μ would increase the number of people attending a church in the given religion and decrease the number of people attending churches of other religions.

The model described below abstracts away from the above demand framework. A number of religious groups will be considered. There is no data on price to generate revenue similar to above. Instead there will be a reduced form per capita variable profit function that uses demographic data for each market. This per capita profit will be multiplied by market population. Instead of per capita profit being split among N churches as an explicit function of N, I allow profits to decline at different rates as N increases.

1.4 Empirical Model

I want to take some aspects of the simple theoretical model above and apply it to data. In this section I discuss the empirical model I use and the equilibrium concept I apply. For the empirical model I abstract away from the demand side and use a reduced form profit equation (similar to that seen in Bresnahan and Reiss [1991]). There are $m = 1, \ldots, M$ markets. Within each market each religious type has a number of potential entrants (religious entrepreneurs), N_r^{max}, which is finite. I allow for different religious groups, $r \in R$ (details and reasoning discussed in section 1.2). Religious entrepreneurs within a certain religious group share a common cost shock and engage in free-entry.[12] Within a religious group the religious entrepreneurs have full information, they know what the other entrepreneurs of the same type will do. This full information structure with free-entry is similar to Bresnahan and Reiss [1991]. While there is full information within a religious type, there will be incomplete information across religious types. For example, a Mainline Protestant entrepreneur does not know the Evangelical Protestant specific cost shock. Across religious groups an imperfect information game is played (much like Seim [2001]).

1.4.1 Profit

For a specific market there are per-capita variable profits that depend on demographic characteristics, X, the number of churches of the same religious type, N_r, and the number of churches of other religious types N_{-r}. The parameters

[12]An example of a religious group specific cost shock could be that perhaps Mainline Protestants in a certain market require an unusually high level of family services.

multiplying demographic variables, β_r and δ_r are religious-type specific. The number of churches of other religious types, N_q for $q \neq r$, is multiplied by $\theta_{r,q}$. $\theta_{r,q}$ is the competitive effect of each church of type q on a church of type r, it is not symmetric ($\theta_{r,q} \neq \theta q_r$ necessarily). If churches of different religious types are competing with each other (if one church can steal members from churches of other types) then $\theta_{r,q}$ will be negative. One specific demographic characteristic is F_r, the fraction of people in the market that are of religious type r. Explicitly, per-capita variable profit is given by:

$$V_r(N_{-r}, X, F_r) = \delta_r F_r + X\beta_r + \alpha_r^1 - \sum_{q \neq r} \theta_{r,q} N_q \tag{1.3}$$

This per-capita variable profit is multiplied by market size, S.[13] There is a fixed cost, γ_r, and a market specific cost shock, ϵ_r, that is common to all entrants of type r. Then profit is given by:

$$\Pi_r(N_r, N_{-r}, X, S, F_r) = \left(1 - \sum_{n=2}^{N_r} \alpha_r^n\right) V_r(N_{-r}, X, F_r)S - \gamma_r + \epsilon_r \tag{1.4}$$

It is assumed that an additional church of type r will decrease profits for a church of type r. Thus $\alpha_r^n \geq 0$ for $n \geq 2$, so profits decrease as N_r increases. The α_r^n terms specify how additional churches of the same religious type reduce per-church variable profit. The situation mentioned in section 1.3 in which each of N_r churches splits revenue N_r ways is a special case with a

[13] F_r is just one demographic characteristic in the per-capita variable profit function for each religious type. The per-capita variable profit is multiplied by market size, S, for all religious groups. If a market has a higher proportion of people of religious type r, F_r, the per-capita variable profit will be higher for that market (given δ_r is positive). Markets with larger population, S, will have larger per firm profit.

certain specification of α_r^n's. This profit specification is more general, allowing for variable profits to be split up at different rates as N_r changes.

To simplify notation, below I will use $Z = \{X, S, \{F_r\}_{r \in R}\}$. Per-capita variable profit will be expressed as $V_r(N_{-r}, Z)$. Per firm profit will be expressed as $\Pi_r(N_r, N_{-r}, Z)$.

1.4.2 Decentralized versus centralized entry

This paper considers two possible regimes for entry. One regime is decentralized entry within religious type r. With decentralized entry, each entrant only cares about its own profit from entering. An alternative regime would be if each religious group in a given market was controlled by a central planner. The central planner cares about the additional profit of the last, N_r^{th}, entrant and also that entrant's effect on existing churches. Specifically, the planner also cares about $-(N_r - 1)\alpha_r^N V_r(N_{-r}, Z)S$ (the N_r^{th} entrant's effect on the existing $N_r - 1$ churches). Since the planner is taking into account the negative effect on existing churches, decentralized entry will result in a higher number of churches than the planner regime. The difference between these two regimes can be internalized. Consider the profit function:

$$\tilde{\Pi}_r(N_r, N_{-r}, Z; \lambda_r) = \Pi_r(N_r, N_{-r}, Z) - \lambda_r(N_r - 1)\alpha_r^n V_r(N_{-r}, Z)S \quad (1.5)$$

Where $\Pi_r(N_r, N_{-r}, Z)$ is defined in equation (1.4). If $\lambda_r = 0$ then the above represents the profit for the N_r^{th} religious entrepreneur engaged in free entry. If $\lambda_r = 1$ then the above represents profit of the N_r^{th} church if religion r is being run by a planner. $\tilde{\Pi}_r(N_r, N_{-r}, Z)$ gives the marginal profit of the N_r^{th} entrant.

Internalizing the presence of a central planner allows me to impose a zero-profit free entry condition whether or not there is centralized or decentralized entry. There will be N_r churches of type r in a market if the expected profit of the N_r^{th} church is positive and the expected profit of the $(N_r + 1)^{\text{th}}$ church is negative.

1.4.3 Equilibrium

Within each religious type all potential entrants know the ϵ_r draw for that religion. However, potential entrants within religion r do not know ϵ_q for religions $q \neq r$. Thus there is an incomplete information game. For the private information game between religions we will treat each religious group as a single player no matter if entry within each religion is decentralized or determined by a planner. Similar to Bresnahan and Reiss [1991], at the level of a religious group I am only interested in the number of churches in a market, N_r. I am not interested in the identity of the churches.

Each religious type, r, has beliefs about the actions of other religious types (number of churches of another religious type that will enter a certain market) that are a function of market characteristics; these beliefs are denoted by $\sigma_{-r}(\cdot|Z)$, where $Z = \{X, S, \{F_r\}_{r \in R}\}$. Define a strategy function $s_r(Z, \epsilon_r, \sigma_{-r}(\cdot|Z))$, that maps market characteristics, error terms and religious group r's beliefs about rival religious groups into a number of churches of type r, N_r. In a Bayesian-Nash equilibrium each religion behaves optimally conditional on its beliefs being correct.

Each religion has expected profits given by:

$$\pi_r(N_r, Z, \epsilon_r; \lambda_r, \sigma_{-r}(\cdot|Z)) = \sum_{N_{-r}} \tilde{\Pi}_r(N_r, N_{-r}, Z, \epsilon_r; \lambda_r)\sigma_{-r}(N_{-r}|Z) \tag{1.6}$$

At the level of a religious type there will be free entry. There will be a number of churches N_r such that expected profit for each of the N_r churches is positive, but per church expected profit is negative if there are $N_r + 1$ churches. This is just like the zero-profit condition used in Bresnahan and Reiss [1991], except expected profits are being used since each religious type is now playing a game of incomplete information with other religious types.

For the game described above a Bayesian-Nash equilibrium can be defined as follows:

Definitions. *A Bayesian-Nash equilibrium for this game is:*

1. *a set of strategies,* $s_r^*(Z, \epsilon_r, \sigma_{-r}^*(\cdot|Z))$
2. *beliefs on rival religions* $\sigma_{-r}^*(\cdot|Z)$

for $r \in R$*, such that:*

$$\pi_r(s_r^*(Z, \epsilon_r, \sigma_{-r}^*(\cdot|Z)), Z, \epsilon_r; \lambda_r, \sigma_{-r}^*(\cdot|Z)) \geq 0 \text{ and}$$
$$\pi_r(s_r^*(Z, \epsilon_r, \sigma_{-r}^*(\cdot|Z)) + 1, Z, \epsilon_r; \lambda_r, \sigma_{-r}^*(\cdot|Z)) < 0$$

and

$$\sigma_r^*(N_r|Z) = \Pr\left[\pi_r(N_r, Z, \epsilon_r; \lambda_r, \sigma_{-r}^*(\cdot|Z)) \geq 0 \text{ and } \pi_r(N_r + 1, Z, \epsilon_r; \lambda_r, \sigma_{-r}^*(\cdot|Z)) < 0\right]$$

where

$$\sigma^*_{-r}(N_{-r}|Z) = \prod_{q \neq r} \sigma^*_q(N_{-r}(q)|Z)$$

1.5 Estimation Strategy

In order to estimate this game I will use the Nested Pseudo Likelihood (NPL) algorithm of Aguirregabiria and Mira [2007], applied to a static game. The general idea is to take a set of beliefs as given. Given these beliefs estimate parameters by maximizing a pseudo likelihood (it is a pseudo likelihood since the true beliefs are not being used). Using the parameter estimates, update the beliefs. This process is repeated until the sets of beliefs converge. One advantage of this method is that it is computationally light; it does not require solving for a fixed point for each set of parameters. Also, in games of incomplete information multiple equilibria are possible. This technique automatically selects the equilibrium that fits the data.

Let the set of parameters to be estimated be denoted by:

$$\omega = \{\delta^r, \{\alpha^r_n\}_{n=1}^{N^r_{max}}, \{\theta_{r,q}\}_{q \neq r}, \gamma^r\}_{r \in R}$$

. Data on observed church counts are given by $\hat{N}_{r,m}$ for $r \in R$ and $m = 1, \ldots, M$.

The algorithm is as follows:

1. At iteration n take set of beliefs $\hat{\sigma}^{(n)}$. For $n = 1$ use arbitrary initial guess.

2. Given beliefs $\hat{\sigma}^{(n)}$ construct a pseudo likelihood function $L(\omega, \hat{\sigma}^{(n)})$ and obtain the pseudo maximum likelihood estimator of ω as $\hat{\omega}^{(n)} = \arg\max_{\omega \in \Omega} L(\omega, \hat{\sigma}^{(n)})$ (this likelihood is defined below).

3. Update beliefs using the probability mapping, $\hat{\sigma}^{(n+1)}(N_{r,m}) = \Psi(N_{r,m}|Z, \lambda, \hat{\omega}^{(n)}, \hat{\sigma}^{(n)})$ (this mapping is defined below).

4. If $\|\hat{\sigma}^{(n+1)} - \hat{\sigma}^{(n)}\|$ is smaller than some set number, then choose $\hat{\omega}^{(n+1)}$, $\hat{\sigma}^{(n+1)}$ as the NPL estimator. Otherwise, repeat above steps using $\hat{\sigma}^{(n+1)}$ as a new guess.

Assuming the religious type specific shock, ϵ_r, is drawn from a standard normal distribution, the likelihood function will be an ordered probit.

As said above, at the level of religious group r, the number of churches in a given market must satisfy a free entry condition. Denote the deterministic portion of expected profit by $\bar{\Pi}_r(N_r, Z; \lambda_r, \sigma_{-r}(\cdot|Z))) = \pi_r(N_r, Z, \epsilon_r; \lambda_r, \sigma_{-r}(\cdot|Z)) - \epsilon_r$. The CDF for the standard normal distribution is denoted by $\Phi(\cdot)$.

There will be zero churches if $\pi_r(1, Z, \epsilon_r; \lambda_r, \sigma_{-r}(\cdot|Z)) < 0$. The probability of zero churches is given by:

$$\Pr(N_r = 0) = \Pr(\epsilon_r < -\bar{\Pi}_r(1, Z; \sigma_{-r}(\cdot|Z))) = \Phi(\bar{\Pi}_r(1, Z; \lambda_r, \sigma_{-r}(\cdot|Z))) \tag{1.7}$$

There will be N churches if $\pi_r(N, Z, \epsilon_r; \lambda_r, \sigma_{-r}(\cdot|Z)) \geq 0$ and $\pi_r(N+1, Z, \epsilon_r; \lambda_r, \sigma_{-r}(\cdot|Z)) <$

0. The probability of there being N churches is given by:

$$\begin{aligned}\Pr(N_r = N) &= \Pr\left(\epsilon_r \geq -\bar{\Pi}_r(N, Z; \lambda_r, \sigma_{-r}(\cdot|Z)) \text{ and } \epsilon_r < -\bar{\Pi}_r(N+1, Z; \lambda_r, \sigma_{-r}(\cdot|Z))\right) \\ &= \Phi\left(-\bar{\Pi}_r(N+1, Z; \lambda_r, \sigma_{-r}(\cdot|Z))\right) - \Phi\left(-\bar{\Pi}_r(N, Z; \lambda_r, \sigma_{-r}(\cdot|Z))\right)\end{aligned} \tag{1.8}$$

Let N_r^{max} be the maximum possible number of churches of type r in one market. There will be N_r^{max} churches if $\pi_r(N_r^{max}, Z, \epsilon_r; \lambda_r, \sigma_{-r}(\cdot|Z)) > 0$. The probability of there being N_r^{max} churches is given by:

$$\begin{aligned}\Pr(N_r = N_r^{max}) &= \Pr(\epsilon_r \geq -\bar{\Pi}_r(N_r^{max}, Z; \lambda_r, \sigma_{-r}(\cdot|Z))) \\ &= 1 - \Phi\left(\bar{\Pi}_r(N_r^{max}, Z; \lambda_r, \sigma_{-r}(\cdot|Z))\right)\end{aligned} \tag{1.9}$$

Then the probability mapping, $\Psi(\hat{\omega}^{(n)}, \hat{\sigma}^{(n)})$, mentioned in the above algorithm can be expressed as:

$$\Psi(N_r|Z, \lambda, \hat{\omega}^{(n)}, \hat{\sigma}^{(n)}) = \begin{cases} \Phi(\bar{\Pi}_r(1, Z; \lambda_r, \hat{\sigma}_{-r}^{(n)})) & \text{if } N_r = 1, \\ \Phi\left(-\bar{\Pi}_r(N_r+1, Z|\lambda^r, \hat{\sigma}_{-r}^{(n)})\right) & \\ -\Phi\left(-\bar{\Pi}_r(N_r, Z|\lambda^r, \hat{\sigma}_{-r}^{(n)})\right) & \text{if } 1 < N_r < N_r^{max}, \\ 1 - \Phi(\bar{\Pi}_r(N_r^{max}, Z|\lambda^r, \hat{\sigma}_{-r}^{(n)}) & \text{if } N_r = N_r^{max} \end{cases} \tag{1.10}$$

Given $\Psi(\hat{\omega}^{(n)}, \hat{\sigma}^{(n)})$, the likelihood $L(\omega, \hat{\sigma}^{(n)})$:

$$L(\omega, \hat{\sigma}^{(n)}) = \sum_{m=1}^{M} \sum_{r \in R} \sum_{N=1}^{N_r^{max}} 1\{\hat{N}_{r,m} = N_r\} \ln \left(\Psi(N_r | \hat{\omega}^{(n)}, \hat{\sigma}^{(n)}) \right)$$

Where $\hat{N}_{r,m}$ are the observed church counts from the data.

1.6 Data

In order to estimate the above model I need data on church counts and market characteristics for a specific set of markets. Instead of taking market definitions from the Census, I will create my own definition of a market.

1.6.1 Defining markets

I will focus on small, isolated, rural markets. There is much religious activity in small towns. Bresnahan and Reiss [1991] use isolated markets as their unit of analysis since it is more likely that the market population is consuming goods within that market. Pre-defined Census markets include Metropolitan Statistical Areas (MSA's) and Census Places. Since religious activity occurs at a very local level, MSA's are far too large. Bresnahan and Reiss [1991] specifically use Census places that meet specific isolation criteria. As Holmes and Lee [2007] describe, designation as a Census place is often arbitrary. Census Places leave out 25% of the US population. Instead of only considering clusters of population that the Census decides are markets, I want to look at all clusters of population and decide whether or not each one constitutes a market. I start with Census blocks (the finest level at which Census data is reported) and aggregate to create a market. Once my markets are created I then impose isolation criteria.

Since the ultimate goal is a set of isolated markets I begin by taking all Census blocks in the lower 48 states and the District of Columbia, that are not in a Metropolitan Statistical Area (MSA). This leaves me with 3,877,307 out of 8,164,718 Census blocks. The general idea is to find a set of population clusters that are some minimum distance from each other. I treat each non-MSA block as a potential "center." I find a set of "centers" that meet certain criteria regarding distance from other "centers." A market is defined to be everything within 3 miles of these selected centers. (See Appendix A.2 for more detail.) There are 5,586 markets that meet my criteria. Market populations are determined by summing up the population of all Census blocks within 3 miles of a market's center. These markets have uniform area, unlike Census Places which vary in area.

I start with these 5,586 markets and then, following Bresnahan and Reiss [1991], I impose additional isolation criteria.[14,15] Specifically, the population within 10 miles of the market must be less than 10,000, the population within 20 miles must be less than 30,000, and the population within 30 miles must be less than 60,000. I also set a minimum population of 100. In this paper I will further be restricting markets to being in the states MT, WY, ND, SD and IA. I also restrict the sample to markets with a population of less than

[14]The 5,586 markets already have some isolation imposed on them through the process by which they were created (since potential markets come from non-MSA's and need to be a certain distance from each other)

[15]The isolation criteria in this paper are based on total population within a certain radius of a potential market. Whereas in Bresnahan and Reiss [1991], the isolation criteria are based on the proximity of other Census places with certain populations.

2,500. After these criteria are imposed, I end up with markets such that the maximum number of churches of a specific religious type in a certain market at 6 ($N^r_{max} = 6$ for all $r \in R$). Having this cap on number of churches of type r in a market is necessary for estimation. Imposing these restrictions results in a sample of 399 markets.

Data on the market characteristic per capita income is taken from the Census. The Census reports per capita income at the blockgroup level. For markets that fall into more than one blockgroup the population weighted average of per capita income is taken. Table 1.2 gives summary statistics for the market characteristics for different groups of markets (all markets, isolated markets, etc.).

1.6.2 Fraction of religious type

For market level characteristic F_r, the fraction of the population that is of a certain religious group, I use data from the Religious Congregations and Membership Study, 2000 (RCMS 2000).[16] This data is at the county level. If a market falls in more than one county I take the population-weighted average of the religious fraction for each county a market is in.

The specific variable given in this data is "adherents." Given the RCMS definition the term adherent includes members, their children and other participants not counted as members. Adherents are used as a uniform measure across religious denominations, since different denominations have different criteria for members. The RCMS reports adherents at the denominational level

[16] This survey was accessed online from the Association of Religion Data Archives, `www.TheARDA.com`, and was collected by Jones et al. [2002].

for each county. I sum over denominations to obtain the number of adherents for the religious groups Catholic, Mainline Protestant and Evangelical Protestant (using the classification given in table 1.1). Since this is county level data, and each market should be a fairly small portion of any county, I consider this fraction to be the average religious tendency of the market.

1.6.3 Church counts

Data on the number of churches in each of these markets have been collected. Due to data collection limitations, this paper will focus on the states of MT, WY, ND, SD and IA. Specifically, the data pertains to markets that are completely contained within these five states.

For each market I need a count of churches. To collect these counts I use two different sources. One is an online directory (a phone book), ReferenceUSA. The other is specifically an online directory for Catholic Churches, `http://parishesonline.com`.

I select all churches from ReferenceUSA (using NAICS=8131008) and all Catholic churches from parishesonline.com that are in the above mentioned states. I have longitude and latitude for each church. Any church that is within 3 miles of the above described "centers" is in that specific market. Churches from ReferenceUSA are classified as being Mainline or Evangelical Protestant. Church counts for different groups of markets can be seen in Tables 1.6 and 1.7.

Table 1.2: Summary Statistics for Market Characteristics

Market Category	Number Markets	Minimum	Maximum	Mean	Standard Deviation
All Markets					
Population (in thousands)	5586	0.001	53.687	4.171	6.671
Per Capita Income (in thousands)	5586	0.000	44.721	16.043	3.808
Share Catholic	5586	0.000	0.947	0.163	0.159
Share Mainline Protestant	5586	0.000	0.932	0.150	0.142
Share Evangelical Protestant	5586	0.000	1.107	0.184	0.174
Isolated Markets					
Population (in thousands)	1857	0.100	44.874	2.512	4.107
Per Capita Income (in thousands)	1857	3.649	44.720	15.529	3.867
Share Catholic	1857	0.000	0.947	0.198	0.163
Share Mainline Protestant	1857	0.000	0.932	0.183	0.172
Share Evangelical Protestant	1857	0.000	0.989	0.156	0.171
Isolated Markets in Select States					
Population (in thousands)	483	0.100	28.735	2.013	3.771
Per Capita Income (in thousands)	483	3.649	35.085	15.602	3.885
Share Catholic	483	0.006	0.869	0.235	0.154
Share Mainline Protestant	483	0.026	0.882	0.303	0.194
Share Evangelical Protestant	483	0.000	0.576	0.081	0.054
Selected Markets					
Population (in thousands)	399	0.100	2.475	0.726	0.616
Per Capita Income (in thousands)	399	3.649	35.085	15.412	4.043
Share Catholic	399	0.006	0.869	0.237	0.156
Share Mainline Protestant	399	0.026	0.882	0.313	0.197
Share Evangelical Protestant	399	0.000	0.576	0.081	0.057

Note: the religious shares come from the RCMS, which says that it is possible for shares to be larger than 1 (i.e. 1.107) due to people living in areas surrounding a county attending a church within that county.

Table 1.3: Adherents and Congregations (churches) by Denominational Group for the Lower 48 States

	Denomination		
	Catholics	Mainline Protestant	Evangelical Protestant
Adherents	61,739,870	26,518,666	36,100,204
Congregations	21,594	83,607	125,539
Adherents per Congregation	2,859	317	287

1.7 Descriptive Evidence

Before estimating the model, I look at the relationship between population and church counts. First, to look at the entire US, I will use the RCMS data mentioned above. The finest level at which this data is available is county-level. For this analysis I will consider a county to be a market. Using the RCMS data, in the year 2000, in total there were 266,459 congregations (churches) with 140,718,046 adherents in the contiguous 48 states and Washington DC (these numbers include all religions).[17]

Differences between denominational groups can be readily seen. Looking at Table 1.3, one can see that Catholics are behaving quite differently than Mainline Protestants and Evangelical Protestants. The Catholics have about as many adherents as Mainline and Evangelical Protestants combined. Yet the Protestant groups have about 10 times as many congregations (churches). This results in the Catholics having a much higher number of adherents per congregation.

[17]These numbers are on the conservative side, but consistent with other sources. See Finke and Scheitle [2005] for a discussion of these data.

Looking at county-level data in Table 1.4 one can crudely see that these denominational groups are behaving differently when it comes to the entrance of a marginal church. There are two points of interest. One is that for any set of churches, the average county population for Catholics is much higher than that for Mainline or Evangelical Protestants. This is consistent with the high number of adherents per congregation seen above. Secondly, Catholics are behaving differently than the Protestants when it comes to the marginal population necessary to reach the next set of churches. For Catholics to get the first group of five churches, an average population of 30,677 is required. In order to get the second set of five Catholic churches, on average an additional 50,000 people are required. This is in contrast to both Mainline and Evangelical Protestants. For these two groups the additional number of people required to get to the second set of churches is roughly the same as the population required for the first set. (For Mainline Protestants roughly 9,000 people are required for each set of five churches. For Evangelical churches, roughly 7,000 people are necessary for each set of five churches.) This implies that Catholics are interested in establishing churches for a certain threshold population, but in order to get twice as many churches, the population must be more than twice the initial threshold. One possibility for this different behavior could be that the Catholic planner takes into account the effects of entry on other Catholic churches.

One can also think about the reverse situation, the average number of churches of different religious types for markets (counties) of a given size. Table 1.5 looks at counties in the Lower 48 split up into four different size categories (counties with population above 80,000 are not included). We can

Table 1.4: Average County Population for Given Number of Churches

	Average County Population		
Number Churches	Catholics	Mainline Protestant	Evangelical Protestant
First Five Churches (1-5)	30,677	9,523	7,452
Second Five Churches (6-10)	78,398	17,721	14,720
Third Five Churches (11-15)	131,694	27,742	21,834
Fourth Five Churches (16-20)	221,560	34,988	29,662
Fifth Five Churches (21-25)	277,422	43,060	36,602
Sixth Five Churches (26-30)	347,768	54,310	36,633

Table 1.5: Average Number of Churches for Counties in Certain Population Range

County		Average Number Churches		
Population Range	Average Population	Catholic	Mainline Protestant	Evangelical Protestant
0 - 10,000	5,605	2.04	7.28	8.31
10,000-20,000	14,677	2.42	12.52	20.64
20,000-40,000	28,750	3.46	18.70	32.29
40,000-80,000	55,223	5.14	27.80	43.65

see that the average number of Catholic churches is much lower than the average number of Protestant churches for all population size categories. As population increases, the increase in the number of Catholic churches is low.

The above analysis is done at the county level since that is the finest level for which data for the entire US is available. Using the sources described in section 1.6, I have church counts for isolated markets in MT, WY, ND, SD, and IA. (See section 1.6.1 for how isolated markets are defined.) Table 1.6 presents the average population of markets with a given number of churches. The patterns exhibited here are similar to the patterns seen at the county level. A small population is necessary for the first Catholic church, but to get a second church there must be a large increase in population. For both Mainline and Evangelical Protestants, smaller populations are required for the first church, and each additional church requires roughly the same increase in population. The behavior of Mainline and Evangelical Protestant churches in these markets is different than the behavior seen in the national county level data. In these markets the average population of markets with a certain number of Mainline Protestant churches is lower than the average population of markets with the same number of Evangelical Protestant churches. This result is the reverse of what's seen in the county level data.

As described in section 1.6.1, the markets used in the estimation are markets such that there are 6 or fewer churches of any one type and market population is less than 2,500. Table 1.7 gives average market population based on number of churches for the markets used in the estimation. The pattern between church count and market size is somewhat obscured.

1.8 Results

I first present the estimates to the game presented above. I then use the parameter estimates in experiments where I consider Catholic churches to be just

Table 1.6: Average Market Population for Given Number of Churches in Isolated Markets

	Religious Group					
	Catholics		Mainline Protestant		Evangelical Protestant	
Number Churches	Number Markets	Average Population (in thousands)	Number Markets	Average Population (in thousands)	Number Markets	Average Population (in thousands)
0	215	0.75	168	0.48	253	0.49
1	255	2.44	103	0.74	95	1.03
2	9	11.37	90	1.16	52	2.20
3	2	20.76	52	2.67	24	3.23
4	2	22.85	17	3.66	13	5.38
5	0		24	5.45	11	5.54
6	0		9	11.90	10	7.33
7+	0		20	13.59	25	14.21

Table 1.7: Average Market Population for Given Number of Churches (markets with population below 2,500)

	Religious Group					
	Catholics		Mainline Protestant		Evangelical Protestant	
Number Churches	Number Markets	Average Population (in thousands)	Number Markets	Average Population (in thousands)	Number Markets	Average Population (in thousands)
0	206	0.41	164	0.41	252	0.29
1	190	1.06	100	0.67	92	0.93
2	3	1.58	84	1.01	36	1.43
3	0		36	1.34	10	1.67
4	0		10	1.46	4	1.91
5	0		5	1.50	3	1.71
6	0		0		2	2.24

like Protestant churches except for the existence of a planner.

1.8.1 Estimates

I estimate the game presented in section 1.4 using the strategy described in section 1.5 . Specifically, I estimate the inter-religious game between Mainline and Evangelical Protestants, so $R = \{MP, EP\}$. I also make the assumption that both of these religious groups are acting under decentralized entry. Thus I set $\lambda_r = 0$ for both MP and EP in equation 1.5. I estimate the restricted model in which the α_r^n's are set so that variable profits are evenly split between N_r churches. I also estimate the case where the α_r^n's are free, so that variable profits decrease as N_r increases, but not necessarily in exact proportion. (I do impose the restriction that $1 - \sum_{n=2}^{N_r^{max}} \alpha_r^n \geq 0$ so that per church profits are always positive.)

The specific markets used were markets in MT, WY, ND, SD, and IA. The restrictions on market population result in markets such that the maximum number of churches of a specific religious type in a certain market is 6. This maximum on number of churches is necessary for estimation, since each α_r^n needs to be estimated (there must be a limit on the maximum number of churches). Table 1.2 gives summary statistics of market characteristics for these markets used in the estimation. The characteristics for this set of markets are similar to those for the set of isolated markets in MT, WY, ND, SD, and IA.

Table 1.8 gives the results of the estimation. The estimates for the two cases (with α's restricted and not restricted) are qualitatively similar. The estimates for $\beta_r, \delta_r, \alpha_r^2, \ldots, \alpha_r^5, \gamma^r$ for $r = \{MP, EP\}$ are all significant at the 5% level. The α_r^n terms are lower for EP than MP. This implies additional EP churches have lower adverse effects on existing entrants. The fixed cost for an EP church is larger than the fixed cost of an MP church. The cross-effect terms, $\theta_{MP,EP}$ and $\theta_{EP,MP}$ are also both significant at the 5% level. They are negative, as would be expected for the competitive effects of another firm.

1.8.2 Experiments

It was seen in section 1.7 that Catholic churches are behaving quite differently than Protestant churches. This section looks at the effect of a planner making entry decisions compared to decentralized entry. The estimates in section 1.8 were obtained making the assumption that Protestant churches were taking part in decentralized entry (this means that a Protestant church's marginal profit given in equation (1.5) has $\lambda_{MP} = \lambda_{EP} = 0$). In this section I want to see to what extent a Catholic planner explains the difference in entry behavior. Specifically, I will address the question: if Catholics are exactly like Mainline Protestants (parameters are those estimated for MP above) except Catholics are being run by a planner (Catholics have marginal profit given by equation (1.5) with $\lambda_C = 1$) what would the Catholic entry pattern look like? This experiment will be repeated treating Catholics just like Evangelical Protestants, except for the λ_C term.

Using the parameter estimates from section 1.8 and assuming a value for λ_C I will obtain fitted values for the number of Catholic churches in each

Table 1.8: Estimates for MP and EP, Restricted α's and Unrestricted α's

		Division of Variable Profits			
		Restricted α's		Unrestricted α's	
Parameter	Variable	Mainline Protestant	Evangelical Protestant	Mainline Protestant	Evangelical Protestant
β_r^1	pinc	2.1721	1.8716	2.1740	2.3152
		(0.2722)	(0.2498)	(0.3191)	(0.1985)
δ_r	F_r	3.9530	2.5708	4.3395	3.4184
		(0.6238)	(1.2928)	(0.7441)	(1.3068)
α_r^1		-0.0833	0.3079	-0.6783	-0.2936
		(0.3182)	(0.3361)	(0.3758)	(0.2604)
α_r^2		0.5000	0.5000	0.4880	0.5079
				(0.0315)	(0.0375)
α_r^3		0.1667	0.1667	0.2784	0.2460
				(0.0262)	(0.0370)
α_r^4		0.0833	0.0833	0.1565	0.1066
				(0.0228)	(0.0322)
α_r^5		0.0500	0.0500	0.0772	0.0665
				(0.0205)	(0.0322)
α_r^6			0.0333		0.0805
					(0.0445)
$\theta_{r,q}$	Cross Effect	0.8817	0.5261	0.8723	0.8055
		(0.1469)	(0.1033)	(0.2124)	(0.1566)
γ_r	Fixed Cost	1.8729	2.1615	1.5599	1.9658
		(0.0945)	(0.1137)	(0.0930)	(0.1346)

Note: Standard errors in parentheses.

Table 1.9: Probability a Market has Given Number of Catholic Churches, Using MP Estimates, for Different λ_C

Number		Restricted α's		Unrestricted α's	
Churches	Actual	$\lambda_C = 0$	$\lambda_C = 1$	$\lambda_C = 0$	$\lambda_C = 1$
0	0.52	0.44	0.44	0.52	0.52
1	0.48	0.20	0.53	0.20	0.46
2	0.01	0.12	0.00	0.18	0.01
3	0.00	0.07	0.00	0.07	0.00
4	0.00	0.04	0.00	0.01	0.00
5	0.00	0.13	0.03	0.02	0.00

market. The per-capita variable profit for a Catholic church is given by:

$$\hat{V}_C(X, F_C) = \hat{\delta}_r F_C + X\hat{\beta}_r + \hat{\alpha}_r^1 \tag{1.11}$$

The profit of the N_C^{th} Catholic church will be given by:

$$\hat{\Pi}_C(N_C, Z, \hat{\omega}_r; \lambda_C) = \left(1 - \sum_{n=2}^{N} \hat{\alpha}_r^n\right) \hat{V}_C(X, F_C)S - \hat{\gamma}_r - \lambda_C(N_C - 1)\hat{\alpha}^N \hat{V}_C(X, F_C)S \tag{1.12}$$

This marginal profit equation is very similar to equation (1.5). The cross-effect of MP or EP churches has been set to 0 ($\theta_{C,MP} = \theta_{C,EP} = 0$). Using the profit function given in equation (1.12), I can obtain a probability mapping similar to Ψ in equation (1.10). I use this probability mapping to produce the probability of there being N_C Catholic churches, assuming Catholics have the same parameters as MP, for the cases $\lambda_C = 0$ and also if $\lambda_C = 1$. Table 1.9 reports the results, along with the probabilities actually seen in the data. Notice that changing λ_C from 0 to 1 does not change the probability of there being 0 Catholic churches. Looking at profit equation (1.12), it can be seen that $\hat{\Pi}_C(1, Z, \hat{\omega}_r; \lambda_C)$ is not affected at all by the λ_C term. Since λ_C does not affect the profit of the first entrant, λ_C will have no impact on the number of markets with 0 Catholic churches. Using MP parameters in the unrestricted α case matches the probability of 0 Catholic churches. In Table 1.9 one can see that, as expected, if λ_C is set to 0 (so if Catholics were engaging in free-entry) the probability of two or more Catholic churches is over-predicted and the number of markets with only 1 Catholic church is under-predicted (this holds for both the restricted and unrestricted α cases). Setting $\lambda_C = 1$ (having a Catholic planner make entry decisions) with unrestricted α's matches the probability of there being 0 Catholic churches, slightly under-predicts the probability of 1 Catholic church and matches the probability of 2-5 Catholic churches. The predictions with $\lambda_C = 1$ are much closer to observed probabilities than predictions with $\lambda_C = 0$. The patterns in both the restricted and unrestricted α cases are qualitatively similar. The unrestricted α case with $\lambda_C = 1$ results in probabilities almost exactly the same as the actual observed fractions.

I also calculate the probability that a person lives in a market with a specified number of churches (population-weighted probabilities). Table 1.10 reports the results using MP parameters. For example, in the data, 29% of the population lives in a market without a Catholic church. Using MP parameters under-predicts the probability that a person lives in a market with 0 Catholic churches. Setting $\lambda_C = 0$ substantially over-predicts the probability that a person lives in a market with 2 catholic churches and under-predicts the probability that someone lives in a market with 1 church. Setting $\lambda_C = 1$ results in probabilities closer to observed probabilities.

Table 1.10: Probability a Person lives in a Market with a Given Number of Catholic Churches, Using MP Estimates, for Different λ_C

Number		Restricted α's		Unrestricted α's	
Churches	Actual	$\lambda_C = 0$	$\lambda_C = 1$	$\lambda_C = 0$	$\lambda_C = 1$
0	0.29	0.16	0.16	0.23	0.23
1	0.69	0.20	0.81	0.25	0.76
2	0.02	0.18	0.00	0.34	0.01
3	0.00	0.13	0.00	0.14	0.00
4	0.00	0.08	0.00	0.02	0.00
5	0.00	0.24	0.03	0.02	0.00

Another fitted value I look at is a prediction of the number of markets with a given number of Catholic churches. To do this I calculate the per church profit if there are N_C Catholic churches using equation (1.12). I assume $\epsilon_C = 0$ for all markets (since standard normal distribution has mean zero). The fitted estimate for number of Catholic churches in a given market will be $\hat{N}_C$ where $\hat{N}_C$ satisfies:

$$\hat{\Pi}_C(\hat{N}_C, Z, \hat{\omega}_r) \geq 0 \text{ and } \hat{\Pi}_C(\hat{N}_C + 1, Z, \hat{\omega}_r) < 0 \tag{1.13}$$

Table 1.11 reports the fitted values using MP parameters. The number of markets with 0 Catholic churches is under-predicted in the restricted α case and over-predicted in the unrestricted α case. As expected, when $\lambda_C = 0$, the number of markets with 1 Catholic church is substantially under-predicted and the number of markets with 2 or more Catholic churches is over predicted. Predictions with $\lambda_C = 1$ are much closer to the data.

The above experiments are also done using EP parameters and $\lambda_C = 0$ and $\lambda_C = 1$. Tables 1.12, 1.13, and 1.14 report the results. We can see

Table 1.11: Estimated Number Markets with Given Number of Catholic Churches, Using MP Parameter Estimates, for Different λ_C

Number	Number of Markets				
		Restricted α's		Unrestricted α's	
Churches	Actual	$\lambda_C = 0$	$\lambda_C = 1$	$\lambda_C = 0$	$\lambda_C = 1$
0	206	196	196	227	227
1	190	69	203	82	172
2	3	65	0	83	0
3	0	37	0	7	0
4	0	18	0	0	0
5	0	14	0	0	0

Table 1.12: Probability a Market has Given Number of Catholic Churches, Using EP Estimates, for Different λ_C

Number		Restricted α's		Unrestricted α's	
Churches	Actual	$\lambda_C = 0$	$\lambda_C = 1$	$\lambda_C = 0$	$\lambda_C = 1$
0	0.52	0.51	0.51	0.52	0.52
1	0.48	0.21	0.48	0.21	0.47
2	0.01	0.11	0.00	0.17	0.01
3	0.00	0.06	0.00	0.06	0.00
4	0.00	0.03	0.00	0.02	0.00
5	0.00	0.02	0.03	0.01	0.00
6	0.00	0.06	0.02	0.01	0.02

the pattern that the predicted probability of 1 Catholic church is lower in the $\lambda_C = 0$ than the $\lambda_C = 1$ case, while the probability of 2 or more Catholic churches is higher in the $\lambda_C = 0$ than the $\lambda_C = 1$ case. The probabilities with unrestricted α's and $\lambda_C = 1$ are nearly exactly the same as the fractions observed in the data (as was the case with the MP estimates).

These results seem to be too good. As mentioned in the introduction,

Table 1.13: Probability a Person lives in a Market with a Given number of Catholic Churches, Using EP Estimates, for Different λ_C

Number		Restricted α's		Unrestricted α's	
Churches	Actual	$\lambda_C = 0$	$\lambda_C = 1$	$\lambda_C = 0$	$\lambda_C = 1$
0	0.29	0.21	0.21	0.22	0.22
1	0.69	0.26	0.77	0.26	0.77
2	0.02	0.20	0.00	0.33	0.01
3	0.00	0.12	0.00	0.13	0.00
4	0.00	0.07	0.00	0.04	0.00
5	0.00	0.04	0.00	0.02	0.00
6	0.00	0.11	0.02	0.01	0.03

Table 1.14: Estimated Number of Markets with Given Number of Catholic Churches, Using EP Parameter Estimates, for Different λ_C

	Number of Markets				
Number		Unrestricted α's		Restricted α's	
Churches	Actual	$\lambda_C = 0$	$\lambda_C = 1$	$\lambda_C = 0$	$\lambda_C = 1$
0	206	223	223	222	222
1	190	82	176	83	177
2	3	51	0	82	0
3	0	31	0	12	0
4	0	8	0	0	0
5	0	4	0	0	0
6	0	0	0	0	0

there could be other explanations for the difference in entry behavior between Catholics and Protestants. The fact that the presence of a planner can explain the entire difference is surprising.

1.8.3 Market Thresholds

Following Bresnahan and Reiss [1991] I use parameter estimates and the average values of variables to calculate entry thresholds for both Mainline and Evangelical Protestants. S_N is the minimum number of people necessary to sustain a market with N churches. Explicitly:

$$S_N = \frac{\hat{\gamma}_r}{\left(1 - \sum_{n=2}^{N} \hat{\alpha}_r^n\right) \hat{V}(N_{-r}, \bar{X}, \bar{F}_r)} \tag{1.14}$$

The bars represent the average value of the variables. The hats represent the estimates for the parameters. For N_{-r} the NPL beliefs are used. For Evangelical Protestants there is quite a difference in entry thresholds between the restricted and unrestricted α's cases. With unrestricted α's, $\hat{\beta}_1$ and $\hat{\alpha}^1$ are larger than the restricted case, while $\hat{\gamma}$ is smaller for the unrestricted case. A larger per-capita variable profit and smaller fixed cost will result in smaller entry thresholds for the unrestricted case. For the unrestricted α case, threshold populations cannot be calculated for Mainline Protestants when $N = 5$ or for Evangelical Protestants when $N = 6$. One can think of the threshold market size as being infinite for these situations. $\frac{S_N}{N}$ is the number of people necessary per church. When the $\alpha's$ are restricted this number will be the same for any number of churches. When α's are unrestricted this number increases as

Table 1.15: Entry Threshold Estimates

	Number of churches					
	1	2	3	4	5	6
Restricted α's						
Mainline Protestant						
S_N	0.482	0.965	1.447	1.919	2.411	
$\frac{S_N}{N}$	0.482	0.482	0.482	0.482	0.482	
$\frac{S_N}{N} / \frac{S_{N-1}}{N-1}$		1.000	1.000	1.000	1.000	
Evangelical Protestant						
S_N	0.788	1.576	2.364	3.152	3.940	4.728
$\frac{S_N}{N}$	0.788	0.788	0.788	0.788	0.788	0.788
$\frac{S_N}{N} / \frac{S_{N-1}}{N-1}$		1.000	1.000	1.000	1.000	1.000
Free α's						
Mainline Protestant						
S_N	0.454	0.887	1.943	5.884		
$\frac{S_N}{N}$	0.454	0.443	0.648	1.470		
$\frac{S_N}{N} / \frac{S_{N-1}}{N-1}$		0.977	1.461	2.271		
Evangelical Protestant						
S_N	0.272	0.554	1.108	1.956	3.736	
$\frac{S_N}{N}$	0.272	0.277	0.369	0.489	0.747	
$\frac{S_N}{N} / \frac{S_{N-1}}{N-1}$		1.016	1.333	1.323	1.528	

N increases for both Mainline and Evangelical Protestants. $\frac{S_N}{N} / \frac{S_{N-1}}{N-1}$ is the ratio of people per church for N churches to the number of people per church for $N-1$ churches. When α's are restricted this ratio is fixed at 1 for all N. When α's are unrestricted these ratios increase.

1.9 Conclusion

This paper takes the existing knowledge capital that IO economists have acquired studying strategic entry and applies it to churches. Observing differences in the behavior of Catholic churches compared to Mainline and Evangelical Protestant churches, this paper addresses the question of how much of that difference can be explained by the presence of a Catholic planner. To address this question, this paper develops a strategic entry model for churches and estimates the model using data on uniquely defined markets. Assuming that Catholics are just like Protestants, other than being centrally planned, I find that a Catholic planner explains virtually all of the difference in entry patterns.

It could be argued that this the presence of a planner explains too much of the difference in behavior. There are other differences in between Catholics and Protestants that could potentially explain the difference in entry behavior. One possibility is a Protestant preference for fewer members per church. Potential future research includes introducing a demand structure into the model to address other possible explanations.

Chapter 2

A Model of Church Exit

2.1 Introduction

Much work has been in the fields of economics and sociology treating religion as an industry.[1] Religious organizations have their own North American Industry Classification System (NAICS) code: 813110.[2] There have been many arguments concerning the similarities and differences between markets for goods traditionally provided by for-profit firms and a market for religion.[3] One significant empirical difference is the difference between exit rates of for-profit firms and exit rates of churches. While there has been much work

[1] Two specific papers that motivate the idea of a market for religion are Finke and Stark [1992] and Iannaccone [1995]. Specific papers that deal with the demand side of the market (an individual's decision regarding religious participation) include Azzi and Ehrenberg [1975] and Iannaccone [1990]. Work dealing with the supply side of the market (the decisions of religious organizations) include Ekelund [1996] and the first chapter of this dissertation.

[2] Religious organizations are a subset of the Other Services classification.

[3] One specific example on the demand side of differences is Azzi and Ehrenberg [1975] which includes after-life consumption in the utility function. On the supply side the objective of a religious "producer" is not necessarily assumed to be profit-maximization (further discussion on the assumption of a religious producers objective function in the second paragraph of this section).

looking at exit rates for a variety of different for-profit industries, only limited work has been done looking at exit rates for churches.[4] The work that has been done shows that exit rates for churches are much lower than exit rates of firms in typical for-profit industries.

In general, when thinking about the decisions of churches versus the decisions of a for-profit firm an immediate potential difference that comes to mind is the objective function. It is assumed that for-profit firms maximize profits. However, in the literature the assumed objective of churches is not as clear. Ekelund [1996] assumes the Medieval Catholic church acted as a profit-maximizer. In the first chapter of this thesis I assume that religious entrepreneurs act as profit-maximizers when making a decision of whether or not to enter a market. Another common assumption is that churches maximize consumer welfare (maximizes the aggregate utility of consumers); specific papers that make this assumption include Iannaccone [1992] and Zaleski and Zech [1992]. This disagreement regarding objectives is also seen in the broader literature on non-profits. Lakdawalla and Philipson [2006] study the decisions of non-profits by treating them as for-profit firms, but with the advantage of lower costs. In Newhouse [1970] hospitals maximize quantity given a certain level of quality. Steinberg [1986] presents an empirical test of whether a non-profit is budget-maximizing or service-maximizing and finds that certain types of non-profits are service-maximizers while other non-profits are budget-maximizers. Under certain conditions (to be discussed more in section 1.4) maximizing consumer surplus is equivalent to maximizing output. This

[4] There is further discussion of existing work looking at the exit rate of churches in section 2.4. Work looking at for-profit exit rates include Dunne et al. [1988], which looks at manufacturing and Jarmin et al. [2003], which looks at retail.

paper will consider both the case of a non-profit acting to maximize profits and the case in which a non-profit maximizes output.

Though the assumed objectives of non-profits vary, the common distinction between non-profits and for-profits is that a non-profit cannot distribute profits to those in control. Whereas for-profits distribute profits to owners (shareholders). When thinking about exit this distinction is important since when a unit (or plant or store) is shut-down there is some scrap value. If a for-profit firm owns a single unit and decides to close it, the scrap value that is obtained is transferred to the shareholders. If there is a religious organization that is not affiliated with a denomination that sells its church, no one in control of the church can receive the proceeds.[5] However, if a single Catholic church closes and is sold (for a scrap value) the proceeds can be used by the Catholics to support other churches.[6] A religious organization deciding whether or not to close a church will take into account whether the organization is single unit or multi-unit.

In literature studying the exit rate of firms in for-profit industries an important factor is whether or not a firm is single-plant or multi-plant (seen in Dunne et al. [1989]). While there is not much work looking at exit of either churches or non-profits more generally, recent literature has looked at the size of non-profits and how it affects a non-profit's expansion into for-profit enterprises (for example see Weisbrod [1997]). This paper will look at how a non-profit's

[5]According to Pew [2008] "'denomination' refers to a set of congregations [churches] that belong to a single administrative structure characterized by particular doctrines and practices." Examples of specific denominations include the Roman Catholic Church, Evangelical Lutheran Church of America and United Methodist.

[6]The Internal Revenue Service states that if a non-profit has any assets remaining when it dissolves the assets must go to other tax-exempt organizations (see Int).

exit decision is affected by whether or not it is single or multi-unit.

This paper proceeds as follows. Section 2.2 presents a model in which there are both for-profit firms and religious entrepreneurs with either one or two units that make a decision of whether or not to exit. Section 2.3 looks at the implications of the model regarding exit rates. Section 2.4 looks at data on exit rates of for-profit industries and churches and compares the data to the model's predictions. Section 2.5 concludes.

2.2 Model

This section presents a simple model of the exit decision of for-profit firms and religious entrepreneurs. This is a one period model. A for-profit firm wakes up with either one or two stores (units); a religious entrepreneur wakes up with either one or two churches (units). If a for-profit firm (religious entrepreneur) chooses to operate a unit it incurs a fixed cost (for each unit it operates). A for-profit firm (religious entrepreneur) can choose to shut down a store (church) and receive some scrap value. The decision to shut down a store (church) is interpreted as exit.

Both stores and churches produce the same good with the only input being labor. Output, q, is determined by:

$$q = \varphi l^{\alpha} \tag{2.1}$$

where $\alpha \in (0, 1)$ and $\varphi \geq 0$ is a productivity shock.

Demand for the good is perfectly elastic at price p. Labor is supplied perfectly elastically at wage w. If a firm (entrepreneur) chooses to operate a unit, it incurs fixed cost θ. If a firm (entrepreneur) chooses to shut down a unit, it receives scrap value ψ.

For-profit firms differ from religious entrepreneurs in objectives and what can be done with scrap value ψ. First I will consider the decision of a for-profit firm, then the decision of a religious entrepreneur.

2.2.1 For-profit firm

Given the environment above, a for-profit firm will choose amount labor, l^*, that maximizes the following profit expression:

$$\Pi(l) = p\varphi l^{\alpha} - wl - \theta \tag{2.2}$$

If a for-profit firm chooses to shut down a unit it can distribute the scrap value ψ to its shareholders. When a for-profit firm makes the decision of whether or not to operate a plant it needs to take this opportunity cost of staying open into account. The firm will shut down a unit if profit is less than the scrap value, ψ, and keep the unit open if profit is greater than the scrap value. If $\Pi(l^*) \geq \psi$ the firm will operate the unit; if $\Pi(l^*) < \psi$ the firm will shut the plant down and distribute ψ to shareholders.

If a firm has two units, the units differ in their productivity shocks, φ_1 and φ_2. The firm chooses l_1^* and l_2^* that maximize equation (2.2). A for-profit firm with two units simply makes the same decision a for-profit single unit firm would two times.[7] If $\Pi(l_i^*) \geq \psi$ the firm will operate unit i; if $\Pi(l_i^*) < \psi$ the firm will shut down unit i. It is possible for the firm to operate either 0, 1, or 2 units.

2.2.2 Religious entrepreneur

There are two key modeling differences between a for-profit firm and a religious entrepreneur. One difference is the objective function. I will consider two different objectives for a religious entrepreneur: profit-maximization and output maximization.[8] Another difference is what can be done with scrap value ψ. A for-profit firm can scrap a unit and distribute ψ to shareholders. A religious entrepreneur cannot distribute ψ to shareholders. If the religious entrepreneur is multi-unit, ψ can be transferred from a closed unit to the other unit (as long as the other unit is operated).

2.2.2.1 Profit-maximization

A religious entrepreneur that maximizes profit would choose the same level of labor as a for-profit firm (maximize equation (2.2)). However, the religious entrepreneur's decision of whether or not to operate will be different given the

[7] A for-profit firm with two units can be thought of as either solving:

$$\max_{l_i} p\varphi_i l_i^\alpha - wl_i - \theta \quad \text{for i = 1,2}$$

or

$$\max_{l_1,l_2} p\varphi_1 l_1^\alpha + p\varphi_2 l_2^\alpha - wl_1 wl_2 - 2\theta$$

Looking at the first order conditions it can be seen that solving either problem results in the same l_1^*, l_2^*.

[8] As mentioned in section 2.1 a commonly assumed objective for churches is maximizing consumer welfare. Assuming perfectly elastic demand, welfare is maximized by maximizing quantity subject to non-negative profits.

different policy with regard to scrap value ψ.

A religious entrepreneur with just one unit would not be able to take advantage of ψ, thus this religious entrepreneur will operate the unit as long as profits are greater than zero ($\Pi(l^*) \geq 0$).

For a religious entrepreneur with two units, suppose l_i^* that maximizes equation (2.2) for $i = 1, 2$. Suppose $\varphi_1 \geq \varphi_2$. The religious entrepreneur compares the following:

$$\begin{cases} \Pi(l_1^*) + \Pi(l_2^*) & \text{(operate both units)} \\ \Pi(l_1^*) + \psi & \text{(operate more productive unit, close down less productive)} \\ 0 & \text{(close down both units)} \end{cases} \tag{2.3}$$

and chooses the option that results in highest total profit (from both units combined).

2.2.2.2 Output-maximization

A religious entrepreneur with one unit chooses employment level $\hat{l}$ that maximizes output subject to a non-negative profit constraint:

$$\begin{aligned} \max_{l} \quad & \varphi l^{\alpha} \\ \text{s.to} \quad & p\varphi l^{\alpha} - wl - \theta \geq 0 \end{aligned} \tag{2.4}$$

For a religious entrepreneur with only 1 unit, the scrap value ψ has no effect on its decision (since there are neither share-holders nor another unit that could benefit from ψ).

A religious entrepreneur with two units has more possibilities. One possibility is that the entrepreneur operates both units independently, choosing an amount of labor for each unit that maximizes that unit's output subject to non-negative profits. Another alternative is that one unit (with higher φ) subsidizes a unit (with lower φ) such that the low-value φ unit produces more than it otherwise could have due to the non-negative profit constraint. Or the firm can close down the unit with lower φ and use scrap value ψ to subsidize the remaining unit (with higher φ).

The entrepreneur must consider each possibility. The entrepreneur must determine $\{\hat{l}_1, \hat{l}_2\}$ that satisfies:

$$\begin{aligned} \max_{l_i} \quad & \varphi_i l_i^\alpha \\ \text{s.to} \quad & p\varphi_i l_i^\alpha - wl_i - \theta \geq 0 \text{ for } i = 1, 2 \end{aligned} \tag{2.5}$$

$\{\tilde{l}_1, \tilde{l}_2\}$ that satisfies:

$$\begin{aligned} \max_{l_1, l_2} \sum_{i=1}^{2} \varphi_i l_i^\alpha \\ \text{s.to} \sum_{i=1}^{2} (p\varphi_i l_i^\alpha - wl_i - \theta) \geq 0 \end{aligned} \tag{2.6}$$

And $\bar{l}$ that satisfies

$$\begin{aligned} \max_{l_i} \quad & \varphi_i l_i^\alpha \\ \text{s.to} \quad & p\varphi_i l_i^\alpha - wl_i - \theta + \psi \geq 0 \\ & \text{where } \varphi_i = \max\{\varphi_1, \varphi_2\} \end{aligned} \tag{2.7}$$

The religious entrepreneur must then choose which labor allocation maximizes combined output across the two units.

2.3 Model Implications

For each of the situations above I am interested in whether a for-profit firm (religious entrepreneur) chooses to operate a unit or shut the unit down. Specifically, I am interested in cutoffs for the productivity shock, $\hat{\varphi}$. Such that for $\varphi \geq \hat{\varphi}$ the firm (entrepreneur) will operate the unit and for $\varphi < \hat{\varphi}$ the firm (entrepreneur) will shut down the unit. I want to see how this cutoff compares for a for-profit firm with one unit ($\hat{\varphi}_{f,1}$), a for-profit firm with two units ($\hat{\varphi}_{f,1}$), a religious entrepreneur with one unit ($\hat{\varphi}_{r,1}$) and a religious entrepreneur with two units ($\hat{\varphi}_{r,2}$) (for the religious entrepreneur I will consider both possible objective functions).

As mentioned above, a for-profit firm with two units acts the same as a single unit firm making its decision two different times. For a for-profit, two-unit firm each plant must satisfy the same productivity cutoff as a single plant. Thus $\hat{\varphi}_{f,1} = \hat{\varphi}_{f,2}$. The rest of the paper will just consider a single for-profit cutoff, $\hat{\varphi}_f$.

I am interested in how the for-profit productivity cutoff compares to the productivity cut-offs for a religious entrepreneur with 1 and 2 units.

I will first consider the case of a religious entrepreneur who maximizes profits.

Proposition 2.3.1. *For $\alpha \in (0, 1)$ and $\psi > 0$ if the religious entrepreneur maximizes profits then $\hat{\varphi}_f > \hat{\varphi}_{r,1} > \hat{\varphi}_{r,2}$.*

Proof. See appendix. □

If both the for-profit firm and the religious entrepreneur are choosing labor to maximize profit, the only difference is what can be done with scrap value ψ. For the for-profit firm to operate a unit, $\hat{\varphi}_f$ must ensure profits are larger than ψ. On the other hand, for a religious entrepreneur to operate a single unit, $\hat{\varphi}_{r,1}$ must ensure profits are just greater than zero. Since profits are increasing in φ, $\hat{\varphi}_f > \hat{\varphi}_{r,1}$ when $\psi > 0$. A religious entrepreneur with two units can scrap the unit with lower φ and use ψ to subsidize the other unit. A two unit religious entrepreneur will operate at least one unit as long as profits given $\hat{\varphi}_{r,2}$ plus ψ are greater than zero (profits with $\hat{\varphi}_{r,2}$ are greater than $-\psi$). Again, since profits are increasing in φ, it must be that $\hat{\varphi}_{r,1} > \hat{\varphi}_{r,2}$.

I will now consider the case in which a religious entrepreneur maximizes output subject to non-negative profits. I first consider a very restricted case analytically.

Proposition 2.3.2. *For $\alpha = 0.5$ and $\psi > 0$ if religious entrepreneurs are maximizing output subject to non-negative profits then $\hat{\varphi}_f > \hat{\varphi}_{r,1} > \hat{\varphi}_{r,2}$.*

Proof. See appendix. □

Intuitively, the key difference between the three cases involve the scrap value, ψ. The for-profit firm has the highest productivity cutoff because in order for the firm to operate a unit its profits must be high enough to cover scrap value ψ. Whereas, for a religious entrepreneur with just one unit only needs a φ high enough to ensure zero profits. A religious entrepreneur with two units can close one unit to subsidize the other unit; with the subsidy the remaining unit can maintain zero profits with a productivity shock lower than the two previous cases.

Theorem 2.3.2 restricts α to 0.5, but the above intuition holds for all $\alpha \in (0, 1)$. Also the above result was verified numerically for $\alpha \in (0, 1)$.

As mentioned above, the key to the differences in $\hat{\varphi}$ was driven by ψ. If $\psi = 0$ then $\hat{\varphi}_f = \hat{\varphi}_{r,1} = \hat{\varphi}_{r,2}$ (for both the case when the religious entrepreneur maximizes profit and when the religious entrepreneur maximizes output). With zero scrap value there will be no benefit to a religious entrepreneur from scrapping a second unit, thus there would be no difference between a one-unit and two-unit religious entrepreneur. With no scrap value a for-profit firm would start operating as soon as φ was high enough to ensure zero profits – the same as a religious entrepreneur with one unit.

The relationship between these productivity cutoffs can be used to think about relative exit rates of different types of firms. Higher productivity cutoffs mean that firms of that type are less likely to stay in the market (more likely to exit). Then for-profit firms, regardless of the number of units, will have the highest exit rate. A religious entrepreneur with one unit will have a lower exit rate and a religious entrepreneur with two units will have the lowest exit rate.

2.4 Exit rates

This section looks at exit rates in existing literature and also looks at new data to see if data reflects the patterns in exit rates predicted in the model above.

2.4.1 Existing studies

There has been much work done looking at exit rates of firms in for-profit industries. For instance Dunne et al. [1988] look at exit rates of manufacturing firms and Jarmin et al. [2003] look at exit of firms in service industries. From these studies annual exit rates range from 6.5-8% for manufacturing firms and 10-12% for retail firms.

In comparison to the work done on the exit of for-profits, there is not much literature on the exit of churches or non-profits more generally. There are a few studies that look at various different types of non-profit organizations. Anderson et al. [2008] specifically study the exit rates of churches by starting with a 1998 census of churches and checking on a randomized sub-sample of churches in 2005. Using this method they found an annual exit rate of about 1%. They note that churches that are not affiliated with a denomination (these churches can be thought of as single-unit) are more likely to exit than churches affiliated with a denomination (multi-unit).

From existing studies the closest comparison of exit rates from for-profits to the exit rates of churches comes from comparing results from Jarmin et al. [2003] and Anderson et al. [2008]. Jarmin et al. [2003] reports that the annual exit rate for the US retail sector between 1992-1997 is 9.7%.[9] Anderson et al. [2008] reports that the annual exit rate for churches in the US between 1998-2005 is 1.0%.

This exit rate for churches is much lower than exit rates reported for for-profit industries; however, the exit rates come from different sources and dif-

[9] Jarmin et al. [2003] present exit rates from 1977-1997. The 1992-1997 exit rate is the lowest at 9.7% per year. The highest annual exit rate is 12.0% and occurs between 1987-1992.

ferent time periods. To gain further insight on the exit rate of churches and form a better comparison to exit rates of for-profit service providers, I look at historical evidence.

2.4.2 Description of historical data

Using city directories from 1901, 1906, 1916, 1926 and 1936 I collected the name and address of every church in seven cities in Iowa and one in South Dakota.[10] I also collected denominational information. A church affiliated with a denomination can be thought of as multi-unit, whereas a church not affiliated with a denomination is single-unit. Table 2.1 provides church counts and average market population for the above years. It can be seen that both population and number of churches grew over this time. In addition to collecting the church data, I also collected data on grocery stores in the three of the same cities for the same years in order to compare the behavior of churches to a specific type of for-profit firm.[11] Table 2.1 provides counts for churches and grocery stores and average city population for the three specific markets.

2.4.3 Analysis of data

With this data I first look at exit rates for for churches (denominationally affiliated and not affiliated) and grocery stores. I then look at regressions of exit on different variables.

[10]The cities in Iowa are Burlington, Cedar Rapids, Council Bluffs, Davenport, Des Moines, Sioux City and Waterloo. Sioux Falls, SD is also included.

[11]The three cities for which I also have grocery data are Burlington, Cedar Rapids and Council Bluffs, all in Iowa.

Table 2.1: Counts for Churches and Grocery Stores

	Year				
	1901	1906	1916	1926	1936
All Markets					
Counts					
Affiliated Churches	266	316	366	430	462
Non-Affiliated Churches	35	49	61	85	82
All Churches	301	365	427	515	544
Average Market Population	28,501	34,233	46,845	57,603	64,119
Limited Markets					
Counts					
Affiliated Churches	92	91	105	118	126
Non-Affiliated Churches	9	14	17	26	19
All Churches	101	105	122	144	145
Grocery Stores	224	238	352	459	434
Average Market Population	24,886	27,240	32,681	39,085	42,552

Using the name and address of each church I was able to determine the entry of new churches and the exit of existing churches. Exit rates for a given time range are calculated by taking the number of churches that left the market over that time range divided by the number of churches at the beginning of the time range; exit rates can be seen in Table 2.2. Roughly, the annual exit rates for all churches are between 1.8-2.4%.[12] The exit rates are then broken down between churches affiliated with a denomination (which can be thought of as churches affiliated with a "multi-unit") and churches not affiliated with a denomination (these churches can be thought of as "single-unit"). It can be seen that the denominationally affiliated churches have noticeably lower exit rates that non-affiliated churches.

Similarly, using address and proprietor name I can determine entry and exit of grocery stores. Exit rates for grocery stores are also reported in table 2.2. Grocery stores are an example of a specific for-profit retail industry. The exit rates for the grocery stores are higher than the exit rates for churches (all churches, denominationally affiliated and non-affiliated). This data supports the implication of the model that exit rates increase as one compares exit rates of multi-unit religious entrepreneurs to single-unit religious entrepreneurs to for-profits.

The exit predictions of the model can also be tested by looking at regressions of firm exit. First, consider just the exit of churches. The model predicts that non-affiliated churches will have higher exit than affiliated churches. Using a probit model I estimate the probability that a church will exit as a

[12]Take the exit rate for the given time periods and divide by number of years in the time period.

Table 2.2: Exit Rates for Churches and Grocery Stores

	Years			
	1901-1906	1906-1916	1916-1926	1926-1936
All Markets				
Affiliated Churches	0.10	0.15	0.13	0.13
Non-Affiliated Churches	0.14	0.55	0.52	0.53
All Churches	0.10	0.24	0.18	0.19
Limited Markets				
Affiliated Churches	0.13	0.09	0.12	0.11
Non-Affiliated Churches	0.33	0.29	0.41	0.46
Grocery Stores	0.36	0.57	0.67	0.58

function of whether or not the church is affiliated and other variables. I specifically use all churches that were existence in 1926; the dependent variable is whether the church exits by 1936 (then dependent variable is 1) or is still open in 1936 (dependent variable is 0). Summary statistics are in Table 2.3. Table 2.4 presents the results of the various specifications. In all specifications the effect of being non-affiliated is significantly positive, which is consistent with the prediction that a non-affiliated church is more likely to exit. The age of the church has a statistically significant negative effect on exit. One specification includes the growth rate in market population from 1926-1936; the population growth rate does not have a statistically significant effect on exit. Another specification includes dummy variables for each city other than Burlington. None of these city dummies have a statistically significant effect.

To test the effect of a for-profit firm versus a church on exit, I look at

Table 2.3: Summary Statistics for Churches That Existed in 1926

Variable	Number Observations	Minimum	Maximum	Mean	Standard Deviation
Exit	515	0.000	1.000	0.196	0.397
Non-affiliated Dummy	515	0.000	1.000	0.165	0.372
Age	515	0.000	25.000	13.922	10.807
Population Growth Rate	515	0.022	0.257	0.112	0.057
Cedar Rapids Dummy	515	0.000	1.000	0.117	0.321
Council Bluffs Dummy	515	0.000	1.000	0.083	0.277
Davenport Dummy	515	0.000	1.000	0.111	0.314
Des Moines Dummy	515	0.000	1.000	0.295	0.457
Sioux City Dummy	515	0.000	1.000	0.153	0.361
Sioux Falls Dummy	515	0.000	1.000	0.062	0.242
Waterloo Dummy	515	0.000	1.000	0.099	0.299

all grocery stores and churches in the three markets for which I have both church and grocery store data. I estimate the probability of exit as a function of whether or not it is a church or grocery store (using a grocery store dummy) and other variables. Summary statistics are available in Table 2.5. Table 2.6 presents the results of the various specifications. In all specifications the effect of being a grocery store (a for-profit firm) is significantly positive, which is consistent with the prediction that a for-profit firm is more likely to exit than a church. The age of the grocery store or church has a statistically significant negative effect on exit. Similar to the church-only regressions, population growth rate and city-specific dummies do not have a statistically significant effect.

Table 2.4: Probit Estimates for Churches Only

	(1)	(2)	(3)
Intercept	-0.8577	-0.7303	-0.8973
	(0.1164)	(0.1808)	(0.2821)
Non-affiliated Dummy	1.0623	1.0680	1.1005
	(0.1629)	(0.1633)	(0.1681)
Age	-0.0188	-0.0191	-0.0168
	(0.0064)	(0.0065)	(0.0067)
Population Growth Rate		-1.1225	
		(1.2103)	
Cedar Rapids Dummy			-0.1592
			(0.3243)
Council Bluffs Dummy			-0.0910
			(0.3495)
Davenport Dummy			0.2895
			(0.3131)
Des Moines Dummy			0.2432
			(0.2776)
Sioux City Dummy			-0.3712
			(0.3230)
Sioux Falls Dummy			-0.6900
			(0.4470)
Waterloo Dummy			-0.0822
			(0.3327)

Note: Standard errors in parentheses.

Table 2.5: Summary Statistics for Churches and Grocers That Existed in 1926

Variable	Number Observations	Minimum	Maximum	Mean	Standard Deviation
Exit	603	0.000	1.000	0.494	0.500
Grocer Dummy	603	0.000	1.000	0.761	0.427
Age	603	0.000	26.000	6.902	10.265
Population Growth Rate	603	0.022	0.257	0.091	0.056
Cedar Rapids Dummy	515	0.000	1.000	0.461	0.499
Council Bluffs Dummy	603	0.000	1.000	0.340	0.474

Table 2.6: Probit Estimates for Churches and Grocery Stores

	(1)	(2)	(3)
Intercept	-0.6348	-0.8704	-0.7599
	(0.1528)	(0.2806)	(0.1973)
Grocery Dummy	0.9607	0.9612	0.9612
	(0.1521)	(0.1522)	(0.1522)
Age	-0.0211	-0.0197	-0.0197
	(0.0062)	(0.0063)	(0.0063)
Population Growth Rate		0.5423	
		(0.9652)	
Cedar Rapids Dummy			0.1404
			(0.1496)
Council Bluffs Dummy			0.1493
			(0.1575)

Note: Standard errors in parentheses.

2.5 Conclusion

This paper presents a model of firms' exit decisions that depend on whether or not the firm is for-profit or a religious entrepreneur and single-unit or multi-unit. This model predicts that the exit rate of for-profits is higher than the exit rate of single-unit churches, which is higher than the exit rate of multi-unit churches. This prediction is seen in historical data comparing exit of grocery stores to exit of churches.

In this model the number of units has no effect on the exit rate of for-profit firms. Potential future research includes making the number of units endogenous. In that case I would expect the productivity shocks of multi-unit firms would be correlated and both be high, decreasing the exit rates for-profit firms and multi-unit religious entrepreneurs.

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Appendix

A.1 Proof of Proposition 1.3.1

Proof. Given a market with population S, if there are N churches each church will attract an equal number of customers:

$$\frac{S}{N + \exp[(V_0 - a + \bar{p})/\mu]}$$

Given constant price $\bar{p}$, profit for each church will be:

$$\Pi_N = \frac{\bar{p}S}{N + \bar{c}} - \gamma$$

Where $\bar{c} = \exp[(V_0 - a + \bar{p})/\mu]$. We can see that Π_N is decreasing in number of churches, N.

In free-entry the number of churches, $\hat{N}^F$, will satisfy a zero-profit condition:

$$\Pi_{\hat{N}^F} \geq 0 \quad \text{and} \quad \Pi_{\hat{N}^F+1} < 0$$

With a planner, the number of churches, $\hat{N}^P$, must maximize total profit:

$$(\hat{N}^P + 1)\Pi_{\hat{N}^P+1} < \hat{N}^P \Pi_{\hat{N}^P} \geq (\hat{N}^P - 1)\Pi_{\hat{N}^P-1}$$

This condition can be re-written as:

$$\Pi_{\hat{N}^P} - \frac{(\hat{N}^P - 1)\bar{p}S}{(\hat{N}^P + \bar{c})(\hat{N}^P + \bar{c} - 1)} \geq 0 \quad \text{and} \quad \Pi_{\hat{N}^P+1} - \frac{\hat{N}^P \bar{p}S}{\left(\hat{N}^P + 1 + \bar{c}\right)\left(\hat{N}^P + \bar{c}\right)} < 0$$

Comparing this condition to the free-entry condition highlights that the planner takes into account the profits of the last church and also the negative effect of that last church on existing churches (the $\frac{(\hat{N}^P-1)\bar{p}S}{(\hat{N}^P+\bar{c})(\hat{N}^P+\bar{c}-1)}$ term). In free-entry each entrant only considers its own profits, not its effect on others.

Since $\frac{N\bar{p}S}{(N+\bar{c}+1)(N+\bar{c})} \geq 0$ for $N \geq 1$, it follows that $\Pi_{N+1} - \frac{N\bar{p}S}{(N+\bar{c}+1)(N+\bar{c})} \leq \Pi_{N+1}$ for $N \geq 1$. Thus the number of churches that satisfies the planner's condition, $\hat{N}^P$, is less than or equal to the number of churches that satisfies the free-entry condition, $\hat{N}^F$.

□

A.2 Market Definition for Chapter 1

I start with the 3,877,307 Census blocks that are in the lower 48 states and the District of Columbia and not in a Metropolitan Statistical Area (MSA). I begin with each of these 3,877,307 blocks as a potential 'center' for a market. For every one of these potential center blocks I find the aggregate population of all blocks within 0.75 miles the potential center block. I now have the three-quarter mile population of every potential center block. Take a specific potential center block, called block A. For block A I find all other potential center blocks within 12 miles of A. Let U_A denote this set of all potential center blocks within 12 miles of block A. I am interested in the block in the set U_A that has the maximum population; call this block m_A. Every potential center has a corresponding m_A (so there are 3,877,307). Out of this set of 3,877,307 m_A's there will be many duplicates. After duplicates are eliminated, I go through each m_A and compare it to all other m_A's. If any two m_A's are within 12 miles of each other the m_A with a smaller population is eliminated. After this process I am left with a set of blocks that I consider to be 'centers.' There are 5,586 centers. Every state but New Jersey has at least one center. I consider a market to be everything within 3 miles of these centers.

A.3 Proof of Proposition 2.3.1

Proof. First look at the cutoff of a for-profit firm, $\hat{\varphi}_f$. This firm chooses l^* to satisfy the maximization problem in equation (2.2). Amount of labor l^* must satisfy the first order condition:

$$\alpha p \varphi l^{*\alpha-1} - w = 0 \tag{8}$$

The above can be re-written, to obtain $l^* = \left(\frac{\alpha p \varphi}{w}\right)^{\frac{1}{1-\alpha}}$. This equation for l^* can be substituted into the equation for profit to obtain an expression for profit in terms of φ:

$$\Pi(\varphi) = p\varphi^{\frac{1}{1-\alpha}} \left(\frac{\alpha p}{w}\right)^{\frac{\alpha}{1-\alpha}} - w\varphi^{\frac{1}{1-\alpha}} \left(\frac{\alpha p}{w}\right)^{\frac{1}{1-\alpha}} - \theta \tag{9}$$

The $\hat{\varphi}_f$ must satisfy:

$$\Pi(\hat{\varphi}_f) = \psi \tag{10}$$

. Differentiating equation (9) with respect to φ shows that profits are strictly increasing in φ.

Now consider the decision of of a religious entrepreneur with one unit. Assuming the religious entrepreneur is also maximizing profits, $\hat{\varphi}_{r,1}$ must satisfy:

$$\Pi(\hat{\varphi}_{r,1}) = 0 \tag{11}$$

. Since $\Pi(\varphi)$ is increasing in φ, $\hat{\varphi}_f > \hat{\varphi}_{r,1}$ as long as $\psi > 0$.

A religious entrepreneur with two units chooses labor that results in highest profit of three alternatives in equation (2.3). Given $\varphi_2 = 0$ the lowest φ_1

that will keep unit 1 operating will be obtained by closing unit 2 and using ψ to subsidize unit 1. $\hat{\varphi}_{r,2}$ must satisfy:

$$\Pi(\hat{\varphi}_{r,2}) + \psi = 0 \tag{12}$$

. Again, since $\Pi(\varphi)$ is increasing in φ, $\hat{\varphi}_{r,1} > \hat{\varphi}_{r,2}$ as long as $\psi > 0$.

Thus $\hat{\varphi}_f > \hat{\varphi}_{r,1} > \hat{\varphi}_{r,2}$.

□

A.4 Proof of Proposition 2.3.2

Proof. First look at the cutoff of a for-profit firm, $\hat{\varphi}_f$. This firm chooses l^* to satisfy the maximization problem in equation (2.2). With $\alpha = \frac{1}{2}$, l^* must satisfy the first order condition:

$$\frac{1}{2}p\varphi l^{*-\frac{1}{2}} - w = 0 \tag{13}$$

The above can be re-written, to obtain $l^* = \left(\frac{p\varphi}{2w}\right)^2$. This equation for l^* can be substituted into the equation for profit to obtain an expression for profit in terms of φ:

$$\Pi(\varphi) = p\varphi\left(\frac{p\varphi}{2w}\right) - w\left(\frac{p\varphi}{2w}\right)^2 - \theta \tag{14}$$

The $\hat{\varphi}_f$ must satisfy:

$$\Pi(\hat{\varphi}_f) = \psi \tag{15}$$

. Differentiating equation (14) with respect to φ shows that profits are strictly increasing in φ.

Now consider the decision of of a religious entrepreneur with one unit. The religious entrepreneur chooses $\hat{l}$ that satisfies equation (2.4). Since $p\varphi l^\alpha$ is increasing in l, $\hat{l}$ will be the largest l that satisfies the non-negative profit constraint:

$$p\varphi\hat{l}^{\frac{1}{2}} - w\hat{l} - \theta = 0 \tag{16}$$

The above can be re-written as:

$$w^2l^2 + (2\theta - p^2\varphi^2)l + \theta^2 \tag{17}$$

Applying the quadratic formula:

$$\hat{l} = \frac{p^2\varphi^2 - 2\theta w + p\varphi\sqrt{p^2\varphi^2 4w\theta}}{2w^2} \tag{18}$$

Given the above we can see that $\hat{l} > 0$ only if $p^2\varphi^2 > 4\theta w$. This condition can be re-written in terms of φ. For $\varphi > \frac{2}{p}\sqrt{\theta w}$ the firm operates the unit. For $\varphi \leq \frac{2}{p}\sqrt{\theta w}$ the firm does not operate the unit ($\hat{l} = 0$). Thus $\hat{\varphi}_{r,1} = \frac{2}{p}\sqrt{\theta w}$.

To compare $\hat{\varphi}_f$ to $\hat{\varphi}_{f,1}$, plug the above value of $\hat{\varphi}_{n,1}$ into the profit equation for a for-profit firm (equation (14)); given $\hat{\varphi}_{r,1}$ the for-profit firm's profit is zero. Since $\psi > 0$, a for-profit firm would not operate a unit given $\hat{\varphi}_{r,1}$ since profits would be less than the scrap value ($\hat{\varphi}_f$ satisfies $\Pi(\hat{\varphi}_f) = \psi$). Since profits are increasing in φ, one can see $\hat{\varphi}_f > \hat{\varphi}_{r,1}$.

A religious entrepreneur with two units chooses labor that satisfy one of the three equations (2.5), (2.6) or (2.7). I will define $\hat{\varphi}_{f,2}$ as the minimum φ_1 necessary to keep unit one operating if the other plant has $\varphi_2 = 0$. Given $\varphi_2 = 0$ the lowest φ_1 that will keep unit 1 operating will be obtained by closing unit 2 and using ψ to subsidize unit 1. This is the situation represented in equation (2.7). The amount of labor employed, $\bar{l}$, will be the largest l that satisfies the non-negative profit constraint:

$$p\varphi\bar{l}^{\frac{1}{2}} - w\bar{l} - \theta + \psi = 0 \tag{19}$$

Applying the quadratic formula:

$$\bar{l} = \frac{p^2\varphi^2 - 2\theta w + p\varphi\sqrt{p^2\varphi^2 4w(\theta - \psi)}}{2w^2} \tag{20}$$

Given the above we can see that $\bar{l} > 0$ only if $p^2\varphi^2 > 4(\theta - \psi)w$. This condition can be re-written in terms of φ. For $\varphi > \frac{2}{p}\sqrt{(\theta - \psi)w}$ the firm operates the unit. For $\varphi \leq \frac{2}{p}\sqrt{(\theta - \psi)w}$ the firm does not operate the unit ($\bar{l} = 0$). Thus $\hat{\varphi}_{n,2} = \frac{2}{p}\sqrt{(\theta - \psi)w}$. As long as $\psi > 0$, then $\hat{\varphi}_{r,1} > \hat{\varphi}_{r,2}$.

Thus $\hat{\varphi}_f > \hat{\varphi}_{r,1} > \hat{\varphi}_{r,2}$.

□