The Political Economy of Pentecostalism: A Dynamic Structural Analysis

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Abstract

This paper examines the role of tax subsidies on the rapid expansion of Pentecostalism in Brazil and its impacts on the political representation of Pentecostal groups in Congress. First, using a dynamic differences-in-differences approach we find that the opening of a new Pentecostal temple in a given market increases the vote share of Evangelical candidates in 2-3 percentage points in that market. The opening of Traditional Protestant or Catholic temples has no effect on the vote share of candidates tied to religious groups. Second, we build and estimate a dynamic game of church entry using administrative temple entry/exit data in Brazilian municipalities for 1992-2018 and simulate the effects of taxes on churches variable payoffs on the expansion of Pentecostal temples. We compute the long-run Laffer Curve and show that the optimal tax rate is 40%, close to the tax rate typically paid by Brazilian firms. We document that the number of Pentecostal temples would have been 80% smaller than the observed if the optimal tax rate had been imposed on churches variable payoffs. Third, combining our DiD and structural estimates we show that the vote share of evangelicals would have been 13-27% lower in Congressional elections if churches were taxed.

Keywords: Religion, Politics, Tax, Dynamic Oligopoly, Dynamic Game Estimation.

JEL Codes: Z12, D72, H25, C57, L66.

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1 Introduction

The most dramatic shift in the global religious landscape in the last 100 years has been the rapid spread of Pentecostalism, which now commands up to a quarter of world Christianity. Brazil, the largest Catholic nation in the world, has seen its Catholic majority drop from 92% in 1970 to 65% in 2010 and is expected to have an Evangelical majority as early as 2030's (Alves et al., 2017). Similar trends are visible to a varying degree in most of Latin America and among US Latinos, as well as in many parts of Africa and Asia.

This movement was accompanied, among other changes, by a remarkable increase in the political representation of Pentecostal groups in various political instances of modern societies (Pew, 2006). In Brazil, where the number of representatives directly tied to Evangelical groups jumped from 27 in 1994 to 187 in 2018, this phenomenon is particularly evident. While we now have a better understanding of how religion shapes human behavior and development (Becker and Woessmann, 2009; Cantoni et al., 2018; Campante et al., 2015; Gruber, 2005) and mediates institutional change (Belloc et al., 2016; Chaney, 2013), the causes of such variation in religiosity are still open for debate.

Recent evidence has shed light on the demand-side mechanism behind the rapid growth of Pentecostals and other groups, linking worsening economic conditions and failures of the secular state with demand for churches with stricter doctrines (Chen, 2010; Costa et al., 2019; Ager and Ciccone, 2018; Bentzen, 2019; Habermas, 2008). Other works used insights from industrial organization to show the relevance of religious competition and state regulation to explain religiosity (Stark and Finke, 1992; Iannaccone, 1992; Barro and McCleary, 2005; McCleary and Barro, 2006). In particular, subsidies to religions are substantial across the world and likely help to determine the supply of religion.[1]

Despite its broader implications to politics and society, the extent to which subsidies affect church expansion still lacks sufficient empirical evidence. In this paper, we fill this

[1]Cragun et al. (2012) estimated annual government subsidy of religion per year of US$71 billion. In Brazil, government subsidies were extended to all faiths in Brazil since the 1988 Federal Constitution.

gap by investigating the effects of tax subsidies to religions on (i) the expansion of Pentecostal churches in Brazil and (ii) their consequential impact on political representation of Pentecostal groups in the Brazilian Congress.

Our study proceeds in three steps. First, we use Brazilian administrative data on the timing of church entry per municipality within a dynamic differences-in-differences design to estimate the causal impact of temple building on the evangelical vote share. Then we develop and estimate a dynamic model of strategic interaction between churches. We solve the model and simulate entry patterns by different denominations across Brazilian municipalities under counterfactual taxation schemes. Finally, we combine the model counterfactuals and the causal links between church entry and voting behavior to evaluate Evangelical political representation in Congress under alternative tax policies.

To understand the role of church entry on politics, we explore the staggered timing of church entry decisions across municipalities between 1991 and 2018. Our empirical strategy is capable of testing for differential pre-trends in voting and recovering any dynamics of the impact of church entry. Our main outcome of interest is the vote share received by elected members of Congress that form the Evangelical Parliamentary Front (FPE, in portuguese) – the evangelical caucus in Brazil. Our results indicate that the entry timing of a Pentecostal temple is not designed as a response to trends in political outcomes. After entry, we find an increase in evangelical vote share of 2-3 percentage points. Part of the effect comes from mobilization through higher turnout. In contrast, neither Catholic nor non-Pentecostal evangelical churches seem to increase voting for FPE. These effects are robust to a variety of controls and are larger in places that are poorer, less white, have less formal schooling and were more evangelical beforehand. These findings are in consonance with survey evidence that shows that faithfuls of Pentecostal denominations are more prone to follow political orientations of their churches than faithfuls of other religions.[2]

Then we analyze how an important institutional change introduced by the Brazilian

[2] See Datafolha survey at http://arte.folha.uol.com.br/poder/2016/12/25/evangelicos-catolicos-costumes/.

Constitution of 1988 that *de facto* extended religious tax-exemption to all faiths influenced the expansion of Pentecostalism in Brazil. Building on the structure proposed by the seminal work of Ericson and Pakes (1995) we develop a dynamic game of church entry.[3] We use data from Brazilian municipalities between 1991 and 2018 to estimate the primitives of the model, including churches discount factor. Temples payoff is a flexible function of entry decisions of competing churches, observed market characteristics and time-varying market characteristics that are relevant to churches but unobserved by the econometrician (Rennhoff and Owens, 2012; Hanson and Xiang, 2013a; Walrath, 2016a). We solve the model and show that it reproduces well the evolution of the number of Pentecostal temples observed during 1992-2018. We then simulate counterfactual time-series of the number of temples imposing different tax rates on churches variable profits. From these simulations we also compute the long-run Laffer Curve associated to the variable profit tax on churches and obtain the tax rate that maximizes government revenues.

Our analysis of church entry patterns gives rise to a series of interesting results. First, we observe that churches of a given religious group compete only with churches of the same religious group. Specifically, the presence of a Pentecostal temple in a given market reduces the entry probabilities of other Pentecostal denominations in that market but has no effect on entry probabilities of the Catholic and Non-Pentecostal churches. The same within-group pattern holds for the Catholic and Non-Pentecostal churches. These results are in line with previous evidence found in the literature (Rennhoff and Owens, 2012). Second, we obtain the long-run Laffer Curve for the tax on churches variable profits. The optimal tax rate is 40%, close to the usual corporate tax paid by Brazilian firms (34%). From a broader perspective, our study shows how strategic iteration between firms and firms entry and exit dynamics affect the Laffer Curve. Intuitively, increases in taxes flatten payoffs, reduce entry and force incumbent firms to leave the market. This, in turn, tend to increase profits of firms that are

[3]This model has been widely used to study evolution of the structure of oligopoly markets – see Ryan (2012), Collard-Wexler (2013) and Sweeting (2013), among many others, for different applications of this framework.

able to operate paying higher tax rates, thus mitigating the effects of tax increases on tax revenues. Our estimates of the Laffer Curve take in to account this mechanism.

Next, we show that tax exemption policies are key to explain the expansion of the Pentecostalism in Brazil. Indeed, if the government had imposed the optimal tax rate of 40% on churches profits the average number of Pentecostal temples observed during 1992-2018 would have been approximately 80% smaller than the average number of temples we observed during this period. Back-of-the-envelope calculations, on the other hand, indicate that the revenue raised from churches taxation is small: a tax of 40% on churches variable profits would yield approximately 0.11% of the Brazilian GDP on average per year in revenues to the government. Plugging the simulated number of temples back into the estimated regression model, we calculate that Evangelicals would have received almost 20% less votes in 2010 under this scenario. Together, our results indicate that the most significant impact of taxes on churches would be in the political composition of the Congress – with its intangible consequences to the society – rather than on the government budget.

Our paper offers new insights to the political economy literature on religion. The rise of the religious vote in Brazil and the US reveal a growing influence of religion on public life, despite the growing share of the non-religious. Costa et al. (2018) finds that Pentecostal political representation grew as a response to economic downturns. Our findings support the notion that the institutional features that determine the allocation of resources to or away from religious organizations play a significant role in their ability to grow and exert electoral influence. In the same vein, Bazzi et al. (2020) show that a large transfer of resources from rural elites to Islamic institutions in 1960 was a key factor behind the ability of the Indonesian Islamic movement to entrench its conservative ideology and influence the course of politics. Cantoni et al. (2018) document a massive reallocation of resources from religious to secular purposes as a consequence of the religious competition during the Protestant Reformation, playing an important role in the secularization of the West.

This paper also relates to the empirical literature that analyzes competition between churches (Hanson and Xiang, 2013b; Barro and McCleary, 2011; Hungerman, 2013). Rennhoff and Owens (2012) and Walrath (2016b) apply a static structural model of church entry to study competition between churches. We take into account churches forward-looking behavior and show that the fitting of the dynamic model to the data is significantly better than the fitting of its static counterpart, suggesting that churches decisions carry an important dynamic component. More broadly, our analysis also contributes to the public economics literature that studies the tradeoff between tax rates and tax revenues. Typically, this tradeoff, summarized by the Laffer Curve, has been studied under the assumption that firms operate in perfectly competitive markets – see Auerbach (1985), Chetty et al. (2009), Chetty (2009) and Evans et al. (1999). A recent paper by Miravete et al. (2018) relaxes this assumption and estimates a ***short-run*** Laffer Curve assuming that firms play a static Nash-Bertrand game with exogenous market structure. They show that strategic responses of firms to tax changes have consequences for the shape and the location of the Laffer curve. Our paper complements the results in Miravete et al. (2018) by providing ***long-run*** Laffer Curve estimates that consider responses of market structures to tax changes.

To estimate the structural model we combine methodologies proposed by Rust (1987), Berry (1992), Sanches et al. (2016b) and Komarova et al. (2018). Typically, to estimate dynamic entry models parameters are chosen to match theoretical and observed entry probabilities (Aguirregabiria and Mira, 2007; Pesendorfer, 2013a; Sanches et al., 2016b). Our estimator, instead, matches directly number of temples observed in each year and number of temples in each year as predicted by the theoretical model. More specifically, starting from an initial guess of churches beliefs that we obtain directly from the data, in each iteration of the algorithm we solve the model and forward simulate the number of temples for different years. Parameters, including churches discount factor, are set to match simulated and observed time-series of the number of temples. We show that the estimator converges relatively fast and that the fitting of the model obtained from this estimator is notably superior to the fitting of the model obtained from traditional two-step estimators.

The rest of the paper is organized as follows. Section 2.1 briefly presents a historical account of the rise of Pentecostalism in Brazil. Sections 2.2 and 2.3 discuss the increasing representation of Pentecostals in politics and present some facts regarding the extent to which religions are tax exempt, respectively. Then we introduce our data, explain our empirical strategy and present the estimated vote share responses to church entry in Section 3. Next, we develop dynamic model of strategic interaction between churches (Section 4). Section 5 discusses identification of the model, estimation procedures and shows structural parameters estimates. In Section 6 we solve the model, compute the long-run Laffer Curve associated to taxes on churches variable profits and show how this taxation scheme would affect the number of evangelical temples in Brazilian municipalities and consequently evangelical vote share. Finally, we conclude. The Appendix contains technical details related to the estimation of the dynamic model and robustness checks of our structural estimates.

2 Church, Politics and State Subsidies to Religion

This section provides detailed descriptions of the context of our empirical analysis. Three aspects of our context deserve special attention: the rise and the historical roots of the Pentecostalism in Brazil, the growth in the participation of Evangelical groups in the Brazilian Congress and the historical perspective of state subsidies to religions in Brazil. In the next three subsections we present comprehensive discussions on these topics.

2.1 Changing Religious Landscape and the Rise of Pentecostalism

Brazilian colonial history witnessed the coming together of three great cultural traditions: European Catholics, native Brazilians and African slaves, with clear hegemony of the former. Despite substantial racial miscegenation and religious syncretism[4], Catholicism prevailed as the official religion through Portuguese domination in the colonial period (1500-1821) and

[4]Religious syncretism refers to the blending of two or more religious belief systems into a new system, or the incorporation into a religious tradition of beliefs from unrelated traditions.

the monarchy era after independence (1822-1888).[5] The first Christian protestants arrived in Brazil with the first waves of Anglican and Lutheran immigrants (***historical protestants***, namely) in the 19^{th} century. From the beginning of the 20^{th} century, successive waves of growth of Pentecostal denominations started to threat Catholic hegemony (Mariano, 2014).[6]

The first wave brought "classic Pentecostalism" to Brazil via Europeans migrants who converted to the new movement in the United States. It started in 1910 with the foundation of the new churches of ***Christian Congregation in Brazil*** and, in 1911, with the ***Assembly of God***.[7] The second wave started in 1950 with the ***Foursquare Church***, brought to Brazil from the US in 1951, and ***O Brasil para Cristo*** (Brazil for Christ), the first Pentecostal denomination founded by a Brazilian – radio-evangelist Manoel de Mello – in 1955.[8] This pattern of successful pastors who later founded their own church with intense use of mass media was a recurring phenomenon in the following decades (Lima, 2007).

The third (neo-Pentecostal) wave has as its most influential church the ***Universal Church of the Kingdom of God*** (or IURD, in Portuguese), founded in 1977. Among other contemporaneous denomination, it followed an aggressive expansion strategy with the intense use of TV and radio and a combination of organizational structure and marketing strategies akin to those of a typical capitalistic corporation.[9] These churches had few traces of sectarianism and did not required followers for adherence to strict rules of conduct that characterized the Pentecostalism of the first generation. They also spread the Prosperity Gospel doctrine and strongly encouraged believers to tithe. Neo-Pentecostal churches openly engaged in politics and started to nominate candidates in the late 1980s, who would participate go on to be part of the Constitutional Assembly of 1988, and obtain radio and TV concessions later used a religious media (Freston et al., 1993). Indeed, recent works show that the strategy of

[5]Indeed, 99% of the population self-reported as Catholic in the 1890 Census.

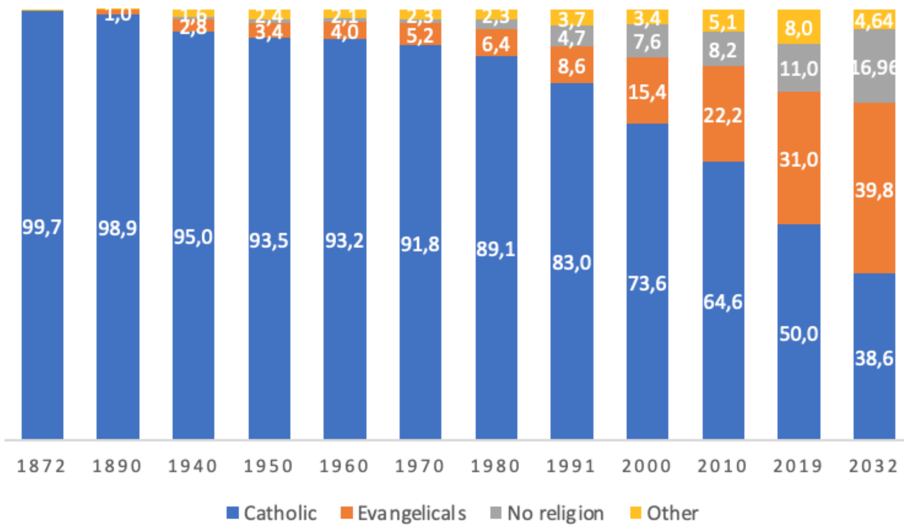
[6]See Table 1 for a classification of all religious denominations in Brazil used in this paper.

[7]These new churches emphasized gifts of the spirit such as speaking in tongues, casting out demons, and prophesying (Freston, 1995; Lingenthal, 2012).

[8]It distinguishing itself from the former wave through its emphasis on divine healing during worship as a gift of the Holy Spirit

[9]The third wave preached the existence of a spiritual warfare against the devil and his followers on Earth, who they would identify as the other religions, especially Afro-Brazilian religions Lingenthal (2012).

Figure 1: Changing Religious Landscape in Brazil



Source: IBGE Census (1872-2010), Datafolha, Alves et al. (2017).

aggressive geographic expansion of temple building complemented with mass TV and radio presence was key for the rise of neo-pentecostalism in Brazil in the last few decades (Corbi and Komtasu, 2019).

Such expansion of Protestantism is reflected in a dramatic shift in the Brazilian religious landscape. Figure 1 shows that the secular decline in the share of Catholics accelerated in the 1990's, from over 92% to 65% in 2010, the last Census available. On the other hand, such decline was accompanied by a substantial increase in religious pluralism, with a steep increase of Evangelicals from 8.6% in 1991 to 31% in 2010, as well as of other religions and the non-affiliated.[10] Indeed, the share of Catholics is predicted to drop below the share of Evangelicals as soon as early 2030's (Alves et al., 2017). The surge in Evangelicals between 1991 and 2010 described above is almost completely driven by the growth of Pentecostal denominations, as opposed to historical Protestant denominations (i.e. Lutherans, Baptists, Presbyterians) which has remained fairly steady over the last few decades.[11]

[10]Other religions include Afro-Brazilian faiths, spiritist movements, and Asian religions such as Buddhism and Islam. No religious affiliation include agnostics and atheists.

[11]In modern Latin America, the term *Evangelical* is often simply a synonym for *Protestant* (Larsen and Treier, 2007). We use both terms interchangeably throughout this paper.

The main factor in the growth of Protestantism in Brazil is religious switching, as nearly half of Brazilian Pentecostals had converted from Catholicism, as opposed to demographic factors such as fertility rates or immigration (Pew, 2013). Although initially changes have been particularly pronounced among younger Brazilians and city dwellers, the Pentecostal transition is taking place widely across most age, income, gender and education groups to a certain degree, as well as in most regions in the country (Alves et al., 2017).

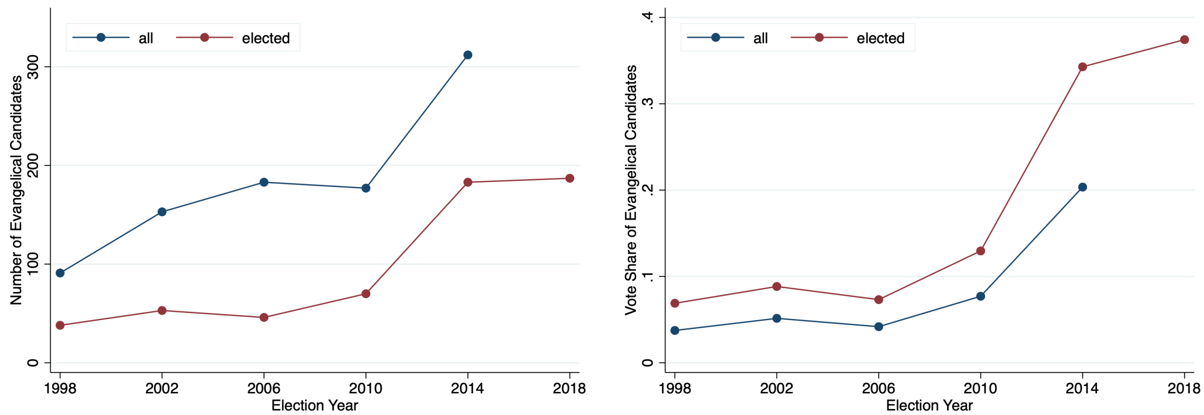
Catholics in Brazil tend to be less conservative than Protestants on these kinds of social issues. In particular, Catholics are less morally opposed to abortion, homosexuality, artificial means of birth control, sex outside of marriage, divorce and drinking alcohol, and are less likely to tithe (Pew, 2013; Neri, 2007). These trends are not unique to Brazil, but common to almost all countries in across Latin America and the Caribbean, including US Latinos.

2.2 Evangelicals and Politics

The rise of Evangelicals, and Pentecostals more specifically, has been marked by an increase in their presence in Brazilian politics. In the post-junta elections of 1986, a Constituent Assembly was elected to draft the new constitution, including 36 Protestants (20 Pentecostals) out of 559 members (Freston 2001: 21-23). Pentecostals took this opportunity to abandon their non-political stance to successfully seek legal equality with the Catholic Church, including equal rights to state subsidies (see Section 2.3).

In Congress, evangelical members of Parliament form an evangelical caucus – the so-called Parliamentary Evangelical Front (Frente Parlamentar Evangélica or FPE) – to pursue political agendas informed by their shared religious beliefs and the interest of their denominations, as opposed to traditional party affiliation or political coalition. They initially receive property and funds from president José Sarney's government to secure its support for government stances, having seen its influence in Brazilian politics grow in the last 30 years. Figure 2 illustrates the evolution of evangelical participation in politics in the last 6 elections. The number of total candidates and elected candidates associated with evangelical denomina-

Figure 2: Evangelical Participation in Politics, 1998-2018



(a) Number of Candidates

(b) Vote share

tions increased by three and fourfold, respectively. The corresponding rise in evangelical vote share are even more dramatic, with the evangelical caucus (FPE) having received less than 7% of the vote share among all elected congressmen in 1998 to more than 37% in 2018. Most of these seats are held by members of the main Pentecostal denominations such as *Assembly of God*, *Christian Congregation* and *Universal Church of the Kingdom of God*, with some also by held more traditional Protestant denominations such as Presbyterians. Catholic politicians do not take part.

Even though it is known for its heterogeneity, the FPE has shown substantial influence in policy-making regarding issues related to morality politics. It positions itself as socially conservative, typically voting *en masse* against issues such as gender equality, abortion, euthanasia and same-sex marriage. It also opposes the criminalizing of discrimination against LGBT, as well as physical punishment imposed by parents on their children.

The growing participation of Evangelicals in Brazilian politics is likely not only due to their increasing share of the population. They go to church more often than Catholics, and are two times more likely to vote for a clergyman and three times more likely to follow political recommendation from the church.[12] This is specially valuable in the context of a

[12]See Datafolha survey at http://arte.folha.uol.com.br/poder/2016/12/25/evangelicos-catolicos-costumes/.

recent campaign finance reform in Brazil that imposed spending limits, a ban on corporate donations and the creation of a public fund to finance campaigns as a compensation. Having increased political competition (Avis et al., 2017), these new electoral funding rules likely benefit politicians that already have a loyal basis at the expense of candidates who need cash to promote themselves (Seror and Verdier, 2018). Indeed, candidates supported by Pentecostal churches spend less money campaigning per vote received than other candidates. However, evangelicals incumbents that lose church support during their term often fail to get reelected, suggesting that active direct support from the church is key (Lacerda, 2018).

2.3 Religious Finance and Tax Exemption in Brazil

State support is key to religious finance, trumping all other factors such as a church's theology, practices, and polity (Iannaccone and Bose, 2010). In one extreme, we have the established (Protestant) churches of post-reformation England and Scandinavia whose activities are supported by the state both via direct funding through taxes and subsidies as well as limited competition. In the other, the free religious market of modern-day USA and most of Latin America enhance competition between churches as barriers to entry fall, leading to more denominations, more differentiation and higher religious participation. Most of less traditional churches that arise in these environments adopts a model more akin to that of a standard commercial market, with fee-for-service transactions in addition to membership dues and contributions. This does not mean that the state is less important in financing religion in the New World. In fact, government subsidies are a key source of funding for religious organization of all faiths, as opposed to state religions only as in most of Europe.

In Brazil, the proliferation of Christian Protestant churches discussed in Section 2.1 was accompanied by an evolving relationship between the church and state, from the monopoly of Catholicism until late 19^{th} century to the current religious market with free entry and substantial state subsidies for all denominations.[13]

[13]Similarly, most American colonies had established churches, and ten of the thirteen original states funded these churches through taxes. Indeed, voluntary giving became central to church revenues in the US

Catholicism was the official state religion and the only faith to enjoy freedom of worship in Brazil under the Monarchy (1822-1888). With the proclamation of the First Republic in 1889, the separation between state and religion was instated and religious freedom became a right. The 1946 Constitution introduced for the first time the possibility of tax exemption for temples of any faith or cult, but restricted to "*cults that observe public order and good customs*". These vague restrictions worked as limiting factors to conceding tax breaks widely and served more for arbitrary interventions by the state into non-dominant faiths (Silva, 2004).

The 1988 Federal Constitution further evened the playing field by removing these constraints, solidifying tax immunity to churches of all faiths. In particular, Article 150 states that religious organizations are exempt from federal, state, and municipal taxes levied on property or income from services related with the essential purpose of religious entities. As a consequence of the generic wording, the interpretation of tax immunity evolved significantly after 1988, leading many religious organizations to become involved in a wide range of economic activities, especially related to real estate and media activities, taking advantage of their non-commercial status to accrue sizable financial benefits from these tax-free operations.[14]

Aggregate estimates of public subsidies to churches in Brazil are unavailable. However, according to official estimates, revenues accrued directly from church-related activities summed up to R$24.2 billions in 2013 (US$10.2 billions), which may give a rough idea of the impacts of the churches tax exemption policy on the government budget.[15] We note, on the other hand, that this figure likely underestimates the true extent of church tax exemption as it does not include other economic activities controlled by churches that are not directly related to temple activities. For instance, *Igreja Universal do Reino de Deus* (IURD, in

Christian churches only in the 20^{th} due to with increased competition as churches lost their capacity to tax Iannaccone and Bose (2010).

[14]See Avila (2010) for a thorough historical perspective of church tax exemption in Brazil

[15]Exchange rate of 42.32 USD = 100 BRL in December 2013. Standard for profit firms pay federal taxes including IRPJ (∼5%), PIS (0,65%) COFINS (3%) and local service tax ISS (3-5%) over gross revenue.

portuguese) famously purchased a top 3 national TV broadcaster in 1990 (Rede Record), which by itself registered net operating income of nearly R$ 2.2 billion in 2019.

State subsidies to religion are hardly unique to Brazil. In the United States alone, Cragun et al. (2012) estimated annual government subsidy of religion per year of US$71 billion. To put into perspective, this is equivalent to roughly 40% of the combined total of US government subsidies to agriculture in 2009 or the entire 2011 state government's budget in Florida.

3 Data and Causal Estimates

In the previous section we described prominent aspects of our empirical context. Following these descriptions, this section introduces the data we use throughout our analysis and proposes an econometric strategy to identify the causal effects of the expansion of religious temples in Brazil during the last years on the share of votes received by the FPE and other election outcomes. Coupled with the simulations from the structural model presented in the following sections, these estimates will allow us to infer the causal effects of churches tax exemption policies on the political participation of Evangelical groups in the Brazilian Congress.

3.1 Data

Our temple-level dataset comes from the Brazilian Internal Revenue Service (*Receita Federal do Brasil*) and comprises all legal entities registered in Brazil since records began. We keep all entities registered as a Religious Organization under the Brazilian Industry Classification (CNAE). Establishment-level start-date, end-date, address, as well as entity name are available. Based on this information, we classify each of the $216,364$ religious establishments as belonging to one of the denominations listed in Table 1 and structure the data retrospectively as an yearly panel with a total of $3,427,626$ denomination-municipality-year observations

Table 1: Religious Denominations in Brazil

	Group	Denominations
I	Catholic	Roman, Orthodox
II	Traditional Protestant	Lutheran, Anglican, Calvinist, Anabaptist, Presbyterian, Menonite Congregationalist, Baptists, Methodist, Adventist
III	Pentecostals	*First Wave* (Christian Congregation, Assembly of God) *Second Wave* (Foursquare, Deus e Amor, Brasil para Cristo) *Third Wave* (Universal, Renascer, Mundial, Bola de Neve, Casa da Benção, Casa da Oração, Maranata, Igreja da Graça, Avivamento Bíblico, Nazareno)
IV	Afro-Brazilian	Espirita, Umbanda, Candomble
V	Other	Eastern Religions, Masonry, Unindentified

Note: Our classi cation follows Mariano (2014).

from 1991 to 2018. All municipalities in Brazil have at least one establishment across the sample period.[16]

Election vote counts are retrieved from the Election Data Repository of *Tribunal Superior Eleitoral* (TSE). Municipality-level number of registered votes and voting for each candidate are available for the Chamber of Deputies, the lower house of the National Congress of Brazil. For each of the 1998, 2002, 2006, 2010, 2014 and 2018 elections we identify elected evangelical deputies who are members of the FPE according to historical archives.[17]

Additional data on municipal characteristics and yearly population estimates are from the 1991 Census and Ipeadata, respectively.

Sample description. Following Bresnahan and Reiss (1991) we restrict our analysis to a sample of isolated municipalities. Differently from larger cities and conurbation areas,

[16]Municipality boundaries in Brazil change substantially throughout 1991-2018. In order to allow us to consistently compare units across time, we define municipality as the widely used “Minimum Comparable Areas” (AMC). See Ehrl (2017) for details on the methodology.

[17]Names of oficials who are members of the Frente Parlamentar Evangélica (FPE) are retrived from DIAP (2002) for 1998, Câmara (2011) for 2002, Dantas (2011) for 2006, FPE blog entry for 2010 (https://web.archive.org/web/20120119083246/http://frenteparlamentarevangelica.blogspot.com/p/membros-da-frente-parlamentar.html) and API *Dados abertos da Câmara dos Deputados* for 2014 and 2018 at https://dadosabertos.camara.leg.br/swagger/api.html#staticfile.

isolated cities constitute a clear and delimited market. We define markets as municipalities with 2010 population below $50,000$ that are at least 30km away from any neighbouring municipality and have at most 5 evangelical establishments at any point in time.[18] After this selection we ended up with 245 markets.

Table 2 reports summary statistics for electoral and temple data in election years in Panel A. The number of registered votes increases 38% from 1998 to 2018, similar to population growth in the period. Turnout remains relatively stable in the 0.69-0.78 range, while invalid votes (blank and null) range between $0.038 - 0.063$ except for 1998 when it reached 0.18.[19] The evangelical vote share increases almost monotonically across elections. The aggregate vote share of elected deputies members of the FPE grow from less than 0.02 in 1998 to more than 0.14 and 0.12 in 2014 and 2018, respectively. Such dramatic increase is accompanied by a geographical expansion of temples of both Pentecostal and non-Pentecostal denominations. The share of municipalities with temples from these denominations grow threefold in our 20-year sample period, while Catholics increase by one half, albeit from higher initial levels. Panel B shows that the municipalities in our sample differ substantially in terms of pre-determined characteristics extracted from the 1991 Census, according to race, religion, schooling, income and size.

3.2 Election Outcomes and Church Entry

In this section we first explain how we investigate the role of evangelical churches on politics by exploring the timing of church entry decisions across municipalities within an event-study framework. Then we present the estimated responses of FPE vote share and other electoral outcomes to entry of different church denominations.

[18]Sanches et al. (2016a) uses a similar strategy to select isolated markets in a study of banking competition in Brazil.

[19]While voting is mandatory, punishments for not voting are relatively small. Historical turnout is likely high in comparison to most democracies. Brazilians are also allowed to invalidate their votes by nullifying or casting them blank.

Table 2: Summary Statistics

Panel A: *Electoral and temple data*

	1998	2002	2006	2010	2014	2018
Population estimate (in 1000's)	12.633	13.296	13.810	14.259	15.059	16.359
Registered voters	7,601	8,135	8,914	9,619	10,208	10,511
Voter turnout	.696	.747	.779	.759	.750	.755
Invalid votes	.184	.038	.039	.043	.050	.063
FPE voteshare	.017	.034	.061	.062	.141	.124
% with Pentecostal temple	.318	.440	.665	.755	.869	.914
% with Non-Pentecostal temple	.122	.163	.236	.310	.387	.453
% with Catholic church	.571	.661	.714	.804	.828	.857

Panel B: *Municipal Socio-demographics*

	mean	s.d.	min	max
% Male	.517	.015	.481	.568
% White	.264	.199	.000	.857
% Cohabit	.482	.040	.328	.621
% Evangelical	.064	.055	.001	.410
% No schooling	.761	.112	.449	.968
% Elementary	.177	.082	.023	.394
% High school	.033	.019	.002	.122
% University	.027	.016	.000	.090
Population (in 1000's)	14.259	8.647	2.612	49.412
Household income	790.1	323.0	247.4	2,323.7

Note: Panel A presents averages of election and temple data for each congressional elections in the sample. Temple variables indicate the share of the 255 markets (municipalities) that have a Pentecostal, non-Pentecostal and Catholic temple at election year. FPE voteshare is the aggregate vote received by any elected deputy who is a member of the *Frente Parlamentar Evangelica*. Panel B presents summary statistics for municipal characteristics from the 1991 Census. Household income is reported in Brazilian reais in 2000 prices.

Empirical Strategy. The decision to enter a municipality is likely influenced by population size and other regional socioeconomic features. While the relative characteristics of different localities do not represent an identification challenge *per se*, the effect of church entry would be confounded if implementation timing was determined as a response to municipality-specific trends in FPE vote share. Our empirical strategy exploits the staggered timing of temple entry by comparing changes in voting patterns for municipalities that have year of temple entry between 1991 and 2018 within an event-study framework. Our key identification assumption is that the timing of temple establishment is uncorrelated with other determinants of changes in evangelical vote share.

We begin by studying whether pre-determined socio-demographic characteristics of municipalities predict the timing of temple entry. Table 1 presents estimates for η in the following equation

$$Year_{ms} = \eta \mathbf{X}_{ms,1991} + \lambda_s + \epsilon_{sm} \tag{1}$$

where $Year_{ms}$ is the year of temple entry in municipality m of state s, $\mathbf{X}_{ms,1991}$ is a vector of pre-determined municipality-level socio-demographic characteristics and λ_s are region fixed effects.

Column (1) of Table 3 presents estimates for equation 1 without socio-demographics and region fixed effects for temples of Pentecostal denominations. Across regions, earlier temple entry took place in more populous localities with larger pre-existing share of evangelicals. When we study the determinants of the time of entry within regions in column (2), share of white population becomes statistically significant while share of evangelicals lose significance. It is not surprising that larger municipalities with larger pre-existing share of evangelical are early entrants. Columns (3) and (4) reestimate the model for non-Pentecostal temple and find that entry is correlated with population size and marginally with share of males. For Catholics, columns (5) and (6) show again a time of entry as negative correlated with population and share of whites. To account for these potential threats to internal validity,

Table 3: Determinants of Timing of Temple Entry

	(1) Pentecostal	(2) Pentecostal	(3) Non-Pentecostal	(4) Non-Pentecostal	(5) Catholic	(6) Catholic
Household income (in 1000's)	-2.526	-0.220	-2.969	-2.040	1.883	2.437
	[2.289]	[2.484]	[3.845]	[4.035]	[2.338]	[2.532]
2010 Population (in 1000's)	-0.176	-0.171	0.195	0.183	-0.236	-0.229
	[0.065]	[0.069]	[0.098]	[0.100]	[0.064]	[0.070]
% Male	-11.600	31.972	63.005	130.961	-45.572	-34.806
	[44.098]	[47.815]	[70.074]	[76.729]	[41.381]	[45.619]
% White	-4.842	-6.927	-1.911	-2.215	-7.738	-8.503
	[3.324]	[3.587]	[5.234]	[5.672]	[3.258]	[3.548]
% Cohabit	-18.650	-22.598	-1.839	-3.077	-16.727	-18.121
	[14.835]	[15.191]	[25.569]	[26.044]	[14.488]	[15.386]
% Evangelicals	-25.325	-15.192	-15.316	-13.750	-3.736	0.848
	[9.272]	[10.080]	[13.430]	[14.664]	[9.690]	[11.007]
% No schooling	-1.824	17.233	53.955	26.950	68.101	76.772
	[54.912]	[56.084]	[77.938]	[79.531]	[52.679]	[54.234]
% Elementary	-9.204	13.667	54.342	49.673	81.424	92.024
	[59.580]	[60.727]	[86.355]	[87.583]	[57.303]	[59.161]
% High School	-10.211	14.252	56.398	33.451	-17.877	-5.228
	[87.605]	[88.278]	[123.920]	[127.199]	[84.000]	[86.095]
Observations	225	225	114	114	212	212
R-squared	0.15	0.18	0.11	0.17	0.17	0.18
Region FE	No	Yes	No	Yes	No	Yes

Note: The table reports regression estimates associating the timing of temple entry to average municipal characteristics from the 1991 Census and population in 2010. The dependent variable is the year of entry of the rst Pentecostal, Evangelical non-Pentecostal and Catholic church, respectively in columns 1-2, 3-4 and 5-6. Each observation corresponds to a municipality. Even-numbered columns add xed e ects for regions (South, Southeast, Center-West, North and Northeast). Robust standard errors are reported in parentheses below the coe cients. Signi cantly di erent from zero at 99% (***), 95% (**) and 90% (*) con dence level.

in the main analysis described below we control for municipality fixed effects to account for pre-existing differences in levels across areas as well as including region dummies and the statistically relevant socio-demographic characteristics interacted with year dummies.

Our event-study research design is capable of testing for differential pre-trends in the outcome variable and recovering any dynamics of the impact of church entry. In particular, we specify the following regression model for FPE vote share:

$$Y_{mt} = \sum_{\tau= \ T}^{T} \beta_\tau D_{mt}^{\tau} + \omega W_{m,1991} \times d_t + \gamma_m + \alpha_{st} + u_{mt} \tag{2}$$

where m and t index municipality and time in years, respectively. Y_{st} denotes vote share of FPE. γ_m accounts for time-invariant municipality-specific factors such as geographical location and historical patterns that correlate with religion trends, and α_{st} are region-year fixed effects. As discussed above, we also control for a set of pre-determined socio-demographics that significantly correlate with the timing of implementation interacted with year fixed effects d_t in order to account for potential differential deterministic trends that might correlate with time of entry and evangelical vote share.

Treatment assignment is denoted by D^{τ}_{mt} that is set to 1 if temple entry occurs τ years away from the current year t in municipality m, with $\tau < 0$ referring to years before entry and $\tau > 0$ after entry.[20] Thus, for a municipality that receives a temple in year e_m we have:

$$D^{\tau}_{mt} = \mathbb{1}_{[t - e_m = \tau]}$$

The β_τ coefficients represent the time path of FPE voteshare relative to the date of entry conditional on the three unobserved variance components d_t, γ_m and an error term u_{mt} which may exhibit arbitrary dependence within municipality but is uncorrelated with the other right hand side variables.

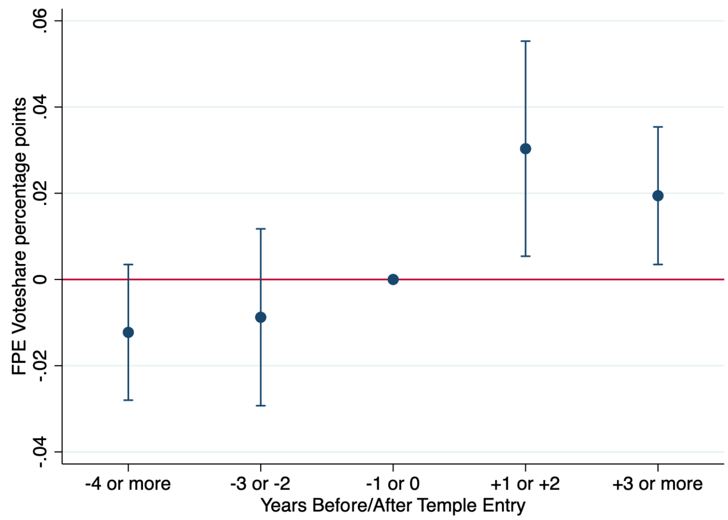
An appealing feature of the event-study research design proposed here is that it provides an explicit way of testing the issue of reverse causality. In other words, we can directly examine whether municipality-specific trends in outcomes determine church entry. More formally, if entry dates are randomly assigned the following restriction should hold:

$$\beta_\tau = 0 \quad \forall \tau < 0$$

Our main results in this paper are obtained by estimating equation 2 by ordinary least squares, including a set of event-time dummies along with time and municipality dummies. For ease of exposition, in our main set of estimates we define τ as a period of 2 years, in practice forcing the treatment effect to be the same within a 2-year period. As usual, not all β's can be identified as D^{τ}_{mt} are perfect collinear in the presence of municipal fixed effects. For this reason, we follow common practice and normalize $\beta_{-1} = 0$, so that all post-implementation coefficients can be thought of as treatment effects. We also impose the

[20]More specifically, treatment is defined according to entry of the first temple of a given church group - Pentecostal, non-Pentecostal ou Catholic. As discussed in Section 3, the municipalities in our sample are relatively small and have on average 1.5 evangelical temples and 5 at the most.

Figure 3: Pentecostal temple entry and vote share of evangelical candidates



following endpoint restrictions:

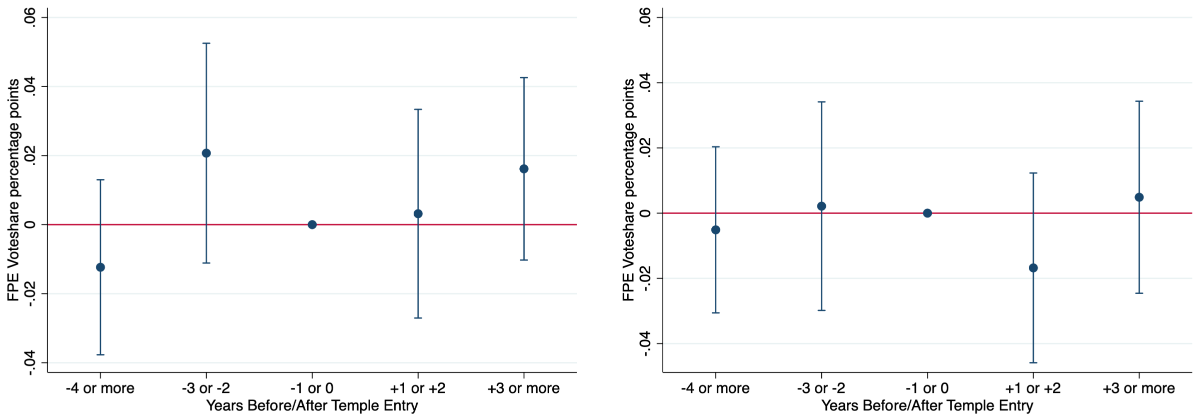
$$\beta_\tau = \begin{cases} \overline{\beta} & \text{if } \tau \geq 4 \\ \underline{\beta} & \text{if } \tau \leq -4 \end{cases}$$

which simply state that any dynamics wear off after four years.[21] This restriction helps to reduce some of the collinearity between the year and event-time dummies. By limiting the analysis to a four-year window pre/post treatment, we ensure that the event-time coefficients are identified off of a nearly balanced panel of municipalities. We report robust standard errors clustered at the municipal level.

Main Results. We begin by examining the impact of Pentecostal temple entry on the Evangelical bloc (FPE) vote share in elections for the lower house of Congress. Figure 3 plots the estimated β_τ coefficients from a regression of the form given in equation (2). Prior to entry, there is no differential trend in vote share across treated and control municipalities. This suggests that the temple entry, despite potentially having a strategic component, was

[21]For another example of such endpoint restrictions, see Kline (2011). Nearly identical results ensue if we fully saturate the model in event time.

Figure 4: Catholic and non-Pentecostal temple entry and evangelical vote share



(a) Non-Pentecostal

(b) Catholic

not designed as a response to trends in political outcomes. We find an increase in evangelical vote share of 3 percentage points (p.p.) in the first 2-year period after entry and of 2 p.p. in the 3 or more years after entry. Column (1) of Table 4 gives estimates corresponding to Figure 3. Column (2) add controls for socio-demographics characteristics interacted with time dummies, $W_{mt,1991}$, and region-year fixed effects, α_{st}. The pattern observed in Figure 3 is virtually unchanged.

Figure 4a-4b reestimate equation (2) for non-Pentecostal and Catholic establishments, respectively. At first glance, neither seem to time their entry into a new market as a response to trends of FPE voting. While being officially part of the political evangelical bloc in Congress, the presence of non-Pentecostal churches does not increase voting for FPE. This is in contrast with the estimated effects of Pentecostal denominations. The Catholic church also has little effect on evangelical vote share. Columns (3)-(4) and (5)-(6) of Table 4 give estimates corresponding to Figure 4.

Figure 5 report the effects of temple entry by church on turnout and invalid (blank/null) vote rates. As before, no systematic correlations is detected between temple entry and these other electoral outcome pre-trends. The effect of Pentecostal temples on FPE vote share shown in Figure 3 may be partially driven by an increase in turnout, albeit short-lived.

This kind of mobilization effect is consistent with the media persuasion literature that finds variation in vote shares due partially to changes in who shows up to vote (DellaVigna and Kaplan, 2007; Barone et al., 2015). Unsurprisingly, entry timing of Non-Pentecostal and Catholic temples do not correlate with turnout. Also, invalid votes are not affected by temple entry. Table 5 give estimates corresponding to Figure 5.

Table 4: Temple Entry and Evangelical Vote Share

	(1) Pentecostal	(2) Pentecostal	(3) Non-Pentecostal	(4) Non-Pentecostal	(5) Catholic	(6) Catholic
-4 or more years	-0.012	-0.001	-0.012	-0.013	-0.005	-0.002
	[0.010]	[0.009]	[0.015]	[0.015]	[0.015]	[0.015]
-3 or -2 years	-0.009	0.009	0.021	0.009	0.002	0.006
	[0.012]	[0.013]	[0.019]	[0.019]	[0.019]	[0.020]
+1 or +2 years	0.030	0.030	0.003	-0.005	-0.017	-0.011
	[0.015]	[0.016]	[0.018]	[0.018]	[0.018]	[0.017]
+3 or more years	0.019	0.020	0.016	0.005	0.005	0.009
	[0.010]	[0.009]	[0.016]	[0.016]	[0.018]	[0.017]
Observations	1470	1470	1470	1470	1470	1470
R-squared	0.46	0.51	0.45	0.51	0.45	0.51
Socio-demograph. X Year FE	No	Yes	No	Yes	No	Yes
Region-year FE	No	Yes	No	Yes	No	Yes

Note: The table reports regression estimates associating the timing of church entry to FPE voteshare (aggregate vote received by any elected deputy who is a member of the Evangelical caucus, or *Frente Parlamentar Evangelica*) as de ned by speci cation (2). Column (1) focuses on the entry of Pentecostal temples and reports estimates that control for municipality and year xed e ects. Column (2) adds region-year xed e ects, α_{st}, and year dummies interacted with socio-demographics characteristics that are statistically relevant for temple entry (see Table 3). Column (3)-(4) and (5)-(6) report estimates on the entry of non-Pentecostal and Catholic temples, respectively. Our main sample consists of a balanced panel of municipality-year pairs and (see sample description in section 3). Heteroskedasticity-adjusted standard errors clustered at the municipality level are reported in parentheses below the coe cients. Signi cantly di erent from zero at 99% (***), 95% (**) and 90% (*) con dence level.

Table 5: Temple Entry, Turnout and Invalid Votes

	Pentecostal		Non-Pentecostal		Catholic	
	(1) Turnout	(2) Blank/Null	(3) Turnout	(4) Blank/Null	(5) Turnout	(6) Blank/Null
-4 or more years	-0.006	-0.009	-0.009	-0.002	0.001	-0.005
	[0.007]	[0.004]	[0.010]	[0.005]	[0.011]	[0.006]
-3 or -2 years	-0.003	0.001	-0.002	0.000	0.003	-0.005
	[0.008]	[0.005]	[0.010]	[0.007]	[0.012]	[0.007]
+1 or +2 years	0.016	0.003	-0.001	-0.005	0.003	-0.004
	[0.007]	[0.005]	[0.010]	[0.006]	[0.010]	[0.007]
+3 or more years	0.003	0.002	-0.000	-0.005	0.012	-0.001
	[0.006]	[0.004]	[0.009]	[0.005]	[0.009]	[0.006]
Observations	1470	1470	1470	1470	1470	1470
R-squared	0.69	0.86	0.69	0.86	0.69	0.85

Note: The table reports regression estimates associating election turnout and invalid (blank/null) voting to the timing of church of Pentecostal, non-Pentecostal and Catholic churches. All speci cations control for municipality and year xed e ects. Our main sample consists of a balanced panel of municipality-year pairs and (see sample description in section 3). Heteroskedasticity-adjusted standard errors clustered at the municipality level are reported in parentheses below the coe cients. Signi cantly di erent from zero at 99% (***), 95% (**) and 90% (*) con dence level.

Next we take advantage of the diverse set of municipalities included in our dataset to

Table 6: Pentecostal Temple Entry and Evangelical Vote Share: Heterogeneous Effects

	(1) baseline	(2) hh income	(3) population	(4) % white	(5) % cohabit	(6) % evangelicals	(7) % no school
-4 or more years	-0.003	-0.004	-0.003	-0.003	-0.003	-0.001	-0.003
	[0.010]	[0.010]	[0.009]	[0.010]	[0.010]	[0.010]	[0.010]
-3 or -2 years	0.007	0.006	0.007	0.007	0.007	0.009	0.008
	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]	[0.013]	[0.012]
+1 or more	0.022	0.046	0.007	0.037	-0.017	0.006	-0.066
	[0.010]	[0.018]	[0.018]	[0.015]	[0.068]	[0.012]	[0.052]
+1 or more X socio-demo		-0.032	0.001	-0.059	0.081	0.303	0.115
		[0.019]	[0.001]	[0.041]	[0.137]	[0.149]	[0.068]
Observations	1470	1470	1470	1470	1470	1470	1470
R-squared	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Socio-demo X Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: The table reports regression heterogeneous estimates associating the timing of church entry to FPE voteshare with respect to municipal socio-demographics in 1991. For comparison, Column (1) re-estimates speci cation in Table 4, pooling together treatment e ect for all years after church entry (\+1 or more years"). Columns (2)-(7) interact entry with household income, population size and share of population who are white,evangelicals, cohabit and have no schooling, respectively. Our main sample consists of a balanced panel of municipality-year pairs and (see sample description in section 3). Heteroskedasticity-adjusted standard errors clustered at the municipality level are reported in parentheses below the coe cients. Signi cantly di erent from zero at 99% (***), 95% (**) and 90% (*) con dence level.

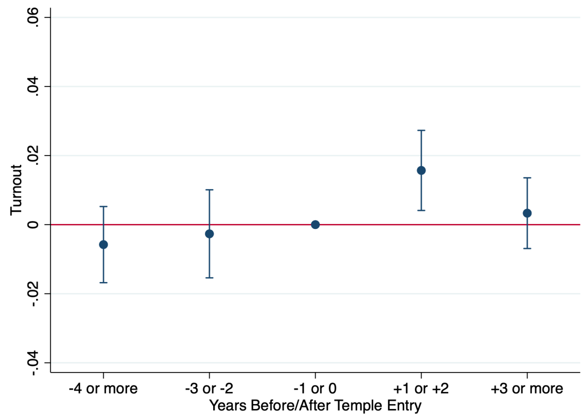
investigate the heterogeneity of the impact of church entry on FPE vote share with respect to socio-demographics. Column (1) of Table 6 re-estimates specification 2 in Table 4 pooling together treatment effect for all years after church entry ("+1 or more years"). Columns (2)-(7) interact entry with household income, population size and share of population who are white, evangelicals, cohabit and have no schooling, respectively. Overall, Pentecostal churches have a stronger effect in politics in places that are poor, less white, have less formal schooling and were more evangelical beforehand.

4 Dynamic Game of Church Entry

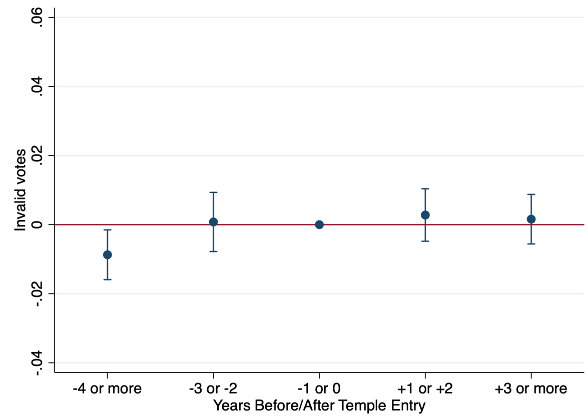
The previous section established causal relationship between churches entry in Brazilian municipalities and the FPE vote share. This section develops a dynamic model of strategic interaction between churches. The model allows us to simulate the effects of churches taxation on the expansion of temples in Brazilian municipalities. Later we combine the predictions of the theoretical model and the causal links between church entry and FPE vote share to quantify the effects of taxes on churches on the vote share of the FPE.

The section is divided in three subsections. First, we examine the main determinants

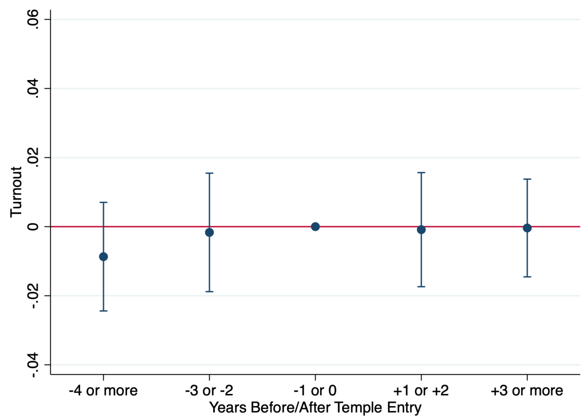
Figure 5: Temple Entry by Church on Turnout and Blank/Null Votes



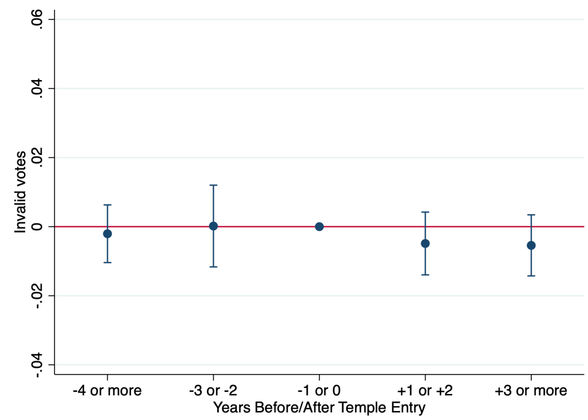
(a) Turnout (Pentecostal)



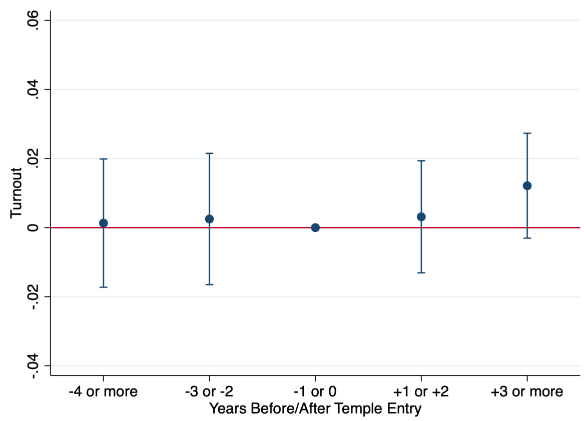
(b) Blank/Null (Pentecostal)



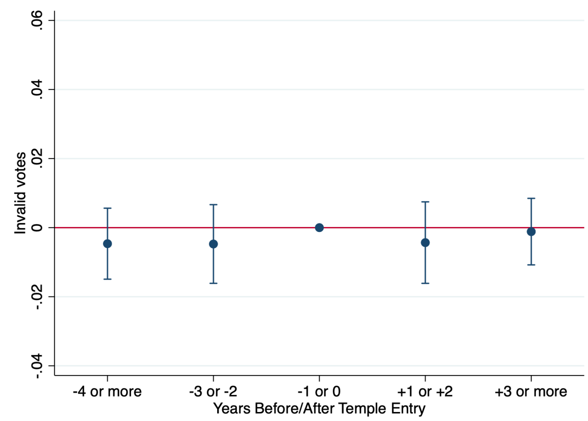
(c) Turnout (Non-Pentecostal)



(d) Blank/Null (Non-Pentecostal)



(e) Turnout (Catholic)



(f) Blank/Null (Catholic)

of churches entry in Brazilian municipalities from a series of descriptive regressions. We pay special attention to competition patterns between churches of different denominations. These regressions will guide the formulation of the dynamic game. Next we describe the main elements of the game. Finally we define the equilibrium concept we will use to solve the model.

4.1 Descriptive Analysis

Before presenting the theoretical model, we examine the relevance of competition and observed and unobserved market characteristics to explain the evolution of the number of active temples of different denominations in Brazilian municipalities. We are particularly interested in understanding how these elements affect the behavior of Pentecostal churches. This is the largest evangelical religious group. Importantly, for the purposes of this paper, (i) this group is directly tied to political parties that compose the FPE and (ii) as showed in the previous section, entry of Pentecostal churches has a causal effect on the vote share of the FPE. Our descriptive study is based on the following Linear Probability Model:[22]

$$a_{im}^{t} = \rho_0 + \rho_1 a_{im}^{t-1} + \sum_{n=1}^{N} \rho_2^n c_{im}^{n,t-1} + \rho_3 p_m^t + \mu_i^t + \mu_m + \zeta_{im}^t, \tag{3}$$

where, $a_{im}^t \in \{0,1\}$ is church i's action in municipality m, period t, $c_m^{n,t-1}$ is the number of temples of other churches, $n = 1, 2, ..., N$, $n \neq i$, competing with church i in market m, period $t-1$, p_m^t is the population in market m, period t, μ_i^t is a church-year fixed effect, μ_m is a market fixed effect and ζ_{im}^t is an idiosyncratic term varying across churches, markets and time periods. This type of regression is commonly employed to describe the determinants of entry/exit movements of firms in different markets – see, for example, Ryan (2012) and Sanches et al. (2016a).[23]

[22]As approximately 80% of the municipalities in our sample have at most 1 temple of the same denomination, we model only entry and exit decisions.

[23]Intuitively, this regression may be interpreted as a reduced form representation of the equilibrium (a map of state variables into players actions) of the game we will develop in the next subsections.

Table 7 shows the results. The table suggests that Pentecostal churches appear to respond only to actions of competing churches that belong to the same religious group. In particular, specification in column (3) indicates that the presence of a Pentecostal incumbent in a given market reduces in approximately 0.8% entry probabilities of other Pentecostal church in the same market. Increases in the number of temples of other religious groups in a given market do not affect the entry probabilities of Pentecostal churches in the same market.

Table 7 also indicates that the coefficients capturing competition between churches are highly sensitive to the inclusion of church-year and market fixed effects. These sets of fixed effects are included in the model to control for unobserved heterogeneity (across churches, markets and periods of time) affecting churches entry/exit decisions. Specifically, we see that the inclusion of player/year and market fixed effects in the regressions increases considerably the magnitude (in absolute values) of the coefficients capturing competition between churches of the same group.[24] For the Pentecostals, when church-year and market fixed effects are included in the regression – i.e. when we move from column (2) to column (3) – the coefficient attached to ρ_2^3 jumps from -0.1% to -0.8%. As in Igami and Yang (2016), this evidence seems to suggest that different types of unobserved heterogeneity may be relevant to explain entry/exit decisions of Pentecostal churches in Brazilian markets. In the context of this paper, unobserved heterogeneity may be capturing, among other factors, the effects of secular competition on churches behavior – see Hungerman (2010) for a survey on competition between churches and secular options. We elaborate more on this aspect of religion markets in the next subsections.

In the Appendix we also show the same Linear Probability Model for Catholic and non-Pentecostal churches, the other two largest religious groups in Brazil. Competition patterns for Catholic and non-Pentecostal churches appear to be similar to those shown in Table 7. Entry decisions of Catholic (non-Pentecostal) temples are affected only by the number of

[24] These patterns are well documented in the Industrial Organization literature. Unobserved heterogeneity tends to attenuate parameters capturing competition between firms – see Igami and Yang (2016) for a detailed discussion.

Catholic (non-Pentecostal) incumbents. This finding is in line with the evidence shown in Rennhoff and Owens (2012) in a study of competition between churches in the US. A potential explanation for these findings is that different religious groups differentiate themselves to serve specific market niches.

In summary, the descriptive evidence shown in this subsection indicates that Pentecostal churches appear to compete with churches of the same group but not with churches of different religious groups. In practice, as we will discuss below, this finding means that, to estimate the counterfactual effects of taxes on the number of active temples, we need to model only the behavior of Pentecostal churches. This reduces substantially the computational costs of the empirical exercises based on the structural model. Another important aspect that emerges from the descriptive analysis is that unobserved heterogeneity seems to be relevant to explain entry and exit decisions of Pentecostal churches. These two facts will drive the construction and the estimation of our structural model. The structural model is presented in the next subsections.

Table 7: Linear Probability Models: Pentecostal Churches

	(1)	(2)	(3)
Lagged Action (ρ_1)	0.985***	0.985***	0.952***
	[0.00]	[0.00]	[0.00]
Catholic (ρ_2^1)	0.002***	0.001***	0.001
	[0.00]	[0.00]	[0.00]
Non Pent (ρ_2^2)	0.001*	0.001	-0.000
	[0.00]	[0.00]	[0.00]
Pent (ρ_2^3)	-0.001***	-0.001***	-0.008***
	[0.00]	[0.00]	[0.00]
Other (ρ_2^4)	0.001***	0.001***	0.001
	[0.00]	[0.00]	[0.00]
Population (ρ_3)		0.015***	0.026
		[0.00]	[0.02]
Observations	64,638	64,638	64,638
R^2	0.917	0.917	0.922
μ_i^t	No	No	Yes
μ_m	No	No	Yes

Note: Standard-errors clustered at the municipality level in brackets. (***) $p < 0.01$, (**) $p < 0.05$, (*) $p < 0.10$.

4.2 Preliminaries

We consider a general class of dynamic games of incomplete information with features that seem to be important to rationalize the expansion of evangelical churches in Brazil. The sequence of events is as follows. At any market churches observe past actions of all players – i.e. which church had/had not a temple in that market – and a set of characteristics of that market and draw a payoff shock from a given distribution. The realization of the shock is private information to the church. The distribution of shocks is common knowledge. The shock denotes elements that are (payoff) relevant to this church but are unobserved by other churches, e.g. costs to operate a temple, sunk costs churches pay to build a temple, etc. Churches simultaneously choose to have (or not not have) a temple in that market to maximize the discounted sum of payoffs taking as given beliefs on the actions of other churches. Churches collect period payoffs. The transition laws for the state vector determine the distribution of states in the next period. The games restarts.[25]

Other works have already applied related methodologies to examine strategic interactions between churches – see, for example, Rennhoff and Owens (2012) and Walrath (2016b). Differently from this literature, we model churches as forwarding looking entities. Forward looking behavior of churches may be justified by the magnitude of sunk costs churches have to pay when deciding to open a temple in a given market. These sunk investments tend to be relatively large. Hence, when deciding to open a temple, churches weigh sunk investments and expected streams of payoffs that are generated by the investment. In Section 6 we compare the predictions of the dynamic model with its static version. Our analyses indicate that the static model fails to reproduce important patterns we see in the data.

[25]Since the seminal contribution of Ericson and Pakes (1995), this type of game is commonly used to model dynamic competition between firms in markets of differentiated goods – for more a detailed discussion on this literature see Arcidiacono and Ellickson (2011), Aguirregabiria and Nevo (2013) or Pesendorfer (2013b).

4.3 Elements of the Game

We now formalize churches decision problem. Time is discrete, denoted by $t = 1, \dots, \infty$. There are $m \in \mathbf{M} = \left\{1, 2, ..., \bar{M}\right\}$ markets. In each market there are $N > 0$ churches. Churches actions at market m, period t, are denoted by $a^t_{im} \in \{0, 1\}$, where 1 means that the church has a temple operating at that market and period and 0 otherwise. Occasionally, we use $\mathbf{a^t}\ _{\mathbf{im}}$ to describe the actions of all churches other than church i. The vector $\mathbf{s^t_m}$ denotes an element of the (publicly observed) state space at market m, period t. This vector contains the actions of all churches at that market in the previous period, $\mathbf{a^{t\ 1}_m}$, and other market m characteristics at period t, which will be denoted by the vector $\mathbf{x^t_m}$. Without loss of generality we assume that $\mathbf{x^t_m}$ is discrete. The vector $\mathbf{s^t_m}$ evolves according to the transition law $H_{im}(\mathbf{s^{t+1}_m}|\mathbf{s^t_m}, \mathbf{a^t_m}) \in [0, 1]$. It characterizes next period probability distribution of observed states conditional on the current state vector and churches action profile.

Church i's decision problem at period t, market m, is to choose an action $a^t_{im} \in \{0, 1\}$ to maximise the expected discounted sum of payoffs. We denote the discounted sum of payoffs by $E_t \sum_{\tau=t}^{1} [\beta^{\tau\ \ t} \Pi_{im}(\mathbf{a^\tau_m}, \mathbf{s^\tau_m}, \varepsilon^\tau_{im})]$, where $\beta \in (0, 1)$ is the discount factor and $\Pi_{im}(\cdot)$ denotes church i's profit in period t at market m. The term ε^τ_{im} is a payoff shock privately observed by church i at market m, period τ. We specify this shock later in this subsection. The cdf of the shock is known by all churches and by the econometrician. We further assume that $\Pi_{im}(\cdot)$ can be decomposed as:[26]

$$\Pi_{im}(a^t_{im}, \mathbf{a^t}\ _{\mathbf{im}}, \mathbf{s^t_m}, \varepsilon^t_{im}) = \pi_{im}(a^t_{im}, \mathbf{a^t}\ _{\mathbf{im}}, \mathbf{x^t_m}) + a^t_{im}\varepsilon^t_{im} + a^t_{im}\left(1 - a^{t\ \ 1}_{im}\right) F_i. \tag{4}$$

Here, $\pi_{im}(a^t_{im}, \mathbf{a^t}\ _{\mathbf{im}}, \mathbf{x^t_m})$ denotes church i's deterministic profits in market m and F_i is an entry cost. Entry costs are paid only at the period churches build a temple at the market.[27]

[26] The structure of this payoff function is, in essence, similar to those adopted by Rennhoff and Owens (2012) and Walrath (2016b).

[27] We assume that if a church decides to close a temple in any market it gets a scrap value equal to zero. Aguirregabiria and Suzuki (2014) and Komarova et al. (2018) show that operating costs, entry costs and scrap values cannot be jointly identified. Given this identification restriction, empirical papers typically normalize scrap values to zero – see, for example, Sanches et al. (2016a) and Collard-Wexler (2013).

We assume that the deterministic payoffs, $\pi_{im}\left(a_{im}^{t}, \mathbf{a^{t}}_{\mathbf{im}}, x_{m}^{t}\right)$, can be written as:

$$\pi_{im}\left(a_{im}^{t}, \mathbf{a^{t}}_{\mathbf{im}}, \mathbf{x_{mt}}\right) = a_{im}^{t}\left\{\theta_{0i} + \theta_{1i}\left(\sum_{j \neq i} a_{jm}^{t}\right) + \theta_{2i} p_{m}^{t}\right\}, \tag{5}$$

where, $p_{m}^{t} \in \mathbf{x_{m}^{t}}$ is the population of market m at period t, and θ_{0i}, θ_{1i} and θ_{2i} are parameters. In particular, the parameter θ_{1i} reflects the effects of a temple of other denominations on the payoffs of church i. It is a measure of competition between churches in our model. We assume that church i receives the payoff $\theta_{0i} + \theta_{1i}\left(\sum_{j \neq i} a_{jm}^{t}\right) + \theta_{2i} p_{m}^{t}$ only if it has a temple operating at that market and period of time. Finally we assume that the payoff profitability shock can be written as:

$$\varepsilon_{im}^{t} = \gamma_{im} \cdot \mu_{im}^{t} + \varsigma_{im}^{t}, \tag{6}$$

where, μ_{im}^{t} is a church specific shock that varies over t and m, γ_{im} is a parameter and ς_{im}^{t} is an iid shock with standard Normal distribution. Its cdf will be denoted by $Q(\cdot)$. We assume that the μ_{im}^{t}s are observed by all churches, but not by the econometrician. We do not impose any distributional assumption on this shock. We allow this element to be correlated across players and periods of time in the same municipality. In practice we will treat γ_{im} (for all markets and players) as another set of parameters to be estimated. The shock μ_{im}^{t} will be an element of the state space, $\mathbf{s_{m}^{t}}$. This element captures unobserved heterogeneity affecting churches actions. As we emphasized in the previous subsection, unobserved heterogeneity appears to be important to explain churches entry/exit decisions and may be capturing, among other factors, competition between churches and secular options. As pointed out by Hungerman (2010) secular competition is particularly important to explain the behavior of faithfuls and, consequently, of churches. Our model takes into consideration this aspect of this market in a parsimonious way.[28] In the next section we show how we obtain estimates

[28]Few works have analyzed explicitly competition between religion and secular options. A notable exception is Gruber and Hungerman (2008) who explore the relationship between religiosity and secular competition. They show that states that repeal *blue laws* that prohibit retail activity on Sunday experience a decrease in religious attendance and donations, and an increase in drinking and drug use.

of μ_{im}^{t} from the data and give details about the estimation of the model in the presence of this object. The only source of asymmetric information in this model is ς_{im}^{t}.

We can rewrite the present value of the expected flow of payoffs in terms of beliefs and transitions of states and restate church i's decision problem as a Bellman equation:

$$V_{im}(\mathbf{s_m^t}, \varsigma_{im}^t; \sigma_{\mathbf{im}}) = \max_{a_{im}^t \in \{0,1\}} \Big\{ \sum_{\mathbf{a^t}_{-\mathbf{im}}} \sigma_{im}(\mathbf{a^t}_{-\mathbf{im}} | \mathbf{s_m^t}) \cdot \big[\Pi_{im}(a_{im}^t, \mathbf{a^t}_{-\mathbf{im}}, \mathbf{s_m^t}, \varepsilon_{im}^t) + \beta \sum_{\mathbf{s_m^{t+1}}} H_m(\mathbf{s_m^{t+1}} | \mathbf{s_m^t}, \mathbf{a_m^t}) \int V_{im}(\mathbf{s_m^{t+1}}, \varsigma_{im}^{t+1}; \sigma_{\mathbf{im}}) dQ(\varsigma_{im}^{t+1}) \big] \Big\}. \tag{7}$$

In this expression, we use the notation $\sigma_{im}(\mathbf{a^t}_{-\mathbf{im}} | \mathbf{s_m^t})$ to denote church i's beliefs that given the state variable realization $\mathbf{s_m^t}$, its rivals will play an action profile $\mathbf{a^t}_{-\mathbf{im}}$; $\sigma_{\mathbf{im}}$ is the vector of church i's beliefs on all possible $\mathbf{a_m^t}$ for all possible states that may be observed in market m and $V_{im}(\mathbf{s_m^t}, \varepsilon_{im}^t; \sigma_{\mathbf{im}})$ is church i's value function in market m when the state vector is $\mathbf{s_m^t}$ and the realization of the private information shock is ς_{im}^t. In the second part of this expression, we assume conditional independence of the distribution of private shocks and factorize the distribution of future states as $H_m(\mathbf{s_m^{t+1}} | \mathbf{s_m^t}, \mathbf{a_m^t}) \cdot Q(\varsigma_{im}^{t+1})$. This assumption is standard in this literature – see, for instance, assumption 2 in Aguirregabiria and Mira (2007); see also Rust (1987).

4.4 Equilibrium Concept

To solve the model, we focus on stationary pure Markovian strategies. This implies that churches optimal decisions only depend on the vector of states, $(\mathbf{s_m^t}, \varsigma_{im}^t)$. The history of the game until period t does not matter and every time church i faces the same realization of the state vector it will play the same action.

Formally, the solution to church i's maximization problem – see equation (7) – gives rise to a collection of best response functions mapping church i's optimal decision on its beliefs for every possible realization of the state vector. Mathematically, let $V_{im}^{\mathbf{1}}(\mathbf{s_m^t}, \varsigma_{im}^t; \sigma_{\mathbf{im}})$ be church i's value function conditional on $a_{im}^t = 1$ net of the payoff shock ς_{im}^t when the state vector is $\mathbf{s_m^t}$ and the payoff shock is ς_{im}^t and $V_{im}^{\mathbf{0}}\left(\mathbf{s_m^t}, \varsigma_{im}^t; \sigma_{\mathbf{im}}\right)$ be church i's value function conditional on $a_{im}^t = 0$ when the state vector is $\mathbf{s_m^t}$ and the payoff shock is ς_{im}^t. Then church i chooses to play $a_{im}^t = 1$ with probability:

$$P\left(a_{im}^t = 1 | \mathbf{s_m^t}; \sigma_{\mathbf{im}}\right) = Q\left(V_{im}^{\mathbf{1}}\left(\mathbf{s_m^t}, \varsigma_{im}^t; \sigma_{\mathbf{im}}\right) - V_{im}^{\mathbf{0}}\left(\mathbf{s_m^t}, \varsigma_{im}^t; \sigma_{\mathbf{im}}\right)\right). \tag{8}$$

Stacking this equation for all possible players and states in market m we can write the vector of churches best response as $\mathbf{P_m} = Q\left(\sigma_{\mathbf{m}}\right)$, where $\mathbf{P_m}$ is a vector that stacks $P\left(a_{im}^t = 1 | \mathbf{s_m^t}; \sigma_{\mathbf{im}}\right)$ for all players and states in market m and $\sigma_{\mathbf{m}}$ is the vector that stacks $\sigma_{\mathbf{im}}$ for all players in market m. Beliefs are consistent in equilibrium, i.e. $\mathbf{P_m} = \sigma_{\mathbf{m}}$, and are computed as a fixed point of the mapping $\mathbf{P_m} = Q\left(\mathbf{P_m}\right)$. Proofs of equilibrium existence are available in Aguirregabiria and Mira (2007), Pesendorfer and Schmidt-Dengler (2008) and Doraszelski and Satterthwaite (2010).[29] This completes the description of our theoretical framework. Next we turn to the estimation of the structural parameters of this model.

5 Identification, Estimation and Structural Estimates

This section discusses identification of the structural parameters of our model, the algorithm we used to estimate these parameters and reports estimates of the parameters. We start with a brief discussion on identification and with a description of the algorithm we used to estimate the model. We focus on key aspects of the estimation algorithm and leave more technical details to the Appendix. Subsequently, we show the estimates of the parameters of the model.

[29] Typically, however, dynamic games of incomplete information have multiple equilibria. When solving the model and performing counterfactuals we numerically show that the equilibrium of the model is locally stable – implying that the counterfactual exercises showed in this paper can be interpreted as typical comparative statics exercises.

5.1 Identification and Estimation

The identification of the vector of structural parameters, $\Theta = \left\{ (\theta_{0i}, \theta_{1i}, \theta_{2i}, F_i, \gamma_{im})_{\forall (i,m)}, \beta \right\}$, follows the two step approach pioneered by Hotz and Miller (1993). We first identify beliefs (Conditional Choice Probabilities or CCPs), $\sigma_{im}(\mathbf{a^t}_{\mathbf{im}}|\mathbf{s^t_m})$, and state transitions, $H_{im}(\mathbf{s^{t+1}_m}|\mathbf{s^t_m}, \mathbf{a^t_m})$, directly from the data. Conditional on the identification of beliefs and transitions and giving the distribution of payoff shocks, ς^t_{im}, Komarova et al. (2018) show that payoff parameters and the discount rates are point identified in dynamic discrete choice games of incomplete information when model payoffs have the same structure as equation (4). We refer the readers to Komarova et al. (2018) for further details on the identification of dynamic discrete choice games under parametric assumptions. Next we characterize the procedures we used to estimate the vector of structural parameters.

We estimate the model only for the group of Pentecostal churches. This group includes Assembly of God, Quadrangular and Universal. These are the three largest Pentecostal denominations and are responsible for approximately 90% of the total number of Pentecostal temples in our data. As we showed in Subsection 4.1, entry and exit decisions of churches of this group are not affected by entry/exit decisions of churches of other groups. Moreover, only the entry of churches of this group affects FPE vote share. Therefore, to simulate the effects of taxes on the vote share of the FPE we need to look only to the behavior of Pentecostal churches.

To estimate the parameters of the model we combine methodologies proposed by Rust (1987), Berry (1992), Sanches et al. (2016b) and Komarova et al. (2018). We outline the steps of our estimation algorithm below.

1. Estimate state transitions and an initial guess for beliefs directly from the data;

2. Given state transitions and the initial guesses for beliefs and for the discount rate estimate $(\theta_{i0}, \theta_{i1}, \theta_{i2}, F_i, \gamma_{im})_{\forall (i,m)}$ in closed form as a function of the discount rate using the estimator proposed by Sanches et al. (2016b);

3. Solve the model for the equilibrium vector of beliefs that is consistent with the model estimates obtained in the previous step;

4. For each market, fix the vector of states in 1991 (first year in our sample) and, using equilibrium beliefs and the state transitions obtained in the first step, simulate the number of temples, $\hat{n}_m^t = \sum_{i=1}^{N} \mathbb{I}\left(a_{im}^t = 1\right)$, S times 27 years ahead (from 1992 until 2018);

5. Take the average of the S simulated paths of the number of temples for each year and find $\hat{\beta} = \underset{\beta}{min} \sum_{t=1}^{27} \left(\hat{n}^t - n^t\right)$, where n^t is the number of temples in year t observed in the data and $\hat{n}^t = \sum_{m=1}^{M} \hat{n}_m^t$.[30]

This algorithm produces parameter estimates that capture very well the evolution of the number of temples observed in the data. Traditional two step estimation algorithms for dynamic games are generally based on steps one and two, only. First stage estimates of beliefs and transitions are plugged into structural model and in the second stage model parameters (including the discount factor) are obtained from the structure of the model. In the Appendix we show that the inclusion of steps 3-5 in the two step algorithm improves significantly the fitting of the model to the data. In what follows we describe in details the first step of the algorithm. We focus on the first step because in this step we recover μ_{im}^t and estimate its transition function. These two objects are important to explain the evolution of the number of temples we observe in the data. We leave the discussion on the other steps to the Appendix.

The first step requires the estimation of initial guesses for beliefs, $\sigma_{im}(\mathbf{a^t}_{\mathbf{im}}|\mathbf{s_m^t})$, and transitions, $H_{im}(\mathbf{s_m^{t+1}}|\mathbf{s_m^t}, \mathbf{a_m^t})$. Typically, in models of binary choices, beliefs are estimated using a Probit/Logit model, where the dependent variable is $a_{im}^t \in \{0, 1\}$ and the explanatory variables are $\mathbf{s_m^t}$ – see, for example, Ryan (2012) and Sanches et al. (2016a). We also

[30]Berry (1992) also estimate the parameters of his model minimizing the distance between observed and simulated number of firms.

estimate beliefs using a Probit model pooling the three Pentecostal churches across markets and years.[31]

The challenge to estimate beliefs is that the state vector contains the shock μ_{im}^{t} that is observed by all churches but not by the econometrician. We obtain estimates of this object using a two step procedure.[32] Precisely:

1. We run a Probit of a_{im}^{t} on (i) a_{im}^{t-1}, (ii) $\sum_{j \neq i} a_{jm}^{t}$ interacted with church dummies, (iii) p_{m}^{t} interacted with church dummies, (iv) year dummies interacted with church dummies and (v) municipality fixed effects;

2. We collect the municipality fixed effects and discretize this vector in 5 bins to construct five different market type dummies. We then run another Probit of a_{im}^{t} on (i) a_{im}^{t-1}, (ii) $\sum_{j \neq i} a_{jm}^{t}$ interacted with church dummies, (iii) p_{m}^{t} interacted with church dummies, and (iv) year dummies interacted with market type dummies and church dummies.

Our estimates of μ_{im}^{t} will be the interactions of year dummies, market type dummies and church dummies we obtain from the Probit in the second step above. Essentially, these dummies are capturing market aspects that are not directly observed by the econometrician but are relevant to explain churches decisions. We note that the discretization of market fixed effects is necessary because the number of markets in our data is large and estimating and solving the model for each of these markets would be computationally prohibitive. The beliefs we use to initialize the algorithm are then estimated as a Probit of a_{im}^{t} on (i) a_{im}^{t-1}, (ii) a_{jm}^{t-1}, $j \neq i$ interacted with church dummies, (iii) p_{m}^{t} interacted with church dummies, (iv) the vector of μ_{im}^{t} for all players and (v) the 5 market type dummies. The parameters of this Probit model for the two groups of denominations are in the Appendix.[33]

[31] Dynamic games typically have multiple equilibria. In this case, first stage of initial guesses for beliefs will be consistent only if the same equilibrium is played in every market. This is a common assumption in this literature – see, for example, Ryan (2012), Collard-Wexler (2013) and Sanches et al. (2016a).

[32] The procedure is similar in spirit to the ones employed by Minamihashi (2012), Lin (2015) and Sanches et al. (2016a).

[33] We also examine the sensibility of the estimates of beliefs with respect to the number of market types. We estimated the initial guesses for beliefs varying the number of market types. The estimates for alternative

Having estimated μ_{im}^t we can estimate its transition. To estimate the transition of μ_{im}^t we imposed two assumptions:

1. **Conditional independence:** Conditional on current actions, $\mathbf{a_m^t} = (a_{im}^t)_{i=1}^N$, and population, p_m^t, μ_{im}^{t+1} does not depend on μ_{im}^t;

2. **Deterministic evolution:** The component μ_{im}^{t+1} is a deterministic function of $\mathbf{a_m^t}$ and p_m^t.

These assumptions deserve qualifications. First, they are empirically driven. We also estimated versions of the model where we allowed μ_{im}^{t+1} to depend directly on μ_{im}^t and to evolve stochastically over time. In these versions, we discretized μ_{im}^t and estimated its transition using an autoregressive ordered logit. The performance of these models were much worse than the performance of model estimated under these two assumptions. In particular, the alternative models were not able to mimic the evolution of the number of temples we observe in the data. The model estimated under the assumptions above, in contrast, reproduced very well the trend of the number of temples we observe in the data – we discuss the fitting of the model later in the next section. Intuitively, as μ_{im}^t is directly observed by the players, then the action profile, $\mathbf{a_m^t}$, will be a function of μ_{im}^t. The first assumption uses this fact to estimate the evolution of μ_{im}^t. Lastly, we argue that this assumption is analogous to the conditional independence assumption in Rust (1987). Rust's conditional independence assumption implies that the evolution of observed states conditional on players actions and previous states do not depend on the idiosyncratic payoff shock, ς_{im}^t. This assumption is frequently employed by papers in this literature – including this paper (see Subsection 4.3) – to model the evolution of observed states.

Second, these assumptions are convenient from the computational point of view. The reason is that assumption 2 implies that the inclusion of μ_{im}^t in the model does not change the size of the state space. Indeed, as this component depends only on actions and population,

numbers of market types are in the Appendix. The results indicate that first stage estimates of beliefs do not vary significantly when we use different discretizations.

once actions and population are determined, μ_{im}^t is consequently determined. Moreover, as actions and population are discrete and finite variables, μ_{im}^{t+1} will be discrete and finite, giving rise to a model that can be solved and estimated using traditional methods. On the other hand, the state space of the alternative model – where μ_{im}^{t+1} depends directly on μ_{im}^t and evolves stochastically – grows exponentially with the number of bins we use to discretize μ_{im}^t. In practice, we estimated a different transition of μ_{im}^t for each player by regressing the μ_{im}^t estimates on past actions of all players, population and market type dummies. The results of these regressions are in the Appendix.

Finally, to estimate the state transition for the population, we discretized this variable in 20 bins and ran an autoregressive ordered logit. Transitions of the vector of past actions are deterministic, i.e. $a_{im}^t = a_{im}^{t\ 1}$. With beliefs and transitions we can initialize our estimation algorithm and estimate the parameters of the model.

5.2 Structural Estimates

We now present the estimates of the payoff parameters and of the discount rates. To obtain standard-errors of the estimates we block bootstrap initial guesses for beliefs and the state transitions 50 times. We note that the estimates of the model do not have a level interpretation because they are scaled by the standard-error of the payoff shock, ς_{im}^t. Hence, only the signs and the relative magnitudes of the parameters matter.

Table 8: Structural Parameters: Pentecostal Churches

	A. of God	Quadrang	Universal
Constant (θ_0)	2.596	2.101	1.547
	[0.10]	[0.10]	[0.52]
Number of Competitors (θ_1)	-0.052	-0.355	-0.109
	[0.09]	[0.15]	[0.11]
Population (θ_2)	2.119	-2.763	0.123
	[0.34]	[0.42]	[0.28]
Shock Market 1 (γ_1)	1.003	0.132	-1.273
	[0.08]	[0.33]	[0.78]
Shock Market 2 (γ_2)	0.861	-2.525	-1.272
	[0.07]	[0.32]	[0.63]
Shock Market 3 (γ_3)	0.514	-0.417	-2.700
	[0.06]	[0.04]	[1.15]
Shock Market 4 (γ_4)	0.455	-0.815	-2.334
	[0.05]	[0.07]	[0.89]
Shock Market 5 (γ_5)	0.902	-1.484	-4.624
	[0.05]	[0.08]	[1.55]
Entry Cost (F)	-4.500	-4.627	-4.971
	[0.11]	[0.11]	[0.16]
Discount Factor (β)		0.540	
		[0.04]	

Note: Standard-errors in brackets.

The structural parameters for the 3 Pentecostal churches are shown in Table 8. Three aspects of these estimates deserve special attention. First, as expected and in consonance with the descriptive regressions showed in the Subsection 4.1, the coefficient θ_1 is negative for all churches, indicating that entry of a denomination (of the same group) in a given market reduces payoffs of the incumbent denomination. The coefficients are statistically significant, however, only for Quadrangular. Second, entry costs are negative, significant and larger (in absolute values) than the other coefficients. This indicates that entry costs are substantial in this market. Third, the estimates of the discount factor are around 0.54. We interpret this parameter as the "weight" churches assign to expectations about the evolution of the market when they make entry/exit decisions. The estimate is relatively small – compared to the usual 0.90-0.99 discount rates that the Industrial Organization literature typically uses to calibrate dynamic models – but statistically significant at 1%. This discount rate is consistent with the fact that during this period interest rates in Brazil were quite high – among the highest in the world.[34] We also analyzed the behavior of the model assuming $\beta = 0.90$, $\beta = 0.95$ and $\beta = 0.99$. Using these discount rates we observed that the model was overestimating severely the number of active temples in the Brazilian market.[35] We resume this discussion in the next section, when we show the fitting of the model to the data and the results of our counterfactual experiments.

6 Counterfactual Analysis

Now we use the estimated model to study how the introduction of a tax on the profits of churches would affect the number of evangelical temples in Brazilian municipalities. To compute these counterfactuals we scale down churches payoffs using different factors, solve the model for the counterfactual configuration of payoffs and simulate the evolution of the number of temples in Brazilian municipalities from 1992 until 2018. We compare the counterfactual paths with the path we obtain after solving the model using the original set of parameters – see Table 8.

Before showing the results of our counterfactual experiments, we analyze the fitting of the model to the data. Additionally, we illustrate the relevance of the forward-looking behavior of the churches by comparing the fitting of the dynamic model with the fitting of its static version.

6.1 Model Fitting

We inspect the performance of our model comparing the time-series of the number of temples of the 3 Pentecostal denominations during 1992-2018 as we observe in the data with the

[34] Indeed, for the period 2011-2018 (period for which interest rates on credit operations are available) real interest rates charged on loans were on average 40% per year (source: Brazilian Central Bank).

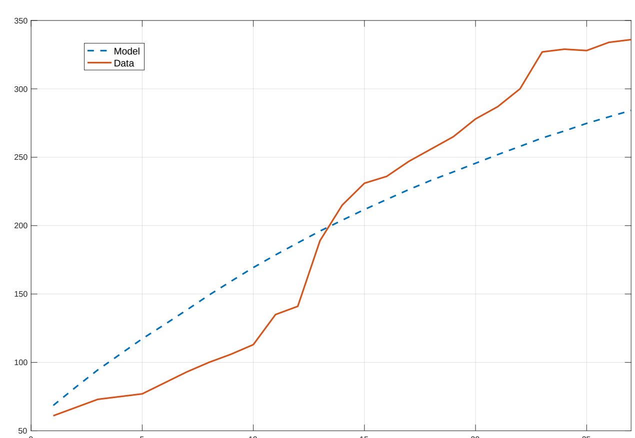
[35] In the Appendix we plot the objective function (step 5) of the algorithm for a discrete grid of β varying from 0 to 0.99. The function has a global minimum at $\beta = 0.54$. The figure also shows that the fitting of the model to the data for $\beta = 0.90$, $\beta = 0.95$ and $\beta = 0.99$ is much worse than the fitting of the model for $\beta = 0.54$.

number of temples of these denominations during the same period as predicted by the model.

To compute the time-series of temples predicted by the model we employ the following procedure. First, using the parameters in Table 8 we solve the model for the equilibrium vector of beliefs. We describe the algorithm we use to solve the model in the Appendix. Having computed the vector of equilibrium beliefs we forward simulate the model starting from the state vector observed by each church in 1991 in each municipality 27 years ahead, until 2018. In total we simulate 100 paths for each church-municipality pair and take the average number of temples of each church in each municipality across the 100 paths. Figure 6 shows the total number of temples of the 3 Pentecostal churches as observed in the data and the corresponding time-series we simulate from the model (dashed line).

Overall, the model captures well the trend in the aggregate number of temples. It overestimates the number of temples in the first years and slightly underestimates the number of temples in the last years. Visually, the fitting of the model is very similar to the fitting of the dynamic model developed in Igami and Yang (2016) to study entry behavior of fast food chains in Canada – see Figure 4 in Igami and Yang (2016). Notably, both models appear to capture well long run trends in the data but fails to capture abrupt variations in entry movements.

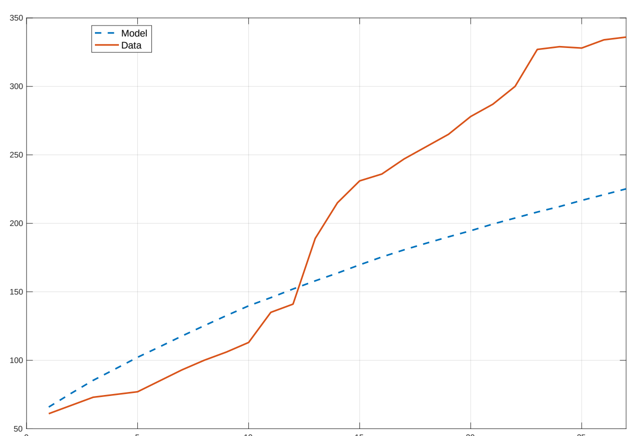
Figure 6: Dynamic Model Fitting – Number of Temples of Pentecostal Churches



We also examine the importance of the forward-looking behavior of churches. To do this we estimate a static version of the model assuming that the discount rate of all churches is zero. We show in the Appendix the coefficients of the static version of our model. Using these coefficients, we solve the model and forward simulate the equilibrium number of churches in each year following the same procedure we employed to construct Figure 6. Figure 7 shows the simulated and observed number of temples in each year. As it is evident, the performance of the static version of the model is remarkably worse than the performance of the dynamic model. The static model, in particular, is not able to capture the trends observed in the data. This finding suggests that churches entry decisions embed an important forward-looking component.

The equilibrium of the model is not necessarily unique. To check whether the equilibrium of the model is locally stable we fix the vector of parameters (including the discount rate) and recompute the equilibrium path of temples varying the initial guess of beliefs we use to start the estimation algorithm. In all our attempts, the resulting path of temples is the same, suggesting that the equilibrium of the model is locally stable. Next we use this model to construct counterfactual experiments.

Figure 7: Static Model Fitting – Number of Temples of Pentecostal Churches



6.2 Counterfactuals

Now we employ the structural model to evaluate how this tax exemption policy affected the number of evangelical temples operating in Brazilian municipalities. Then, we use the simulated number of temples under different taxation levels and the model estimated in Section 3.2 to predict the vote share received by evangelicals elected to Congress.

Tax exemption and the number of temples. We begin by recalculating the equilibrium of the model, assuming that churches pay a proportional tax on their variable payoffs – payoffs net of entry costs –, i.e. multiplying their variable payoffs by $1 - \varrho$, where $\varrho \in [0, 1]$ is the tax rate. Under each scenario, we take the corresponding vector of equilibrium probabilities and simulate 100 times the number of temples of the 3 Pentecostal denominations for each year during 1992-2018 in each municipality. We compute yearly averages of the total number of active temples and the tax revenues collected from these temples across the 100 paths.

Figure 8: Counterfactual Number of Temples and Tax Revenues for Different Tax Levels

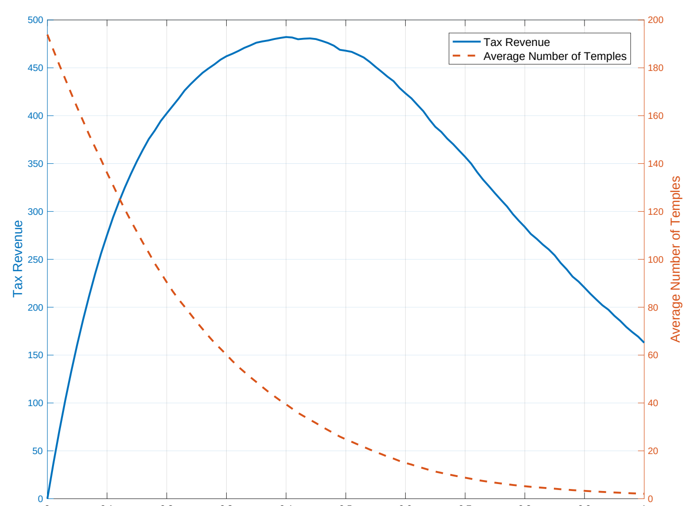


Figure 8 shows the result of this exercise. The horizontal axis shows the tax rate. The dashed line shows the average number of active temples in all municipalities across 1992-2018. As expected, as the tax rate increases, the number of temples reduces. The reduction in the number of temples is substantial. If the government had charged a 34% tax on profits since 1992 – the average corporate tax paid by firms in Brazil[36] – the average number of active temples of Pentecostal churches in a given year would fall from 193 to 51, or approximately 74%.

The solid line illustrates the Laffer Curve of the tax on churches variable profits. More specifically, it shows the present value of total revenues collected by the government from taxes on churches variable profits for different tax rates. The Laffer Curve peaks at $\varrho = 0.40$, indicating that the tax rate that maximizes tax revenue is large but close to the average corporate tax charged on profits in Brazil.[37] Interestingly, when the tax rate is equal to 100% the tax revenue is still relatively large. Two forces explain this result. First, there is a stock of temples already operating in 1992, the initial year of our analysis. When the tax rate is 100% the present value of the contribution of these temples in the first years after the tax change overshoots, pushing up the present value of the sum of tax revenues over the entire period. Second, when $\varrho = 1$ temples that were in operation in 1992 will be indifferent between playing $a = 1$ and $a = 0$. Some of these temples will continue to operate in the short run. Eventually, as the time passes these temples will leave the market. However, because some incumbent temples leave the market and the entry of new temples decreases, competitive pressures on temples that stay on the market reduces. The result is an increase in the payoffs of the stayers.

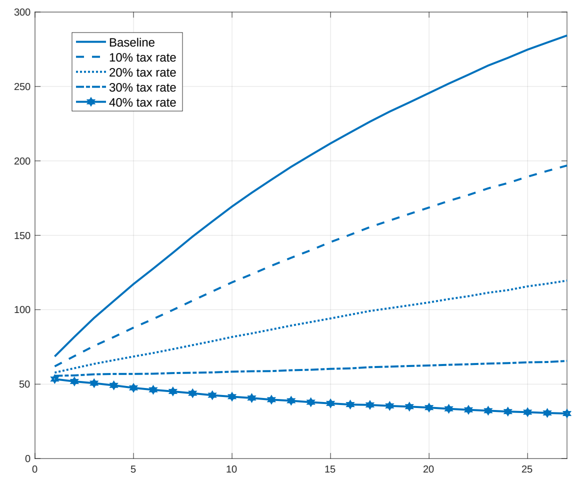
This exercise also sheds light on an interesting fact. It suggests that firm entry and exit dynamics may have clear implications for the estimation of the Laffer Curve. Indeed, increases in taxes flatten payoffs, reduce entry and force incumbent firms to leave the market. This, in turn, tend to increase profits of firms that are able to operate paying higher tax

[36]See https://home.kpmg/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html.

[37]To calculate the present value of tax revenues collected by the government, we assumed that the government discount rate is 0.90. The baseline discount rate is relatively small because during 1992-2018 rates in Brazil were quite high reaching 45% in some periods. We present in the Appendix versions of the Laffer Curve assuming that the government discount rate is 0.95 and 0.99. Using a discount of 0.95 and 0.99 for the government, the revenue maximizing tax rate would be $\varrho = 0.30$ and $\varrho = 0.26$, respectively.

rates, thus mitigating the effects of tax increases on tax revenues. The interaction of these forces may have consequences for the estimation of the Laffer Curve.[38]

Figure 9: Evolution of the Number of Temples at Different Tax Levels



We also show the evolution of the number of temples over time for different tax rates. Figure 9 shows the number of temples for the period 1992-2018 for $\varrho = 0$, $\varrho = 0.10$, $\varrho = 0.20$, $\varrho = 0.30$ and $\varrho = 0.40$. The figure shows that for $\varrho < 0.30$ the number of temples is still increasing over time, indicating that for tax rates below 30% we would still observe entry of new temples in the market. When $\varrho = 0.30$ the number of temples is relatively constant over time, and when $\varrho > 0.30$ the stock of temples observed in 1992 starts to reduce.

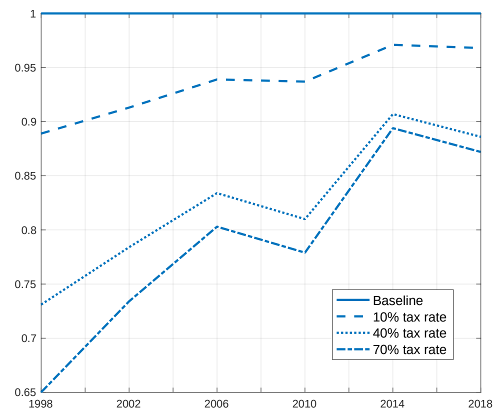
FPE vote share under alternative tax scenarios. The results above imply that the impact of different tax rates on the evolution of the number of temples over time is sizable. Figure 10(a) displays the evangelical vote share in election years 1998-2018 that FPE

[38] Miravete et al. (2018) study how strategic interactions between firms in noncompetitive markets affect the shape of the Laffer Curve. They estimate a static Bertrand model and show that the shape of the Laffer curve in this market differs significantly from the shape of the Laffer curve in perfectly competitive markets. Our contribution here is to study the same question in a dynamic framework with endogenous market structure, i.e. allowing the number of temples to evolve over time. A potential caveat of our analysis is that increases in taxes may induce churches to "force" faithfuls to increase their donations (tithes, for example) counterbalancing the effects of the taxes on profits. Because we do not observe "prices" our model cannot accommodate this effect. On the other hand, for the market we are analysing, the tax pass-though must be relatively small because donations to the churches are voluntary.

members would have received if the level of taxation was 0 (baseline), 0.10, 0.40 or 0.70. Figure 10(b) plot vote shares normalized by baseline levels. We calculate vote share under alternative tax scenarios as $\widetilde{Y}_{mt}(\varrho) = Y_{mt} + (\tilde{x}_{mt}(\varrho) - x_{mt})\hat{\beta}_1 + (\tilde{x}^2_{mt}(\varrho) - x^2_{mt})\hat{\beta}_2$, where Y_{mt} and x_{mt} are observed FPE vote share and observed number of temples in municipality m in election year t, respectively; $\tilde{x}_{mt}(\varrho)$ is the counterfactual number of temples for different tax rates and $\widehat{\beta}_1, \widehat{\beta}_2$ are the linear and quadratic term estimates of the effect of (continuous) number of temples on vote share reported in column 2 of Table 14.

Figure 10: Evangelical Vote Share under Alternative Tax Rates, 1998-2018

(a) Predicted vote share



(b) Normalized by baseline

The effect of taxation on vote share is monotonic and substantial, as expected. For instance, Evangelicals would have received almost 20% less votes in 2010 if tax rates levied upon religious entities were set at 0.40 – the rate at which Laffer curve peaks and just slightly above what churches would pay in taxes as regular for-profit organizations (0.34).

Back-of-the-envelope subsidies calculations. We also used aggregate information on churches revenue to provide meaningful back-of-the-envelope estimates on the magnitude of the subsidies received by churches in R$ (Brazilian Real). The Brazilian Internal Revenue

Service[39] estimated that in 2013 the revenues of all temples was approximately R$24.27 billion.[40] From this information we extrapolate our model and compute an approximate measure of the total revenue received by all Brazillian temples at any year t between 1992 and 2018 and an upper bound of the subsidies granted by the government to all churches.[41] Mathematically, let $\hat{n}^t(\varrho)$ and $\hat{\bar{\pi}}^t(\varrho)$ be, respectively, the counterfactual number active temples of all Pentecostal churches and the counterfactual average variable payoff of a temple at period t in values of 2013 when the tax rate is $\varrho \in [0,1]$. We calculate the upper bound of government expected revenues at year t as:

$$R_G^t(\varrho) = \varrho \left(\frac{\hat{\bar{\pi}}^t(\varrho)\, \hat{n}^t(\varrho)}{\hat{\bar{\pi}}^{2013}(0)\, \hat{n}^{2013}(0)} \right) R_G^{2013}, \tag{9}$$

where, R_G^{2013} is churches aggregate revenue as calculated by the Brazilian Internal Revenue Service in 2013. The term in brackets rationalizes the effects of the taxes on (i) the number of active temples and (ii) on the average variable payoffs of active temples.

Table 9: Revenues of a Tax on Churches' Variable Profits (R$ Billion of 2013)

Tax Rate	Rev (1992-2018)	Avg Rev /Year	% GDP
10%	R$ 90,659.92	R$ 3,357.77	0.063%
20%	R$ 132,217.60	R$ 4,896.95	0.092%
30%	R$ 151,154.29	R$ 5,598.31	0.106%
40%	R$ 156,093.74	R$ 5,781.25	0.109%

The first column in Table 9 shows $R_G^t(\varrho)$ in R$ of 2013 for different tax rates accumulated over the 1992-2018 period. The table shows that revenues raised from a tax on churches variable profits would be relatively small, varying between R$91 and R$156 billion[42] during the 1992-2018 period – or between R$3.4 and R$5.8 billion on average per year (column 2). The third column shows that yearly revenues with the tax would represent between 0.063% and 0.109% of the Brazilian GDP (in 2013). In practice, these numbers reveal that churches

[39] https://www1.folha.uol.com.br/mercado/2019/08/receita-de-igrejas-quase-dobra-em-oito-anos-e-vai-a-r242-bi.shtml

[40] Or, equivalently, US$11.3 billion using the average exchange rate R$/US$ in 2013.

[41] Our estimates give an upper bound of tax revenues because we only have estimates of churches revenues in R$.

[42] US$42 and US$73 billion, respectively, using the average official exchange rate in 2013.

taxation would have little impact on the government budget. Intangible consequences arising from changes in the composition of the Congress appear to be more relevant.[43]

7 Conclusion

The rapid spread of Pentecostalism during the last century is a social phenomenon that has been observed in most of Latin America and among US Latinos, as well as many parts of Africa and Asia. This movement was followed by a dramatic increase in the political and social influence of Pentecostal groups. Given how religion shapes economic development and human behavior more broadly, understanding the causes behind such rapid shift in the religious landscape are crucial to better inform policy-makers, scholars and the general public, and to help ensure that political representation and the allocation of public resources reflect the interests of the population as a whole.

Our analysis was developed in three steps. First, using a dynamic differences-in-differences approach we found a positive causal effect of Pentecostal temple building on the vote shares of candidates affiliated with Pentecostal groups. Second, we built and estimated a dynamic game of church entry using temple entry/exit data in Brazilian municipalities for 1992-2018. We solved the model and simulated the number of temples for each year under different tax scenarios. We also computed the long-run Laffer Curve associated to this exercise, and showed that the optimal tax rate is 40%, close to the the rate typically paid by Brazilian firms. We documented that the number of Pentecostal temples would have been 80% smaller than the observed if the optimal rate had been imposed on churches variable payoffs. Third, combining our DiD and structural estimates we show that the vote share of evangelicals would have been 13-27% lower in Congressional elections if churches were taxed. Despite having a relatively small impact on the government budget, our results indicated that tax

[43]For example, Costa et al. (2018) show that the political agenda of Pentecostal representatives in the Brazilian Congress differs considerably from the political agenda of representatives that are not directly tied to religious groups. In particular, bills proposed by the first group are much more focused on religious-sensitive themes.

subsidies have played a significant role on the geographical expansion of Pentecostal churches and had consequential impacts on the growing political representation of Pentecostal groups in the Brazilian Congress.

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Online Appendix (Not for Publication)

Appendix A: LPM Catholic and Non Pentecostal Churches

This Appendix shows the estimates of the Linear Probability model described in Subsection 4.1 for the Catholic and Non Pentecostal churches.

Table 10: Linear Probability Models: Catholic and Non Pentecostal Churches

	Pentecostals			Non Pentecostals		
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged Action (ρ_1)	0.943***	0.943***	0.853***	0.993***	0.992***	0.961***
	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]	[0.00]
Catholic (ρ_2^1)	0.001	0.001	-0.009*	0.001	0.001	0.001
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Non Pent (ρ_2^2)	0.001	0.001	-0.009	-0.003***	-0.003***	-0.018***
	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]	[0.00]
Pent (ρ_2^3)	-0.000	-0.000	0.002	0.000	0.000	0.002**
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Other (ρ_2^4)	0.000	0.000	-0.005**	0.001*	0.001*	0.001
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Population (ρ_3)		-0.018	-0.155		0.014***	0.047**
		[0.02]	[0.10]		[0.00]	[0.02]
Observations	7,182	7,182	7,182	28,728	28,728	28,728
R^2	0.920	0.920	0.926	0.933	0.933	0.935
μ_i^t	No	No	Yes	No	No	Yes
μ_m	No	No	Yes	No	No	Yes

Note: Standard-errors clustered at the municipality level in brackets. (***) $p < 0.01$, (**) $p < 0.05$, (*) $p < 0.10$. The coe cient ρ_2 for the Catholic church is identi ed because we have in a few markets more than one catholic temple.

Appendix B: Algorithms

This appendix describes the algorithms that we used to estimate the parameters of the structural model and subsequently to solve the model and perform counterfactuals. We focus on the details of steps 2-5 of the estimation algorithm. Step 3 of the estimation algorithm has a description of the algorithms we used to solve the model and to perform the counterfactual experiments. The descriptions of the first step are in Subsection 5.1.

Second Step: Estimation of the Vector of Payoff Parameters. Sanches et al. (2016b) shows that if the payoff of dynamic discrete choice models takes a linear-in-parameters form, then, for a given discount rate, payoff parameters can be estimated by OLS. Specifically, from equation (7) define the ex-ante expected value function value as – see, for example, Pesendorfer and Schmidt-Dengler (2008):

$$E_\varsigma\left[V_{im}\left(\mathbf{s_m^t},\varsigma_{im}^t;\sigma_{\mathbf{im}}\right)\right]=$$

$$\sum_{\mathbf{a_m^t}}\sigma_{im}\left(\mathbf{a_m^t}|\mathbf{s_m^t}\right)\left\{\Pi_{im}\left(\mathbf{a_m^t},\mathbf{s_m^t}\right)+\beta\sum_{\mathbf{s_m^{t+1}}}H_m\left(\mathbf{s_m^{t+1}}|\mathbf{s_m^t},\mathbf{a_m^t}\right)E_\varsigma\left[V_{im}\left(\mathbf{s_m^{t+1}},\varsigma_{im}^{t+1};\sigma_{\mathbf{im}}\right)\right]\right\}$$
$$+E\left[\varsigma_{im}^t|\mathbf{s_m^t},a_{im}^t=1\right]\sigma_{im}\left(a_{im}^t=1|\mathbf{s_m^t}\right),$$

where, $E_\varsigma\left[V_{im}\left(\mathbf{s_m^t},\varsigma_{im}^t;\sigma_{\mathbf{im}}\right)\right]$ denotes the expectation of the unconditional value function over the distribution of ς_{im}^t, $\Pi_{im}\left(\mathbf{a_m^t},\mathbf{s_m^t}\right)$ is the payoff described by equation (4) net of the payoff shock, ς_{im}^t, and $E\left[\varsigma_{im}^t|\mathbf{s_m^t},a_{im}^t=1\right]$ is the expectation of ς_{im}^t conditional on $\mathbf{s_m^t}$ and $a_{im}^t=1$. Let N_s be the cardinality of the state vector in market m and N_p the number of parameters of the model. Stacking the previous equation for every state $\mathbf{s_m^t}$:

$$\mathbf{V_{im}}=\mathbf{\Pi_{im}}+\mathbf{D_{im}}+\beta\mathbf{G_{im}}\mathbf{V_{im}}. \tag{10}$$

Here, $\mathbf{V_{im}}$ is a $(N_s\times 1)$ vector stacking the expected unconditional value functions for every possible state, $\mathbf{\Pi_{im}}$ is a $(N_s\times 1)$ vector stacking $\sum_{\mathbf{a_m^t}}\sigma_{im}\left(\mathbf{a_m^t}|\mathbf{s_m^t}\right)\Pi_{im}\left(\mathbf{a_m^t},\mathbf{s_m^t}\right)$ for every possible state, $\mathbf{D_{im}}$ is a $(N_s\times 1)$ vector stacking $E\left[\varsigma_{im}^t|\mathbf{s_m^t},a_{im}^t=1\right]\sigma_{im}\left(a_{im}^t=1|\mathbf{s_m^t}\right)$ for every possible state and $\mathbf{G_{im}}$ is a a $(N_s\times N_s)$ transition matrix mapping $\mathbf{s_m^t}$ into $\mathbf{s_m^{t+1}}$ given $H_m(\cdot)$, $\sigma_{im}(\cdot)$ and $\mathbf{a_m^t}$. Solving equation (10) for $\mathbf{V_{im}}$ we have that:

$$\mathbf{V_{im}}=\left[\mathbf{I}_{N_s}-\beta\mathbf{G_{im}}\right]^{\ 1}\left(\mathbf{\Pi_{im}}+\mathbf{D_{im}}\right),$$

with $\mathbf{I}_{N_s}$ representing a $(N_s\times N_s)$ identity matrix. Notice that because $\Pi_{im}\left(\mathbf{a_m^t},\mathbf{s_m^t}\right)$ is linear in the $(N_p\times 1)$ parameter vector, $\tilde{\mathbf{\Theta}}_{\mathbf{im}}=\left(\theta_{0i},\theta_{1i},\theta_{2i},F_i,\gamma_{im}\right)^{0}$, we can write $\mathbf{\Pi_{im}}=\mathbf{X_{im}}\tilde{\mathbf{\Theta}}_{\mathbf{im}}$, where $\mathbf{X_{im}}$ is a $(N_s\times N_p)$ matrix stacking $\mathbf{X_{im}}\left(\mathbf{s_m^t}\right)$ for every state, and $\mathbf{X_{im}}\left(\mathbf{s_m^t}\right)$ is a $(1\times N_p)$ known vector that depends only on states and beliefs. Using this fact we can write the vector of unconditional value functions as:

$$\mathbf{V_{im}}=\tilde{\mathbf{X}}_{\mathbf{im}}(\beta)\,\tilde{\mathbf{\Theta}}_{\mathbf{im}}+\tilde{\mathbf{D}}_{\mathbf{im}}(\beta), \tag{11}$$

where $\tilde{\mathbf{X}}_{\mathbf{im}}(\beta)=\left[\mathbf{I}_{N_s}-\beta\mathbf{G_{im}}\right]^{\ 1}\mathbf{X_{im}}$ and $\tilde{\mathbf{D}}_{\mathbf{im}}(\beta)=\left[\mathbf{I}_{N_s}-\beta\mathbf{G_{im}}\right]^{\ 1}\mathbf{D_{im}}$. Therefore, defining $\tilde{\mathbf{X}}_{\mathbf{im}}\left(\mathbf{s_m^{t+1}},\beta\right)$ as the $(1\times N_p)$ vector in the row of $\tilde{\mathbf{X}}_{\mathbf{im}}(\beta)$ that corresponds to state $\mathbf{s_m^{t+1}}$

and $\tilde{\mathbf{D}}_{\mathbf{im}}\left(\mathbf{s_m^{t+1}},\beta\right)$ as the element in the row of $\tilde{\mathbf{D}}_{\mathbf{im}}\left(\beta\right)$ that corresponds to state $\mathbf{s_m^{t+1}}$ we can write:

$$\int V_{im}\left(\mathbf{s_m^{t+1}},\varsigma_{im}^{t+1};\sigma_{\mathbf{im}}\right)dQ\left(\varsigma_{im}^{t+1}\right)=\tilde{\mathbf{X}}_{\mathbf{im}}\left(\mathbf{s_m^{t+1}},\beta\right)\tilde{\mathbf{\Theta}}_{\mathbf{im}}+\tilde{\mathbf{D}}_{\mathbf{im}}\left(\mathbf{s_m^{t+1}},\beta\right). \tag{12}$$

On the other hand, the value function conditional on $a_{im}^t=1$ net of the payoff shock ς_{im}^t – see equation (8) – is:

$$\begin{gathered}V_{im}^1\left(\mathbf{s_m^t},\varsigma_{im}^t;\sigma_{\mathbf{im}}\right)=\\ \theta_{0i}+\theta_{1i}\sum_{\mathbf{a^t}_{\mathbf{im}}}\sigma_{im}\left(\mathbf{a^t}_{\mathbf{im}}|\mathbf{s_m^t}\right)\left(\sum_{j\neq i}a^t{}_{im}\right)+\theta_{2i}p_m^t+\gamma_{im}\mu_{im}^t+a_{im}^{t-1}F_i+\\ \beta\sum_{\mathbf{a^t}_{\mathbf{im}}}\sigma_{im}\left(\mathbf{a^t}_{\mathbf{im}}|\mathbf{s_m^t}\right)\left\{\sum_{\mathbf{s_m^{t+1}}}H_m\left(\mathbf{s_m^{t+1}}|\mathbf{s_m^t},\mathbf{a^t}_{\mathbf{im}},a_{im}^t=1\right)\int V_{im}\left(\mathbf{s_m^{t+1}},\varsigma_{im}^{t+1};\sigma_{\mathbf{im}}\right)dQ\left(\varsigma_{im}^{t+1}\right)\right\}\end{gathered} \tag{13}$$

Substituting equation (12) into equation (13):

$$\begin{gathered}V_{im}^1\left(\mathbf{s_m^t},\varsigma_{im}^t;\sigma_{\mathbf{im}}\right)=\\ \left(\mathbf{X_{im}^1}\left(\mathbf{s_m^t}\right)+\beta E_{\mathbf{s_m^{t+1}}}\left[\tilde{\mathbf{X}}_{\mathbf{im}}\left(\mathbf{s_m^{t+1}},\sigma_{\mathbf{im}},\beta\right)|\mathbf{s_m^t},a_{im}^t=1\right]\right)\tilde{\mathbf{\Theta}}_{\mathbf{im}}+\\ \beta E_{\mathbf{s_m^{t+1}}}\left[\tilde{\mathbf{D}}_{\mathbf{im}}\left(\mathbf{s_m^{t+1}},\beta\right)|\mathbf{s_m^t},a_{im}^t=1\right],\end{gathered} \tag{14}$$

where,

$$\mathbf{X_{im}^1}\left(\mathbf{s_m^t}\right)=[1\quad\sum_{\mathbf{a^t}_{\mathbf{im}}}\sigma_{im}\left(\mathbf{a^t}_{\mathbf{im}}|\mathbf{s_m^t}\right)\left(\sum_{j\neq i}a^t{}_{im}\right)\quad p_m^t\quad\mu_{im}^t\quad a_{im}^{t-1}],$$

and,

$$\begin{gathered}E_{\mathbf{s_m^{t+1}}}\left[\tilde{\mathbf{X}}_{\mathbf{im}}\left(\mathbf{s_m^{t+1}},\sigma_{\mathbf{im}},\beta\right)\tilde{\mathbf{\Theta}}_{\mathbf{im}}+\tilde{\mathbf{D}}_{\mathbf{im}}\left(\mathbf{s_m^{t+1}},\beta\right)|\mathbf{s_m^t},a_{im}^t=1\right]=\\ \sum_{\mathbf{a^t}_{\mathbf{im}}}\sigma_{im}\left(\mathbf{a^t}_{\mathbf{im}}|\mathbf{s_m^t}\right)\left\{\sum_{\mathbf{s_m^{t+1}}}H_m\left(\mathbf{s_m^{t+1}}|\mathbf{s_m^t},\mathbf{a^t}_{\mathbf{im}},a_{im}^t=1\right)\int V_{im}\left(\mathbf{s_m^{t+1}},\varsigma_{im}^{t+1};\sigma_{\mathbf{im}}\right)dQ\left(\varsigma_{im}^{t+1}\right)\right\}.\end{gathered}$$

Simplifying the notation:

$$V_{im}^1\left(\mathbf{s_m^t},\varsigma_{im}^t;\sigma_{\mathbf{im}}\right)=\mathbf{X_{im}^1}\left(\mathbf{s_m^t}\right)\tilde{\mathbf{\Theta}}_{\mathbf{im}}+\beta E_{\mathbf{s_m^{t+1}}}\left[\tilde{\mathbf{D}}_{\mathbf{im}}\left(\mathbf{s_m^{t+1}},\beta\right)|\mathbf{s_m^t},a_{im}^t=1\right],$$

with $\tilde{\mathbf{X}}_{\mathbf{im}}^{\mathbf{1}}\left(\mathbf{s_m^t},\beta\right)$ representing the term inside brackets in equation (14). Using the same reasoning we can write the value function conditional on $a_{im}^t=1$ as $V_{im}^0\left(\mathbf{s_m^t},\varsigma_{im}^t;\sigma_{\mathbf{im}}\right)=\tilde{\mathbf{X}}_{\mathbf{im}}^{\mathbf{0}}\left(\mathbf{s_m^t},\beta\right)\tilde{\mathbf{\Theta}}_{\mathbf{im}}$. Now, plugging $V_{im}^0\left(\mathbf{s_m^t},\varsigma_{im}^t;\sigma_{\mathbf{im}}\right)$ and $V_{im}^1\left(\mathbf{s_m^t},\varsigma_{im}^t;\sigma_{\mathbf{im}}\right)$ into equation (8) we have that:

$$Q^{-1}\left(P\left(a_{im}^{t}=1|\mathbf{s_m^t};\sigma_{\mathbf{im}}\right)\right)=\left(\tilde{\mathbf{X}}_{\mathbf{im}}^{\mathbf{1}}\left(\mathbf{s_m^t};\beta\right)-\tilde{\mathbf{X}}_{\mathbf{im}}^{\mathbf{0}}\left(\mathbf{s_m^t};\beta\right)\right)\tilde{\mathbf{\Theta}}_{\mathbf{im}}+\tilde{\mathbf{D}}_{\mathbf{im}}^{\mathbf{10}}\left(\mathbf{s_m^t},\beta\right),$$

where, $Q^{-1}(\cdot)$ is the inverse of the CDF of the iid shock, ς_{im}^{t}, and,

$$\tilde{\mathbf{D}}_{\mathbf{im}}^{\mathbf{10}}\left(\mathbf{s_m^t},\beta\right)=\beta\left(E_{\mathbf{s_m^{t+1}}}\left[\tilde{\mathbf{D}}_{\mathbf{im}}\left(\mathbf{s_m^{t+1}},\beta\right)|\mathbf{s_m^t},a_{im}^{t}=1\right]-E_{\mathbf{s_m^{t+1}}}\left[\tilde{\mathbf{D}}_{\mathbf{im}}\left(\mathbf{s_m^{t+1}},\beta\right)|\mathbf{s_m^t},a_{im}^{t}=0\right]\right).$$

Stacking this equation for all states and market types:

$$\mathbf{Y_i}=\left(\tilde{\mathbf{X}}_{\mathbf{i}}^{\mathbf{1}}(\beta)-\tilde{\mathbf{X}}_{\mathbf{i}}^{\mathbf{0}}(\beta)\right)\tilde{\mathbf{\Theta}}_{\mathbf{i}},$$

where $\mathbf{Y_i}$ is a column vector stacking $Q^{-1}\left(P\left(a_{im}^{t}=1|\mathbf{s_m^t};\sigma_{\mathbf{im}}\right)\right)-\tilde{\mathbf{D}}_{\mathbf{im}}^{\mathbf{10}}\left(\mathbf{s_m^t},\beta\right)$ for all states and market types. Multiplying both sides of the equation above by $\left(\tilde{\mathbf{X}}_{\mathbf{i}}^{\mathbf{1}}(\beta)-\tilde{\mathbf{X}}_{\mathbf{i}}^{\mathbf{0}}(\beta)\right)'$ and solving for $\tilde{\mathbf{\Theta}}_{\mathbf{i}}$:

$$\tilde{\mathbf{\Theta}}_{\mathbf{i}}(\beta)=\left[\left(\tilde{\mathbf{X}}_{\mathbf{i}}^{\mathbf{1}}(\beta)-\tilde{\mathbf{X}}_{\mathbf{i}}^{\mathbf{0}}(\beta)\right)'\left(\tilde{\mathbf{X}}_{\mathbf{i}}^{\mathbf{1}}(\beta)-\tilde{\mathbf{X}}_{\mathbf{i}}^{\mathbf{0}}(\beta)\right)\right]^{-1}\left[\left(\tilde{\mathbf{X}}_{\mathbf{i}}^{\mathbf{1}}(\beta)-\tilde{\mathbf{X}}_{\mathbf{i}}^{\mathbf{0}}(\beta)\right)'\mathbf{Y_i}\right]. \tag{15}$$

From the estimates of initial guesses for beliefs and state transitions obtained in the first stage $\left(\tilde{\mathbf{X}}_{\mathbf{i}}^{\mathbf{1}}(\beta),\tilde{\mathbf{X}}_{\mathbf{i}}^{\mathbf{0}}(\beta),\mathbf{Y_i}\right)$ can be computed and $\tilde{\mathbf{\Theta}}_{\mathbf{i}}$ can be estimated using this estimator.

Differently from popular estimators in this literature – see Aguirregabiria and Mira (2007), Bajari et al. (2007) and Pesendorfer and Schmidt-Dengler (2008), among others – this estimator does not require the utilization of complex optimization methods and has a global maximum. Conveniently, because the estimator has a closed form it speeds up considerably the estimation algorithm.

Third Step: Model Solution. Given the discount rate, we compute the other parameters in the model in closed form and solve the model for the vector of equilibrium beliefs. This step is analogous to the solution of the inner fixed point problem in the Nested Fixed Point (NFPX) algorithm developed in Rust (1987). The algorithm we use to solve the model is similar to that used by Sweeting (2013). The algorithm works as follows:

1. Given the initial guesses for beliefs, the state transitions, the discount rate and the vector structural parameters estimated using equation (15), in step h compute the vector of equilibrium probabilities implied by the model for all states, market types and players using equation (8):

$$P^{h}\left(a_{im}^{t}=1|\mathbf{s_m^t};\sigma_{\mathbf{im}}\right)=Q\left(V_{im}^{1}\left(\mathbf{s_m^t},\varsigma_{im}^{t};\tilde{\mathbf{P}}_{\mathbf{im}}^{\mathbf{h-1}}\right)-V_{im}^{0}\left(\mathbf{s_m^t},\varsigma_{im}^{t};\tilde{\mathbf{P}}_{\mathbf{im}}^{\mathbf{h-1}}\right)\right), \tag{16}$$

   where, $\tilde{\mathbf{P}}_{\mathbf{im}}^{\mathbf{h-1}}$ is the vector of probabilities obtained in step $h-1$. We represent the vector of probabilities for all states and churches in market m obtained from equation (16) by $\mathbf{P_m^h}$.

2. If $||\mathbf{P_m^h}-\mathbf{P_m^{h-1}}||<\lambda$ the algorithm stops; otherwise set $\tilde{\mathbf{P}}_{\mathbf{m}}^{\mathbf{h}}=\mathbf{P_m^h}\psi+\mathbf{P_m^0}(1-\psi)$, where $\psi\in[0,1]$ is a parameter and $\mathbf{P_m^0}$ is the initial guess for beliefs, and go back to (1)

substituting $\tilde{\mathbf{P}}^{\mathbf{h}}_{\mathbf{m}}$ on the right hand side of equation (16).

In practice we used $\lambda = 10^{-3}$ and $\psi = 0.5$. The advantage of this algorithm is that it is quite fast. Convergence was always achieved after a few iterations. To examine the plausibility of the estimates, for some choices of β we compare the equilibrium probabilities produced by this algorithm with the equilibrium probabilities obtained from the solution of the following problem:

$$\min_{\mathbf{P}} \mathbf{\Phi}(\mathbf{P})^{\prime} \mathbf{\Phi}(\mathbf{P}),$$

where, $\mathbf{\Phi}(\mathbf{P})$ is the vector with the difference between the left and the right hand side of equation (8) stacked for all states, markets and churches. For different values of β the solutions obtained from both algorithms were very close (differences are indeed very small and explained by the parameter λ). We opted for the first algorithm because it is considerably faster than the second. All counterfactuals in this paper were computed using this algorithm.

Fourth Step: Simulation of the Number of Temples. With the equilibrium probabilities obtained in the previous step and with the estimates of state transitions we forward simulate the number of temples of each denomination in each market. What we do is:

1. Starting from the vector of states observed in 1991 in every market, draw an action for every church from the equilibrium probability distribution obtained in the previous step for every market and compute the total number of active temples.

2. Using the transition function for the state vector, compute the state vector for 1992.

3. Repeat the procedure described in (1) and (2) to generate a time series of the total number of active temples until 2018.

4. Repeat this process S times and take the average number of temples for every year across simulations.

In practice, we repeat this process $S = 100$ times. We also analyzed the performance of the algorithm setting using larger values for S, results were quite close to those obtained when we used $S = 100$. The computational costs of increases in S, on the other hand, is large. To keep the estimation time within reasonable limits we fixed $S = 100$.

Fifth Step: Estimation of the Discount rate. Let $\{\hat{n}^t\}_{t=1992}^{2018}$ be the number of active temples obtained in the previous step for every year in our sample. Let $\{n^t\}_{t=1992}^{2018}$ represent the total number of active temples for every year as observed in the data. Compute $\hat{\beta}$ as the solution of the following minimization problem:

$$\min_{\beta} \sum_{t=1992}^{2018} \left(\hat{n}^t - n^t\right).$$

In practice, we compute a discount rate for Pentecostal churches and one for Non Pentecostal churches.

Appendix C: Conditional Choice Probabilities and State Transitions

This Appendix shows the estimates of the initial guesses for beliefs and of the transitions of the unobservables, μ_{im}^t. The initial guesses for beliefs are based on the following Probit model:

$$P\left(a_{im}^t = 1 | \mathbf{s_m^t}\right) = \Phi\left(\rho_0 + \rho_1 a_{im}^{t\;1} + \sum_{n=1}^{N} \rho_2^n n_m^{n,t\;\;1} + \rho_3 p_m^t + \sum_{n=1}^{N} \rho_4^n \mu_{nm}^t + \mu_m\right).$$

where, $a_{im}^t \in \{0,1\}$ is church i's action in municipality m, period t, $c_m^{n,t\;\;1}$ is the number of temples of other churches, $n = 1, 2, ..., N$, $n \neq i$, competing with church i in market m, period $t-1$, p_m^t is the population in market m, period t, μ_{nm}^t is church n's unobservable component, $n = 1, 2, ..., N$, μ_m is a market type fixed effect. The components μ_{nm}^t were obtained as explained in Subsection 5.1. The results are presented in the next table. In this table, the columns have the estimates when we vary the number of market types we used to discretize market fixed effects.

We discretize market fixed effects in 3,4,5 and 6 bins. We did not increased the number of bins beyond 6 because the Probit models for finer grids were not converging. Increases in the number of market types lead to exponential increases in the number of interactions between market type dummies, year dummies and denomination dummies, making the estimation of the Probit model that we use to compute μ_{im}^t more difficult. We could have discretized market dummies in 6 bins but results of structural estimates obtained from this discretization were close to the ones we show in the paper but the computational costs are higher. We have to pay attention to assumptions that lead to any increase in the state space of our model. As the algorithm we are using to estimate the model nests a step that requires the solution of the model for any possible value of the discount rate, β, any increase in the state space will lead to non trivial increases in the time we use to estimate the model.

Overall, the signs of the coefficients are qualitatively close to the signs of the LPM coefficients shown in Table 7. The unobserved components capturing unobserved heterogeneity across players, market types and years, μ_{nm}^t, are significant at 1% in all regressions. All coefficients appear to be robust to changes in the number of market types.

To estimate the transitions of μ_{nm}^t we run a linear regression for each church. The specification of the regression model is:

$$\mu_{im}^t = \rho_0 + \sum_{n=1}^{N} \rho_1^n a_m^{n,t\;\;1} + \rho_2 p_m^t + \mu_m + \zeta_{im}^t,$$

where, $a_{nm}^{t\;1} \in \{0,1\}$ is church n's, $n = 1, 2, ..., N$, action in municipality m, period $t-1$, p_m^t is the population in market m, period t, μ_m is a market type fixed effect and ζ_{im}^t is an idiosyncratic component that varies across churches, markets and years. In general, coefficients of churches lagged actions are statistically significant at 1%, suggesting that lagged actions are important to explain the evolution of the unobserved component of our model – as postulated by assumption 1 in Subsection 5.1.

Table 11: Initial Guess for Beliefs: Pentecostals

	(1)	(2)	(3)	(4)
Lagged Action	4.628***	4.753***	4.753***	4.829***
	[0.10]	[0.11]	[0.11]	[0.11]
Competition Assembly of God	0.059	0.055	0.052	0.071
	[0.07]	[0.07]	[0.07]	[0.07]
Competition Quadrangular	-0.543***	-0.503***	-0.490***	-0.515***
	[0.10]	[0.11]	[0.11]	[0.11]
Competition Universal	-0.106	-0.098	-0.106	-0.081
	[0.07]	[0.07]	[0.07]	[0.07]
Population Assembly of God	2.658***	2.454***	2.584***	2.587***
	[0.32]	[0.32]	[0.30]	[0.32]
Population Quadrangular	-3.014***	-3.370***	-3.270***	-3.292***
	[0.46]	[0.46]	[0.45]	[0.45]
Population Universal	0.364	0.180	0.295	0.337
	[0.25]	[0.24]	[0.25]	[0.24]
μ^t_{im} Assembly of God	0.481***	0.479***	0.467***	0.460***
	[0.04]	[0.04]	[0.03]	[0.03]
μ^t_{im} Quadrangular	0.282**	0.204**	0.334***	0.219**
	[0.12]	[0.09]	[0.09]	[0.09]
μ^t_{im} Universal	0.222***	0.248***	0.246***	0.274***
	[0.05]	[0.04]	[0.04]	[0.04]
Constant	-2.309***	-2.209***	-2.141***	-2.063***
	[0.04]	[0.04]	[0.04]	[0.04]
Observations	18,873	18,873	18,873	18,873
Number of Market Types	3	4	5	6

Note: Standard-errors clustered at the municipality level in brackets. (***) $p < 0.01$, (**) $p < 0.05$, (*) $p < 0.10$. All regressions include market type dummies.

Table 12: Transitions μ_{im}^{t} – Pentecostals

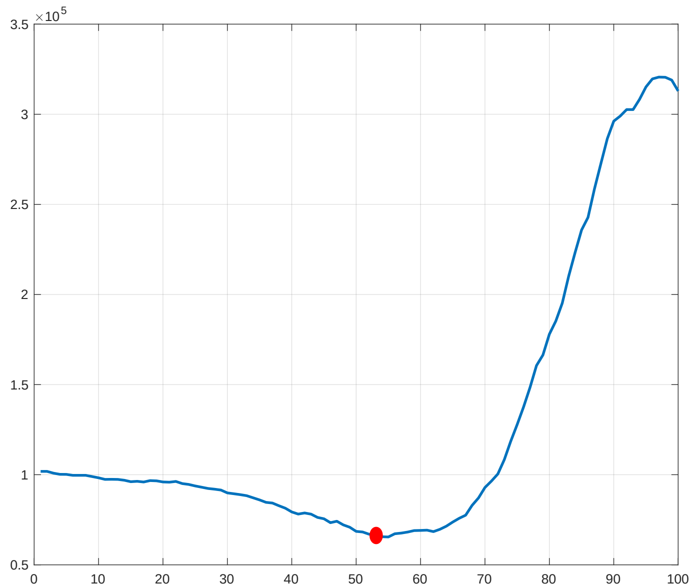
	Assembly of God	Quadrangular	Universal
Lagged Action	0.413***	-0.035***	-0.063***
(Assembly of God)	[0.02]	[0.01]	[0.02]
Lagged Action	0.061*	-0.045***	-0.000
(Quadrangular)	[0.03]	[0.01]	[0.03]
Lagged Action	0.181***	-0.035***	0.076***
(Universal)	[0.03]	[0.01]	[0.03]
Population	0.141	-0.007	-0.095
	[0.12]	[0.04]	[0.11]
Dummy Market Type 2	0.162***	-0.001	-0.145***
	[0.03]	[0.01]	[0.03]
Dummy Market Type 3	0.152***	-0.721***	0.216***
	[0.03]	[0.01]	[0.03]
Dummy Market Type 4	0.671***	-0.516***	0.100***
	[0.03]	[0.01]	[0.03]
Dummy Market Type 5	0.619***	-0.406***	0.344***
	[0.03]	[0.01]	[0.03]
Constant	-0.655***	0.018**	-0.664***
	[0.03]	[0.01]	[0.03]
Observations	6,524	6,524	6,524

Note: Standard-errors in brackets. (***) $p < 0.01$, (**) $p < 0.05$, (*) $p < 0.10$.

Appendix D: Discount Rate

In the figure below we plot the objective function in step 5 of our estimation algorithm, $f(\beta) = \sum_{t=1}^{27} \left(\hat{n}^t(\beta) - n^t\right)^2$, for a discrete grid of β varying from 0 to 0.99. Figure 11 shows that the function has a global minimun at $\beta = 0.54$.

Figure 11: Objective Function of the Estimation Algorithm for a Discrete Grid of β



Appendix E: Static Version of the Structural Model

This appendix shows the estimates of the static version of our entry game. To obtain this model we fix $\beta = 0$ to all churches. We used this model to plot Figure 7. Table 13 shows the estimates of the structural parameters. Overall, the parameters of the static model are close to the parameters of the dynamic model. As Figure 7 shows, however, the fitting of the static model is much worse than the fitting of the dynamic model. This happens because entry probabilities implied by the static model are usually lower than entry probabilities implied by the dynamic model at any state.

Table 13: Structural Parameters – Static Model

	A. of God	Quadrang	Universal
Constant (θ_0)	2.613	2.236	2.184
	[2.62]	[2.27]	[2.67]
Number of Competitors (θ_1)	0.010	-0.406	-0.052
	[0.1]	[-0.31]	[-0.03]
Population (θ_2)	2.512	-3.175	0.230
	[2.33]	[-3.75]	[0.42]
Shock Market 1 (γ_1)	1.019	0.396	-0.221
	[1.11]	[0.83]	[0.57]
Shock Market 2 (γ_2)	0.890	-2.364	-0.409
	[0.87]	[-2.62]	[0.17]
Shock Market 3 (γ_3)	0.518	-0.408	-1.112
	[0.53]	[-0.38]	[0.01]
Shock Market 4 (γ_4)	0.493	-0.806	-1.118
	[0.48]	[-0.79]	[-0.26]
Shock Market 5 (γ_5)	1.003	-1.485	-2.570
	[1.02]	[-1.53]	[-1.13]
Entry Cost (F)	-4.591	-4.724	-4.925
	[-4.65]	[-4.77]	[-4.95]

Note: Standard-errors in brackets.

Appendix F: Sensitivity of Laffer Curves to Different Discount Rates

This appendix shows the Laffer Curve for alternative government discount rates. Figure 12 plots the Laffer Curve when the discount rate of the government is equal to 0.95. To construct Figure 13 we assume that this discount rate is 0.99. When the discount rate is 0.95 the Laffer Curve peaks at $\varrho = 0.30$. In the second case, when the discount rate is 0.99, the Laffer Curve peaks at $\varrho = 0.26$.

Figure 12: Counterfactual Number of Temples and Tax Revenues for Different Tax Levels – Government $\beta = 0.95$

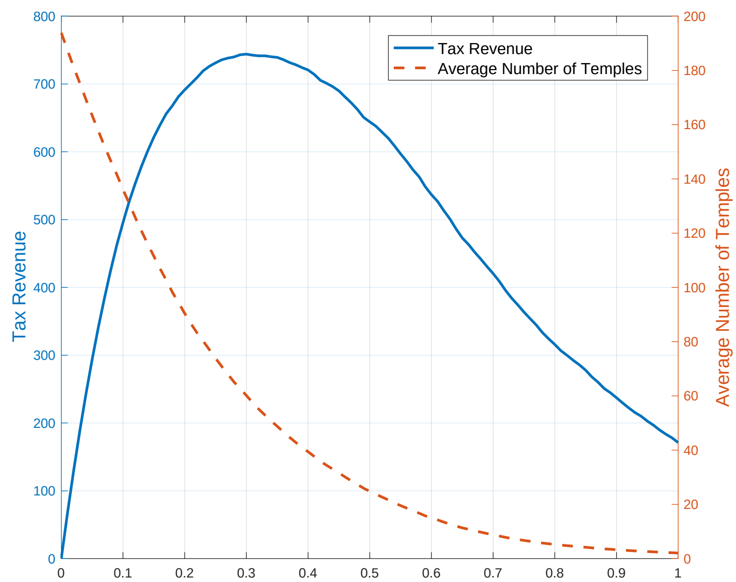
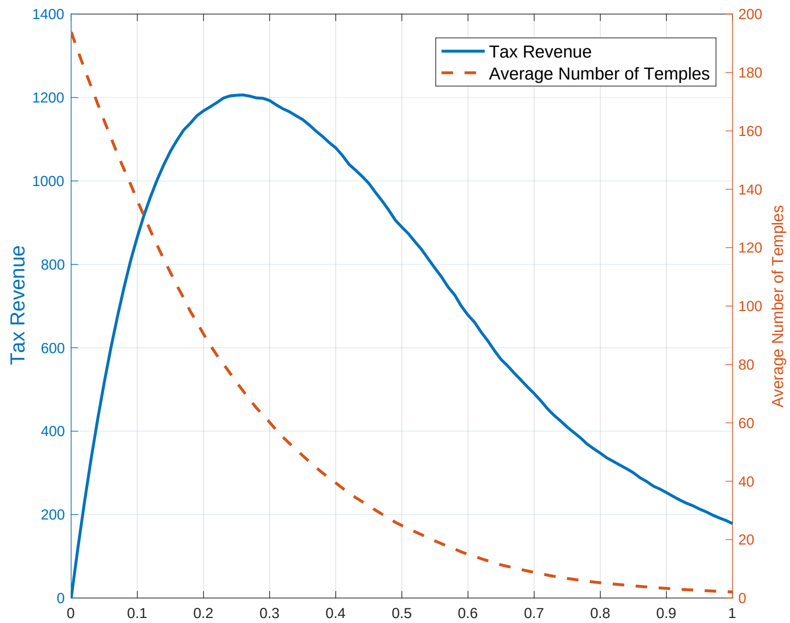


Figure 13: Counterfactual Number of Temples and Tax Revenues for Different Tax Levels – Government $\beta = 0.99$



Appendix G: Comparison of Algorithms

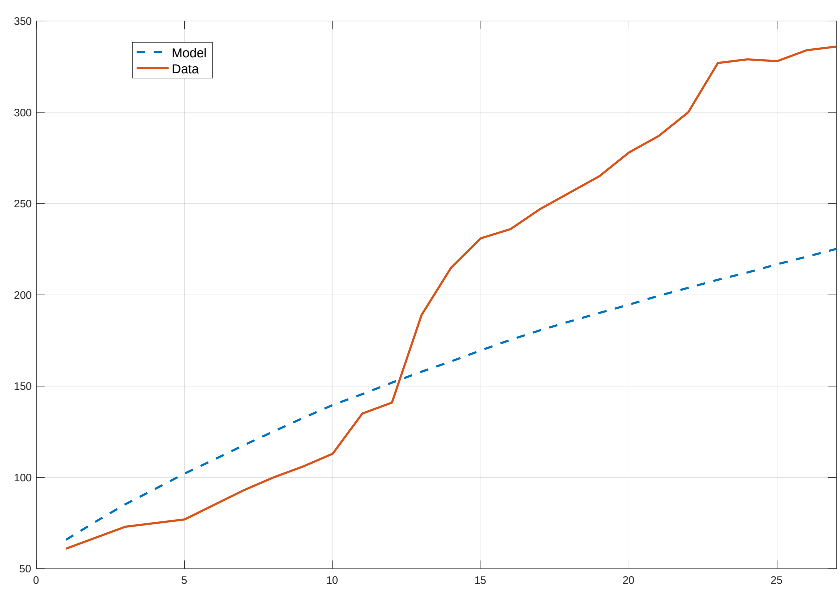
This appendix provides a comparison between the estimation algorithm used in this paper and traditional two step algorithms found in the literature. We compare the fitting of the model that is based on structural estimates produced by our algorithm to the fitting of two alternative models that are based on two step estimates. The parameters of the first alternative model are obtained using only steps one and two of our estimation algorithm. For this model we estimate using steps 1 and 2 only the structural parameters and the discount factor solving:

$$\min \boldsymbol{\Phi}\left(\hat{\mathbf{P}}, \boldsymbol{\Theta}\right)^{0} \boldsymbol{\Phi}\left(\hat{\mathbf{P}}, \boldsymbol{\Theta}\right)$$

where, $\boldsymbol{\Phi}\left(\hat{\mathbf{P}}, \boldsymbol{\Theta}\right)$ is a function stacking the difference between the left hand side and the right had side of equation (8) for all players, states and markets and $\hat{\mathbf{P}}$ is the vector of beliefs estimated following the procedures described in Subsection 5.1. The vector of parameters of the model is $\Theta = \left\{(\theta_{0i}, \theta_{1i}, \theta_{2i}, F_i, \gamma_{im})_{8(i,m)}, \beta\right\}$.

We solve the model using the vector of parameters obtained from this estimation algorithm. The estimated discount rate is 0.0426, much smaller than the discount rate obtained from the main algorithm. The estimates are close to the estimates obtained from the static model. Figure 14 show the fitting of this model. As expected, the fitting of this model is close to the fitting of the static model and much worse than the fitting of the baseline model.

Figure 14: Fitting of the Alternative Algorithm



Appendix H: FPE votes and Number of Temples

This Appendix shows the estimates of the model used to calculate FPE vote share under counterfactual taxation scenarios discussed in Subsection 6.2:counterfactual. Table 14 reports fixed-effect estimates when treatment is discrete in column 1 (similarly to our baseline specification 2) and continuous in column 2 (number of Pentecostal temples), including also a quadratic term. Column (3)-(4) and (5)-(6) report estimates for non-Pentecostal and Catholic temples, respectively.

Table 14: Number of Temples and Evangelical Vote Share

	(1) Pentecostal	(2) Pentecostal	(3) Non-Pentecostal	(4) Non-Pentecostal	(5) Catholic	(6) Catholic
$\mathbb{1}$(temples$>$ 0)	0.024		0.012		0.005	
	[0.009]		[0.008]		[0.010]	
Number of temples ($\widehat{\beta}_1$)		0.017		0.011		0.010
		[0.008]		[0.014]		[0.011]
Number of temples sq. ($\widehat{\beta}_2$)		-0.004		-0.000		-0.003
		[0.002]		[0.007]		[0.002]
Observations	1470	1470	1470	1470	1470	1470
R-squared	0.45	0.45	0.45	0.45	0.45	0.45

Note: The table reports regression estimates associating the number of temples to FPE voteshare (aggregate vote received by any elected deputy who is a member of the Evangelical caucus, or *Frente Parlamentar Evangelica*). Column (1) focuses on Pentecostal temples and reports estimates that control for municipality and year xed e ects, with $\mathbb{1}$(temples$>$ 0) denoting an indicator function of whether a municipality has a positive number of temples. Column (2) instead focuses on the actual (continuous) number of temples, allowing linear and quadractic terms. Column (3)-(4) and (5)-(6) report estimates for non-Pentecostal and Catholic temples, respectively. Our main sample consists of a balanced panel of municipality-year pairs and (see sample description in section 3). Heteroskedasticity-adjusted standard errors clustered at the municipality level are reported in parentheses below the coe cients. Signi cantly di erent from zero at 99% (***), 95% (**) and 90% (*) con dence level.