Spatial Patterns in the Relationship Between Religion and Economic Growth

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Abstract

Using a modified version of the partial equilibrium adjustment model with spatial spillovers, we test how the density of religious congregations and religious diversity influence regional economic growth. With U.S. county-level data and using Geographically Weighted Regression, we find evidence that there can be significant spatial variation in the relationship between religion and economic growth. Our results show that religion corresponds to both higher and lower economic growth depending on the region. While religion is found to be important in understanding growth, the results strongly suggest that religion should not be treated as a monolithic concept, as different religious traditions have different impacts and those impacts vary across space.

1 Introduction

It has only been in the last few decades that economists have come to accept that culture plays an important role in economic performance at both the individual and regional level (North, 1994; Landes, 1998; Guiso et al., 2006; Gorodnichenko and Roland, 2011, 2017). From an institutional economics perspective, culture establishes the norms of acceptable and unacceptable behavior or the informal rules governing the economic system. While earlier economic philosophers including Adam Smith, Karl Marx and Max Weber all acknowledged that understanding cultural contexts were required to understand economic outcomes, most economists shied away from studying culture because it is difficult to quantify for rigorous hypotheses testing. Advances in theoretical frameworks within behavioral economics, institutional economics and the interdisciplinary study of social capital and entrepreneurship among other topics, coupled with innovative data sets, have moved economists away from the rational economic agent of neoclassical economics.

One element of culture that is receiving attention within economics is the role of religion in understanding economic outcomes (Iannaccone, 1994; Rupasingha, 2009; Iyer, 2016; Strulik, 2016; Basedau et al., 2018; Mayoral and Esteban, 2019; Qayyum et al., 2020). Some researchers, such as Inglehart and Welzel (2005) and Deaton (2008), have observed that countries that tend to be more religious also tend to be poorer compared to countries that are more secular. In many societies, religious traditions shape the cultural norms, both formal and informal, that are known to influence economic performance (Campante and Yanagizawa-Drott, 2015). In a series of studies, Barro and McCleary using a panel of country level data, showed that the religiosity of a country can have an effect on economic performance (Barro and McCleary, 2003; McCleary and Barro, 2006). Specifically, higher levels of monthly church attendance are associated with lower levels of growth. The findings of Barro and McCleary (2003) imply that a one-standard-deviation increase in churchgoing would be associated with a 1.1 percentage point decline in growth rates. Equally important, these results varied by religious traditions with Hindu, Muslim and Orthodox traditions having a negative affect while eastern religions were associated with positive growth.

Although some (e.g., Young, 2009) have taken issue with the work of Barro and McClearly (e.g., their results are sensitive to model specification), others, such as Fernandez et al. (2001), Sala-i Martin et al. (2004), Durlauf et al. (2012), Campante and Yanagizawa-Drott (2015), and Qayyum et al. (2020) also find a relationship between religion and economic performance. Regardless of the robustness of the original work of Barro and McCleary, these two studies have spurred further interest in these relationships between religion and economic performance and, in particular, growth.

This study contributes to this small but growing literature by examining how concentrations of religious organizations, religious diversity and types of religious traditions influence regional economic growth. This study differs from the Barro and McCleary work, and those that rely on the international panel data of Barro and McCleary (e.g., Young, 2009; Durlauf et al., 2012; Qayyum et al., 2020) and follows the work of Rupasingha (2009) by using U.S. counties and data from the decennial Religious Congregations and Membership Study carried out by the Association of Statisticians of American Religious Bodies (ASARB). Our work differs from (Rupasingha, 2009) in that we explicitly test for spatial heterogeneity in the underlying relationship between religion and economic growth.

This spatial approach is motivated by Qayyum et al. (2020) who found that religion helps explain economic growth in Asia and Europe (positive and statistically significant), somewhat in Africa (positive by insignificant), but the relationship is unclear in America. We suggest that the unclear results in America may be due to significant spatial heterogeneity in the underlying relationship. Specifically, unlike many countries, there is significant heterogeneity in religious intensity and traditions across the United States. We specifically model this heterogeneity in religious traditions and underlying spatial patterns.

In addition, Rupasingha (2009) uses a Barro-type growth framework which limits the notions of growth to only income. We adopt a partial equilibrium adjustment modeling framework introduced by Carlino and Mills (1987), and expanded by Deller et al. (2001), that explore not only income growth but also employment and population growth. The data are drawn from the U.S. Census, the Bureau of Economic Analysis, Regional Economic Information System (BEA-REIS) and the decennial Religious Congregations and Membership Study carried out by the Association of Statisticians of American Religious Bodies (ASARB). This is an extensive survey that is intended to mimic a census-like inventory of congregations by type, membership levels and levels of adherence. Given that the ASARB is for 2010, we model how religion in 2010 influences economic growth from 2010 to 2018.

Beyond these brief introductory comments, the study is composed of five additional sections. In the next section we lay out the theoretical and empirical literature that has attempted to better understand the underlying influence religion has on economic growth. We then lay out our partial equilibrium adjustment model followed by a discussion of our empirical methods. The results are then presented and the study closes with a discussion and implications of our findings.

2 Literature Review

As noted by Gorodnichenko and Roland (2017), the fundamental role of culture in economic growth and development can be traced to the thinking of many of the moral, political and economic philosophers from 200 years ago. Adam Smith's The Wealth of Nations, where he lays out ideas around competitive markets and capitalism, is built upon his earlier work on moral philosophy, The Theory of Moral Sentiments. He discusses the role of sympathy, empathy, and altruism, all integral components to the notion of societal culture, in relationship to the economy—yet these behaviors are largely absent from modern discussions of neoclassical economics. Max Weber's The Protestant Ethic and the Spirit of Capitalism argued that economic differences across Europe could be traced to differences in religious traditions (e.g., Protestantism and Calvinism, in particular) that influenced how people worked in a secular world. The notion of the "Protestant Work Ethic" encouraged people to develop their own businesses and engage in trade and investments to enhance economic well-being. As noted by Iyer (2016), Richard Ely argued at the founding of the American Economic Association in 1885 that notions of the "Social Gospel" should be integrated into the study of economics. Morals and ethics, generally found within religious traditions, should be a focal point of economics and, in particular, discussions of policies

In following with those arguing for the influence of culture, values and, by extension, religion on economic

outcomes, there is a growing body of empirical literature exploring the central premise that religion can influence growth at the regional level. Several studies challenge the original work of Barro and McCleary (Barro and McCleary, 2003; McCleary and Barro, 2006) relating religion and economic growth (e.g., Young, 2009). Studies by both Young (2009) and Durlauf et al. (2012) use the same data as Barro and McCleary and, employing a Bayesian Model Averaging approach to address modeling uncertainty inherent in modelling economic growth, find that the results around religion and economic performance are sensitive to model specification. While both studies do find some support for religion playing a role in understanding economic performance, the results tend to not be robust. Similarly, Carpantier and Litina (2019) find that religion matters in a simplified model of income growth, but as additional drivers of economic growth are included in the model, specifically measures of social capital, the role of religion weakens.

Yet several studies give evidence that there is an important relationship between religion and economic growth. Using a 100-year time series of secularization in different nations, Ruck, Bentley and Lawson (2018) find that a rise in secularization generally has preceded economic growth over the past century. Though, they find that tolerance for individual rights predicted 20th century economic growth better than secularization. Using a panel of countries from 1925 to 1990 Herzer and Strulik (2017) find a negative long-run relationship between the level of religiosity, measured by church attendance, and the level of income (log of GDP per capita). Using data from 25 western countries, Bettendorf and Dijkgraaf (2010) find that religion's influence on economic growth is different between high and low income countries where church membership has a positive effect on income in high income countries, but a negative effect for low income countries. Building on the notion that innovation is a fundamental driver of economic growth, Bénabou et al. (2015) find that there is a negative correlation between religiosity and patents per capita using both international and U.S. data. Campante and Yanagizawa-Drott (2015) find that differences in the length of the Ramadan fasting period has a negative effect on economic growth across Muslim countries. (Mayoral and Esteban, 2019) find that increases in the intensity of religious beliefs is associated with a decrease in the number of hours worked per week.

The study that is most relevant to the analysis presented here is Rupasingha (2009). They use U.S. county level data to look at income growth from 1990 to 2000 to coincide with the 10-year interval of the U.S. decennial Census and to utilize the American Religious Data Archive (ARDA) census which also takes place in the same years as the decennial Census. After controlling for spatial spillover effects and accounting for potential endogeneity Rupasingha and Chilton (2009: 446) report "results support the view that religious adherence rates matter in economic growth in the United States." They also find, however, that the results vary by religious denomination across models. Specifically, the results are robust for Catholic denominations but the results for both Evangelical and mainline Protestants differ depending on the specification of the model and estimator employed. This apparent inconsistency in the results aligns with the conclusion of the literature review on modeling religion and economic growth by de Jong (2011): the relationship is at best perplexing and inconclusive.

Considering the complicated relationship between religion and growth, several studies have explored the nuance and nature of the connection, illuminating mechanisms for how religion influences the economy. From this related literature, there are at least three mechanisms through which religion can influence economic performance, specifically economic growth. The first is through the lens of institutional economics where religion directly and indirectly influences the "rules of the game", both formal rules through statutes and informal rules such as the norms of acceptable behavior. These rules play a vital role in laying the groundwork for economic growth. The second lens is through social capital and specifically the generation of networks and trust. Innovation is a key to economic growth and innovation hinges on access to information and knowledge. The flow of information is facilitated through networks of connections. Equally important is the level of trust in the information that is flowing across those networks. Religion influences those networks and levels of trust, alas in complex ways. Shah et al. (2020) addresses how religious traditions and beliefs can have a major influence on social capital through what they refer to as "religion dependent social capital" or RDSC.

The final lens is entrepreneurship and how religion traditions influence the norms around entrepreneurial behavior (e.g., Dana, 2021). Some religious traditions strongly encourage self-sufficiency and self-employment, others encourage strong networking and support for entrepreneurs within the congregation. There is also evidence that working outside of congregation-based networks can be discouraged which limits the flow of

information. Ellison et al. (2009) found that even the size of the congregation can play a role in how religion influences social and economic behavior. The third mechanism is through labor market decisions, such as the value of work (e.g., Weber's notion of the "Protestant Work Ethic"), specifically notions of self-sufficiency and the role of entrepreneurship and new business formation. In the end, the theoretical mechanisms are in place relating religion to economic outcomes, but in practice those mechanisms are complex.

Institutional economics offers a framework for understanding the first potential mechanism or a relationship between religion and growth (Iyer, 2016; Qayyum et al., 2020). Specifically, institutions within this context can be thought of as the "rules of the game" that influence not only social behavior but also economic interactions. These rules are both formal and informal Shaffer et al. (2006) with the former embodied in laws and statutes and the latter can be thought of as norms of acceptable behavior. It is in these informal rules that ethics and morals play a direct role in how people, including businesses, interact. As noted by Qayyum et al. (2020), religion shapes these informal rules which are often transformed into formal rules, such as laws, contracts, and policies. The influence of religious traditions on the economy, however, is complex and varies across traditions. (Guiso et al., 2006), for example, conclude that Buddhism and Christianity in general seem most conducive to capitalist type economic systems, but Islam the least. The Calvinist tradition argues that labor and earthly success were indicators of salvation. Jewish and Islamic traditions have opposing views on debt and lending of money. Thus, not only does religion influence both formal and informal rules governing the economy but there is significant heterogeneity across those traditions.

Religious organizations also influence economic outcomes through the theoretical lens of social capital (Markeson and Deller, 2015), offering the second potential mechanism. The literature is clear that social capital, or networks, norms, and trust, has both direct and indirect impacts on economic performance (Whiteley, 2000; Westlund and Adam, 2010). Networks are vital to the flow of information that is foundational to economic growth and development–trust in that information is vital. The norms are reflective of the rules of the game that dictate acceptable behavior. Features of a faith community, such as attending services, facilitate all three of these primary components of social capital–networks, norms, and trust. Attending religious services gives one immediate access to networks through ongoing and varying interactions. Indeed, (Coleman, 2003, p. 33) claims that "[i]t has become now almost cliché that religion in the United States generates more 'social capital' than any other American institution."

The influence of religion via social capital, however, cannot be treated as a monolithic relationship because traditions vary significantly across religions. These differences are clearer when thinking in terms of bonding and bridging social capital. That is, social capital can manifest differently when thinking about how congregation members engage with each other (bonding social capital) and how they engage with non-members and other organizations (bridging social capital). Welch et al. (2007) find that different religious traditions can have a large impact on the level of trust with people who are not within the congregation. For example, when it comes to trusting someone you do not know, Catholics and other non-Protestant religions (Jew, Hindus, Muslim, etc) seem to be less trusting then mainline Protestants. Along these same lines, using an experimental framework, Benjamin et al. (2016) find that Catholics are less likely to contribute to public goods than Protestants. Yet, the Catholic Church has a rich tradition of offering a variety of community wide social services, generally through the church's Catholic Social Services program. The findings of Benjamin, et al. could be attributed to Catholics investing in the public good through the church. Schwadel (2005) notes that from the literature, religion and civic activity (one element of social capital) are related, but the nature of the relationship depends on the religion. Higher levels of church participation tend to be associated with higher levels of civic activity, but the more conservative the membership (i.e., literalism in biblical interpretation), the less likely are members to be engaged in outside church organizations. In a study of Dutch "new age spiritualism", which tends to be more individualistic and less focused on congregation gathering, Berghuijs et al. (2013) find that "traditional" religious people tend to be the most engaged civically, secular people the least engaged, with those that follow "new age spiritualism" fall in the middle but are more committed to organizations for environmental protection, peace or animal rights than others.

A third mechanism through which religion can influence economic performance is through labor market decisions, specifically the decision to start and own a business. While the role of entrepreneurship in economic growth has been well recognized in the academic literature (e.g., Wennekers and Thurik, 1999; Acs and Szerb, 2007; Stephens and Partridge, 2011)), it is the work of Haltiwanger et al. (2013) that has driven the point home, particularly within a U.S. context. There is a growing body of literature that identifies several

mechanisms through which religion influences rates of entrepreneurship (Dodd and Seaman, 1998; Dodd and Gotsis, 2007; Abereijo and Afolabi, 2017). Beyond conceptual arguments, generally within the framework of social capital, there are several studies that empirically link religiosity and entrepreneurial activity (Audretsch et al., 2007, 2013; Kingma and Yeung, 2014; Gursoy et al., 2017) or success in entrepreneurial behavior ((Bellu and Fiume, 2004).

For example, in a study of 30 OECD countries covering the period 1984–2010, Hoogendoorn et al. (2016) find a relationship between religion and business ownership that reflects the internal aspects of religiosity such as norms of behavior. Audretsch et al. (2007) and Audretsch et al. (2013) find that some types of religious belief increase the likelihood of entrepreneurship, but others hinder it. Deller et al. (2018) find that communities with a large concentration of religious congregations have a correspondingly higher level of small business activity. At the same time, they found important differences across religious traditions, that a higher concentration of Muslims corresponds to less proprietorship activity at the county-level but a higher concentration of Evangelicals has a positive impact on small business activity, suggesting that religion should not be treated as a uniform dimension.

In sum, the literature relating religion to economic outcomes finds than an underlying relationship is present, but it is both subtle and complex. Actively participating in an organized religion can help establish the norms of behavior, create opportunities for networking and influence one's outlook on life including work. Some religions encourage inclusion which can foster bridging social capital while others are more internal looking which hinders bridging social capital. Religion can also influence one's perspectives about work and self-reliance which influences rates of entrepreneurship. But at the same time, differences in religious views and traditions can influence those relationships. Further, as people become more educated, those relationships change. The literature is clear, religion is multidimensional and ever evolving meaning different things to different people (Basedau et al., 2018).

3 Modeling Framework

To model the relationship between religion and regional economic growth we use the partial equilibrium adjustment modeling framework commonly referred to as a Carlino-Mills type modeling approach. As noted by Carruthers et al. (2008) and Carruthers and Mulligan (2007) a partial adjustment model is a reformulation of the geometric lag structure where the present values of a dependent variable is driven by information on its past. The problem is that these structures lack any theoretical foundations as to the nature of the relationships. Partial equilibrium adjustment models argue that the variable of interest, such as regional employment or income, is constantly adjusting to some unknown or constantly shifting equilibrium.

The adjustment process can be expressed in the general form

$$\Delta y_t = (y_t - y_{t-1}) = \lambda_y({y^*}_t - y_{t-1}) \tag{1}$$

where y_t is the observed variable of interest, such as income, that adjusts through time to some unknown equilibrium level ${y^*}_t$. The rate of adjustment to that equilibrium, λ_y, is between zero and one. Given that Δy_t is equal to the product of the adjustment parameter (λ_y) and the ratio of its equilibrium and past levels, the actual level of the variable at time t can be expressed as the weighted averages of the two, or

$$y_t = \lambda_y {y^*}_t + (1 - \lambda_y) y_{t-1}. \tag{2}$$

This representation demonstrates that the observed level of y lies somewhere between y_t^* and y_{t-1}.

This partial equilibrium adjustment approach was adopted by Carlino and Mills (1987) to address a basic question raised by Steinnes and Fisher (1974) as to whether people followed jobs, or do jobs follow people. A two equation system looking at changes (growth) in employment and population has served as the foundation for several regional economic growth models (e.g., Boarnet et al., 2005; Hoogstra et al., 2017; Østbye et al., 2018; Mulligan and Nilsson, 2020). Rickman (2010, p.33) describes this framework as "a workhorse model for regional policy analysis". For this study we adopted the expanded version of the two equation Carlino-Mills specification suggested by Deller et al. (2001) and utilized in other regional economic growth studies (e.g.,

Nzaku and Bukenya, 2005; Hailu and Brown, 2007; McGranahan and Wojan, 2007; Carruthers et al., 2008; Grassmueck and Shields, 2010; Gebremariam et al., 2010; Kahsai et al., 2011; Carpenter and Loveridge, 2019). The expanded version appeals to the migration literature and argues that the "people follow jobs, or jobs follow people" question ignores the role of wages in the decision to move. By formally introducing wages, often measured by per capita income, into the framework, we advance the analysis. In addition, the empirical specification of the income equation, closely mimics the neoclassical growth empirical modeling of a Barro-type model, thus allowing researchers to draw from that larger empirical growth literature.

The general structure of the empirical model can be expressed as

$$P^* = f(E^*, I^* | \Omega^P) \tag{3}$$

$$E^* = h(P^*, I^* | \Omega^E) \tag{4}$$

$$I^* = g(E^*, P^* | \Omega^I) \tag{5}$$

where P^*, E^* and I^* are equilibrium levels of population, employment and per capita income, and Ω^P, Ω^E and Ω^I are a set of variables describing initial conditions and other historical information. A simple linear representation of those conditions can be expressed as

$$P^* = \alpha_P + \beta_{1P} E^* + \beta_{2P} I^* + \epsilon_j \delta_{jP} \Omega^P \tag{6}$$

$$E^* = \alpha_E + \beta_{1E} P^* + \beta_{2E} I^* + \epsilon_j \delta_{jE} \Omega^E \tag{7}$$

$$I^* = \alpha_I + \beta_{1I} E^* + \beta_{2I} I^* + \epsilon_j \delta_{jI} \Omega^I \tag{8}$$

Moreover, population, employment and income likely adjust to their equilibrium levels with substantial lags (i.e., initial conditions). Placing the population, employment and income framework within the partial adjustment process outlined above we have

$$P_t = P_{t-1} + \lambda_P (P^* - P_{t-1}) \tag{9}$$

$$E_t = E_{t-1} + \lambda_E (E^* - E_{t-1}) \tag{10}$$

$$I_t = I_{t-1} + \lambda_I (I^* - I_{t-1}) \tag{11}$$

Rearrangement of terms this yields:

$$\Delta P = (P_t - P_{t-1}) = \lambda_P (P^* - P_{t-1}) \tag{12}$$

$$\Delta E = (E_t - E_{t-1}) = \lambda_E (E^* - E_{t-1}) \tag{13}$$

$$\Delta I = (I_t - I_{t-1)} = \lambda_I (I^* - I_{t-1}) \tag{14}$$

where λ_P, λ_E and λ_I are speed of adjustment coefficients to the desired levels of population, employment and income, respectively, which are generally positive between zero and one; ΔP, ΔE and ΔI are the region's changes in population, employment and per capita income, respectively; and P_{t-1}, E_{t-1} and I_{t-1} are initial conditions of population, employment and per capita income.

Substituting into the simple linear specification and rearranging terms allows us to express empirical models that are to be estimated as

$$\Delta_P = \alpha_P + \beta_{1P}P_{t-1} + \beta_{2P}E_{t-1} + \beta_{3P}I_{t-1} + \gamma_{1P}\Delta E + \gamma_{2P}\Delta I + \Sigma_j\delta_{jP}\Omega^P + \varepsilon_P \tag{15}$$

$$\Delta_E = \alpha_E + \beta_{1E}P_{t-1} + \beta_{2E}E_{t-1} + \beta_{3E}I_{t-1} + \gamma_{1E}\Delta P + \gamma_{2E}\Delta I + \Sigma_j\delta_{jE}\Omega^E + \varepsilon_E \tag{16}$$

$$\Delta_I = \alpha_I + \beta_{1I}P_{t-1} + \beta_{2I}E_{t-1} + \beta_{3I}I_{t-1} + \gamma_{1I}\Delta E + \gamma_{2I}\Delta P + \Sigma_j\delta_{jI}\Omega^I + \varepsilon_I \tag{17}$$

Note that the speed of adjustment coefficient (λ) becomes embedded in the linear coefficient parameters, α, β, γ and δ. This framework is particularly useful for this analysis because it allows us to capture structural relationships while simultaneously isolating the influence of specific attributes on regional economic growth. In essence, we are modeling short-term adjustments (i.e., ΔP, ΔE and ΔI) to long-term equilibrium (i.e., P^*, E^* and I^*).

One of the shortcomings of this particular specification is that population and employment tend to be very highly correlated introducing a serious collinearity problem. With this in mind, it is difficult to directly test the question of "do people follow jobs, or jobs follow people" outlined by Steinnes and Fisher (1974) and directly tested Carlino and Mills (1987). In order to partly address the difficulty of causality, we use the notion of deep lags in prior growth, imposing some quasi-exogeneity. Here we can rewrite the linear models as

$$\Delta_P = \alpha_P + \beta_{1P}P_{t-1} + \gamma_{1P}\Delta P_{t-2\to t-1} + \Sigma_j\delta_{jP}\Omega^P + \varepsilon_P \tag{18}$$

$$\Delta_E = \alpha_E + \beta_{2E}E_{t-1} + \gamma_{1E}\Delta E_{t-2\to t-1} + \Sigma_j\delta_{jE}\Omega^E + \varepsilon_E \tag{19}$$

$$\Delta I = \alpha_I + \beta_{3I}I_{t-1} + \gamma_{1I}\Delta I_{t-2\to t-1} + \Sigma_j\delta_{jI}\Omega^I + \varepsilon_I \tag{20}$$

Here $\Delta P_(t-2 \to t-1)$ is a deeply lagged change. Also, note that the specification of the income equation within this modified specification closely approximates a Barro-type neoclassical growth modeling specification. For this study of how religion influences economic growth we adopt this more simplified version to side-step collinearity issues.

4 Modeling Approach

There are two potential problems with using traditional classical regression analysis to estimate the underlying patterns using community or regional (in our case county) level data. First, there is an extensive body of empirical research using this framework (e.g., Bao et al., 2004; Deller and Lledo, 2007; Hoogstra et al., 2017) that uncovers spatial dependency within the data. Specifically, the spatial units of analysis, counties, are not independent from their neighbors. This makes intuitive sense because county boundaries, the unit of analysis where the data are collected and reported, represent the spatial boundaries of local units of government and do not necessarily reflect relevant economic regions. Economic linkages, whether they be commuting patterns, shopping patterns or input supplies, cross county lines. In their study of religion and economic growth within the U.S., Rupasingha (2009) found evidence of such spatial spillover effects. As is well known in the regional economics literature, the presence of such spatial dependency can lead to biased, inconsistent and inefficient estimates (LeSage and Pace, 2009). As described in detail below, several approaches have been offered to not only correct for spatial dependency within the data but also explicitly model those spatial spillover effects including the spatial error, spatial lag and spatial Durbin models.

The second general problem is the explicit assumption that the estimated parameters are a global representation of the underlying relationships. Specifically, the relationship between religion and economic growth is the same across geography. Within a U.S. context, the underlying relationship in the Bible Belt portions

of the U.S. is the same as in the Pacific Northwest or New England. Qayyum et al. (2020) found evidence of geographic variation: religion helps explain economic growth in Asia and Europe, somewhat in Africa, but the relationship is unclear in America. A more reasonable assumption would be to allow for spatial heterogeneity in those underlying relationships. Specifically, we can allow for the relationship between religion and economic growth to vary across space. One approach might be to use fixed effects for regions and then explore for patterns in those fixed effects.

4.1 Estimation Methods

An alternative approach that has gained widespread use within regional economics (e.g., Deller, 2010a,b; Thissen et al., 2016) is Geographically Weighted Regression (GWR) as offered by Fotheringham et al. (2003). Based on Casetti (1972)'s expansion method to explicitly model the properties of non-stationarity in regression analysis and locally weighted regression (Cleveland, 1979; Cleveland and Devlin, 1988), GWR allows for individual parameter estimates to vary by spatial observations. Unlike the fixed effects approach where the research pre-imposes the effects, the GWR process allows the data to determine the appropriate spatial patterns. For this study, we elect to use four spatial estimators as a form of a robustness check on our results: GWR, spatial error, spatial lag and spatial Durbin estimators.

The three specifications are used including a special lag (SAR), spatial error (SEM) and spatial Durbin (SDM) specifications, respectively:

$$y = \rho W y + \beta x + \epsilon \quad \text{(SAR)} \tag{21}$$

$$y = \beta x + \epsilon; \epsilon = \lambda W \epsilon + \mu \quad \text{(SEM)} \tag{22}$$

$$y = \rho W y + \beta x + \delta W x + \epsilon \quad \text{(SDM)} \tag{23}$$

In the spatial lag model, economic growth (y) in one community (county) are influenced by nearby counties ($\rho W y$) in a fundamentally structural way. The spatial error model treats the spatial dependency in the data mostly as a nuisance that must be corrected. The spatial Durbin model suggests that there is not only a structural relationship across space in growth, as in the spatial lag model, but religious activity or traditions in neighboring communities influence growth rates in the host community. LeSage and Pace (2009) have argued that the spatial Durbin is perhaps the most flexible of the three specifications outlined above and thus the most general. As used here, employing all three specifications provides for a robustness check rather than a specific test of questions about the nature of the spatial relationships.

In these spatial models, the spatial weight matrix (W) explicitly captures the spatial dependence between observations (counties) and takes the form of an n by n spatial weighting matrix of the form

$$W(i) = \begin{bmatrix} w_{11} & \cdots & w_{1n} \\ \vdots & \ddots & \vdots \\ w_{n1} & \cdots & w_{nn} \end{bmatrix} \tag{24}$$

where $w_i j$ is a nonzero element if observations j and i are geographic neighbors and zero otherwise. Typically, the matrix W is row-stochastic, which in linear algebra means that w_{ij} is non-negative and each row sums to one. As noted by LeSage and Pace (2014), there has been significant debate within the spatial econometrics literature as to how sensitive model estimates are to alternative specifications of the spatial weight matrix. For example, in the spirit of spatial gravity models, the level of influence across geographic units should be stronger among those that are in close proximity and weaken as distance increases. At what point across space does w_{ij} becomes zero and how sensitive are the parameter estimates to changes in w_{ij}?

LeSage and Pace (2014) argue that the nature of any biases in parameter estimates hinges on if the interpretation of the estimated coefficients are treated as the true partial derivative. While one can directly interpret the estimated coefficients from the spatial error model as the partial derivative, the spatial lag and spatial Durbin models require an additional step. Consider the general form of the spatial Durbin model which can be expressed as $y = \rho W y + \beta x + \rho W x + e$ and in reduced form as $y = (I - \rho W)^{-1}\beta x + (I - \rho W)^{-1}\rho W x + (I - \rho W)^{-1} e$. Let $V(W) = (I - \rho W)^{-1}$ then write the reduced form as $y = V(W)\beta x +$

$V(W)\rho Wx + V(W)e$. Because $V(W)$ is a matrix and not a scalar, the common approach of using point estimates to test the hypothesis as to whether or not spatial spillovers exist can lead to erroneous conclusions (LeSage and Pace, 2009, p.74). Instead we need to use the partial derivatives to properly interpret the impact of changes to the variables. Specifically, $\frac{\partial y}{\partial x} = V(W)\beta + V(W)\rho W$ or $\frac{\partial y}{\partial x} = direct + indirect = total$. Here the direct effect is the impact within the county and the indirect is the impact across counties, or the neighborhood effect. For reporting purposes LeSage and Pace (2009) suggest the using the averages of the diagonal element of $V(W)\beta$ for the direct effects, or within geographical unit effects, as well as the averages of the sum of the columns or rows (the symmetric nature of the matrix makes it irrelevant if one used the columns or rows) of the $V(W)\rho W$ for the indirect effects, or across geographical unit effects. LeSage and Pace (2014) show that if the proper partial derivatives of the spatial lag and Durbin models are used, then the sensitivity of results to the specific form of the spatial weight matrix becomes a non-issue. For our analysis, we will report only the total effects for the spatial lag and Durbin for brevity.

As noted above one of the limitations to the spatial error, lag and Durbin models is that they provide global parameter estimates in that the underlying data generating process linking religion and economic growth is the same across space. To test if the religion and growth relationship varies across space, we use the Geographically Weighted Regression (GWR) methods outlined by Fotheringham et al. (2003). The GWR model can be written as

$$y_i = \beta_0(u_i, v_i) + \sum_k \beta_k(u_i, v_i)X_k + e_i \tag{25}$$

where (u_i, v_i) indicates that location of the i^{th} point and $\beta_k(u_i, v_i)$ is a realization of the function at point i. The individual value of $\beta_k(u_i, v_i)$ is the value of the parameter for each observation. The GWR specification recognizes that spatial variations in the parameters might exist and provides a method for estimating this variation.

One potential issue in this general specification is that there are more unknowns than observed variables. Fotheringham et al. (2003) acknowledges this issue and notes that they do not consider the coefficients to be random; rather they view them as a function of locations in space. In this model, the data closer to location i are weighted more heavily in the estimation than those further from i. The model is very similar to weighted least squares in its operation. The weighting scheme can be written as

$$\hat{\beta}(u_i, v_i) = (X'W(u_i, v_i)X)^{-1}X'W(u_i, v_i)y \tag{26}$$

where the estimates are weighted according to the n by n matrix $W(u_i, v_i)$ whose off diagonal elements are zero and the diagonal elements are the weighting of each of the n observations for regression point i. Each parameter is estimated using,

$$\hat{\beta}(i) = (\mathbf{X'}W(i)\mathbf{X})^{-1}\mathbf{X'}W(u_i, v_i)\mathbf{Y} \tag{27}$$

where i represents a row in the matrix and $W(i)$ is an n by n spatial weighting matrix similar to the one defined above.[1]

Because we are using U.S. county data, the geographic size of counties varies significantly, particularly if we compare counties in the northeastern to western regions. In the northeast, the counties tend to be much smaller geographically than in the western U.S. To adjust for these differences, we use what Fotheringham et al. (2003) refer to as adaptive spatial kernels. Specifically, we use the adaptive bi-square kernel:

$$w_i j = \begin{cases} (1 - \frac{d_{ij}^2}{\theta_{i(k)}})^2 & d_{ij} < \theta_{i(k)} \\ 0 & d_{ij} \geq \theta_{i(k)} \end{cases} \tag{28}$$

where d is the Euclidean distance between observation i and location j, θ is a fixed bandwidth and $\theta_{i(k)}$ is an adaptive bandwidth size defined by the distance measure. The latter is estimated using a golden section search process by minimizing the Akaike Information Criterion (AIC). Thus, the spatial weighting schemes

[1] It is important to note that the spatial weighting scheme between the spatial lag, spatial error and spatial Durbin models that provide global parameter estimates are similar in spirit to the weight matrix used in the Geographically Weighted Regression, the means in which they are calculated and implemented are different.

in GWR adapt themselves to the size variations in the density of the data, larger bandwidths in sparser areas (e.g., geographically larger counties in the western U.S.) and smaller in more highly concentrated areas (e.g., geographically smaller counties in the northeast). The essential idea is that for each regression point, i, there is an area of influence around i described by the weighting function so that observations near to i have more weight in the estimation of the parameters than those further away.

The resulting variation in parameters will be used to determine the degree of misspecification in the global model. Consider two models, a fitted GWR model and a counterpart model in which only the k^{th} coefficient is fixed globally. If the difference between the k^{th} parameters from each model is positive, then the k^{th} parameter should be considered a global estimate. If there is a difference in the AIC score greater than two, then the lower scoring model achieves better fitting results. The power of this approach is that it not only allows for the data to determine the spatial patterns of the estimated coefficients, it also allows for individual standard errors and hypothesis testing for each parameter estimate across that space.

The power of this approach when modeling the role of religion in regional economic growth is that it not only explicitly allows for spatial variation in the underlying relationship, including tests of statistical significance in those patterns, but also allows for a mapping of those relationships. In addition, the method allows the relationship between religion and economic growth to vary from positive to negative, and statistically insignificant, across space. Thus, it is possible that the underlying relationship is positive in some places within the U.S. and negative in others. If researchers relied on a single global parameter estimate, it is likely to result in a Type 2 error. Indeed, not accounting for potential spatial variation in the underlying relationship might explain some of the inconsistency in the religion and economic performance/growth literature.

4.2 Model Specification

The empirical specification of our models has three blocks of variables: (1) the lagged partial adjustment growth measures (population, employment and income), (2) our measures of religious traditions, and (3) a block of control variables. Growth is measured as percent change in population, employment and per capita income from 2010 to 2018, the base year is 2010 and the "deep lags" are growth rates in each measure of growth from 2000 to 2010.

The appropriate selection of control variables has generated significant debate within the growth literature, often within the framework of modeling uncertainty (e.g., Chatfield, 1995; Durlauf and Quah, 1999; Brock and Durlauf, 2001; Fernandez et al., 2001; Brock and Durlauf, 2001; Winkler et al., 2015; Watson and Deller, 2017). Young (2009), for example, was highly critical of the two Barro and McCleary studies that linked religion and economic growth on the grounds that the key results were highly sensitive to the selection of the control variables.

For this study we appeal to the extensive empirical literature that has used U.S. county level data within the partial equilibrium model outline above to identify our control variables (e.g, Deller et al., 2001; Deller and Lledo, 2007; Boarnet et al., 2005; Hoogstra et al., 2017; Carpenter and Loveridge, 2019; Carruthers and Mulligan, 2019). These include: (1) an education index, (2) the unemployment rate, (3) population density, (4) a measure of social capital, (5) an ethnic diversity index, (6) an age index, and (7) a measure of economic diversity. The unemployment rate in 2010 reflects the rate of recovery from the Great Recession where some regions, particularly more rural regions within the U.S., were slower to rebound than other regions and the unemployment rate controls for that factor. We expect that higher unemployment rates in 2010 should dampen economic growth from 2010 to 2018. Population density is a very simple measure of agglomeration effects that vary with population across the rural-urban continuum. Here we expect counties with higher population densities to benefit from agglomeration effects and hence have higher rates of growth.

Education is a measure of human capital measured by the distribution of education attainment within the county across seven categories (less than a 9th grade education to graduate or professional degree). Specifically the 3rd moment of the distribution, or the level of skewness.[2] If the data is skewed to the right (3rd moment is negative) this means that a larger share of the population falls into higher educational

[2]For this study, the 3$^{\text{rd}}$ moment is calculated as $(\sum_{i=1,\ldots,v} s_i^3)v$ where s_i is the percent of the population in age category i and v is the number of age categories. There are seven educational attainment categories ($v = 7$).

attainment categories whereas if the data are skewed to the left (3rd moment is positive) then the county will tend to have lower levels of education. Consistent with human capital theory, we expect counties with higher educational attainment to have higher rates of growth. The age index is computed in the same manner as the education index but using the percent of the population in five-year age increments ranging from 0-4 years of age to 85 and over. There are 17 age categories that the index is constructed over. We offer no prior hypothesis on the impact of age on regional economic growth.

The measure of economic diversity is a standard Herfindahl Index of the distribution of employment shares across 20 industrial categories. A lower value of the index means that employment is more evenly distributed across the 20 industries and the economy is said to be more diversified. At the extreme, if the index is equal to one then all employment is in one industry and the economy is highly specialized. These data are drawn from Woods and Poole, Inc to take advantage of their methodology to "fill in" missing data that is due to disclosure problems. The ethnic variable is a standard measure of ethnic diversity (Simpson Index) and equals the probability that two people taken at random from the community have the same ethnic heritage. Therefore, a higher value of the index means a more homogeneous (less diversified) population whereas a small value means a more heterogeneous (more diversified) population.

The social capital measure requires a bit more explanation. As outlined in detail in Halstead and Deller (2015), social capital, or the networks, norms and social trust that allow for the free flow of information and community action, is fundamental to the economic growth and development process. To control for this, we use the social capital index developed by Rupasingha et al. (2006, with updates) using principal component analysis to combine several factors that could be associated with social capital into a scalar index. Rupasingha et al. (2006) argue that the concentration of associations such as professional, business, volunteer and sports organizations along with the concentration of non-profits proxy networking opportunities and the willingness of the community to come together to pursue common objectives. In addition, civic engagement measures, such as the response rate to Census surveys and voter turnout (for the 2008 presidential election for the 2010 updates), adds another element of social capital. Here four distinct measures (the sum of associations listed previously per 10,000 persons, total number of non-profits per 10,000 persons, census response rates and voter turnout) are combined using principal components where higher values of the index are associated with higher values of social capital. We expect that higher values of the RGF social capital index will be associated with higher rates of economic growth.

Another challenge is how to measure levels of religious activity for different religious traditions. For an ecological study of regional economic growth, the answer to this question hinges on the availability of data at the regional or local level. Following Rupasingha (2009) as well as Deller et al. (2018) we used the decennial Religious Congregations and Membership Study carried out by the Association of Statisticians of American Religious Bodies (ASARB). This is an extensive survey that is intended to mimic a census type inventory of congregations by type, membership levels and levels of adherence.[3]

The data collected by ASARB allows us three basic measures: concentrations of the number of congregations within a community, adherence rates, and congregational sizes. While the count of congregations provided by the ASARB is reliable, the estimates of adherence rates and membership levels are less reliable as they are self-reported and thus incorporate personal variations on what defines adherence and who is a member varies across religious traditions. For example, are children counted as members and is adherence simply attending services periodically? Thus, we limit our analysis to just the number of congregations. We aggregated the 236 different religious groups in the ASARB study into seven larger classifications based on the absolute size within the U.S. We based these classifications on the work of the Pew Research Center on Religion and Public Life's Religious Landscape Study and these include Evangelical, Black Protestant, Catholic, Latter-day Saints (Mormon), Muslim, Jewish and Eastern traditions.[4] We look at the concentration of these by taking the number of congregations per one thousand persons. The simple logic is that a higher concentration of congregations is linked to higher levels of religiousness.

We also explore the role of religious diversity in economic growth by computing a fractionalization index.

[3]These data were downloaded from the Association of Religion Data Archives at: `https://www.thearda.com/Archive/ChCounty.asp`. The 2010 survey allowed for 236 religious groups ranging from 217 Christian denominations to four Jewish, Muslims and Zoroastrian among others. The 236 groups reported a total of 344,894 congregations with 150,686,156 adherents, comprising 48.8 percent of the total U.S. population of 308,745,538 in 2010.

[4]This work can be found at: `https://www.pewforum.org/religious-landscape-study/`

This index measures the probability that two randomly drawn congregations from a county belong to the same religious tradition. Here the index is computed as $1 - \sum_i (Congregation_i)^2$ where $Congregation_i$ is the concentration of each of the seven ($i = 1, \ldots, 7$) different religious traditions. The higher the index the more religious diversity there is within the community (county). This is comparable to the ethnic index used above except the interpretation is reversed (i.e., probability that two people taken at random from the community have the same ethnic heritage). Using the theoretical lens of social capital higher levels of religious diversity can impact economic growth in at least two ways. First, it can hinder growth because of heightened potential for conflict within the community. If members of religious group are less open to the views and beliefs of other traditions, conflict can occur and such conflict can hinder economic growth. While there may be strong bonding social capital within the faith organization, bridging social capital is likely weak or negative. Second, religious diversity can help foster economic growth through broadening networks and alternative ways of thinking about issues and problem solving which in turn fosters economic growth. As evidence of this, in a recent study of religion and levels of entrepreneurship within the U.S. Deller et al. (2018) found that higher religious diversity is associated with higher levels of business formations.

5 Empirical Results

The results of the base model, with no religion measures included, is provided in Appendix Table 1 and for brevity we provide the results for the spatial error, spatial lag and spatial Durbin models. A detailed discussion of the control variable results is beyond the scope of this study, but we do find relative stability in the estimated parameters (total effects for the spatial lag and Durbin models) providing some evidence of the robustness of our results. We also find that the spatial lag parameter is statistically significant across all models strongly suggesting the presence of spatial dependency within the data. The base model explains about 55 percent of the variation in population growth, just over 20 percent in employment growth, but less than 15 percent in per capita income growth.

5.1 Results for Core Model

Some of the more interesting findings center on evidence of divergence in growth over the study period. In general, for all three measures of economic growth, the lagged level and growth rate have a positive and significant coefficient suggesting that larger places (counties), in terms of population, employment, and income, tended to experience higher rates of growth. This includes initial levels of per capita income which point to divergence in income, inconsistent with the notion of Barro-convergence. Higher rates of lagged (2000 to 2010) income growth, however, are associated with slower rates of income growth over the 2010 to 2018 period. As expected, higher education (lower values of the education index) is associated with higher rates of population and employment growth, but the results for income are not robust. A higher unemployment rate coming out of the Great Recession is tied to lower rates of population growth but higher rates of employment and income growth. Population density, our measure of rurality, appears to have a positive impact on all three growth measures suggesting more urban place grow faster, but the results for population and employment are not robust. This result is consistent with expectations where more urban areas tend to have a comparative advantage over more rural areas.

The results on the social capital measure are somewhat unexpected and inconsistent with prior research as the results are inconsistent across models for population growth, negative on employment growth and not robust on income growth. The results on ethnic diversity (higher values of the index are associated with a more ethnically homogeneous population) are consistent across all three measures of growth: higher levels of homogeneity are linked to higher rates of economic growth. This result, along with social capital, is unexpected but a deeper analysis is beyond the scope of this study. We also find that counties with an older population tend to have higher rates of population and employment growth, but age has no impact on income growth. The final control variable in the base model, economic diversity, performs as expected: higher levels of economic diversity (as measured by the distribution of employment across industries) is linked to higher rates of population, employment and income growth.

5.2 Results on Religion Measures

Now consider the results of our two comprehensive measures of religion: the concentration of all congregations (number of congregations per one thousand population) and the diversity of congregations across different religions (higher values of the index indicate more religious diversity) (Table 1). First, we consider the four estimators that provide a global parameter estimate, traditional regression analysis and the three spatial estimators, and then the results for the GWR are discussed below. Note that a higher concentration of congregations tends to be linked to lower rates of economic growth, but the results are not particularly robust across the different global estimators with the exception of employment growth where higher concentrations of congregations are significantly associated with slower growth. For population and income, the traditional regression model suggests slower growth rates, but the results are not significant for the spatial estimators. Only the spatial error (SEM) result for population growth is consistent with the traditional regression result. In places with higher diversity, or a greater mix of different types of religions, income growth is higher, population growth is lower, though the result is weak, and there is no relationships to employment growth. The population growth result, however, is not consistent across the different global parameter estimators. If we take these results in tandem, we could argue that the data tends to support the basic results of Barro and McCleary along with others, that regions that have higher levels of religious activities tend to have slower rates of economic growth. Our results are also similar to Rupasingha (2009): there is evidence to suggest that relatively secular regions grow faster but the results are not robust.

Turn attention now to the results of the Geographically Weighted Regression for the two comprehensive measures of religion (Table 1). For computational ease, we set the parameters for all the control variables to their global values. In other words, we only allow the measures of religion to vary across space. For reporting purposes, we ranked the individual parameter estimates from smallest to largest then report the lower and upper quartile, median and mean. The key statistic for this analysis is the diff-criterion: a positive difference greater than two indicates that the coefficient on the kth variable is global, meaning the spatial estimator(s) are more appropriate than the GWR estimator. Conversely, values less than two, and particularly those that are negative, suggest that the spatially heterogeneous GWR estimates are an improvement over the global estimates. A test of consistent underlying relationships between our measures of religion and economic growth across space (i.e., the global parameter is correct) would be rejected in favor of the conclusion that these underlying relationships vary across space.

Based on the diff-criterion the impact of the total concentration of all congregations on population does not vary across space and the global parameter estimates are reasonable. The results for employment and income growth, however, suggests that the global parameters may be masking spatial variations in the underlying relationships. For employment growth the lower and upper quartile values are negative, which suggests that a higher concentration of congregations is associated with slower rates of employment growth, but the rates vary across space. To better understand this spatial variation, we map the GWR parameters relating concentration of congregations to employment growth (Figure 1). Here we map three possible combinations: (1) a positive parameter that is significant at or above the 0.05 level (t-statistic $\geq$ 1.96), (2) negative and significant at or above the 0.05 level (t-statistic $\leq$ -1.96), or (3) statistically insignificant at the 0.05 level. It is clear that for much of the U.S. the relationship is negative and statistically significant, however, there are geographic pockets were the relationship is insignificant and indeed positive and significant. Specifically, along the Pacific coast including most of California, Nevada, Oregon and Washington State. But from Michigan south into Tennessee, there is a part in the U.S. where higher concentrations of congregations are linked to higher rates of employment growth.

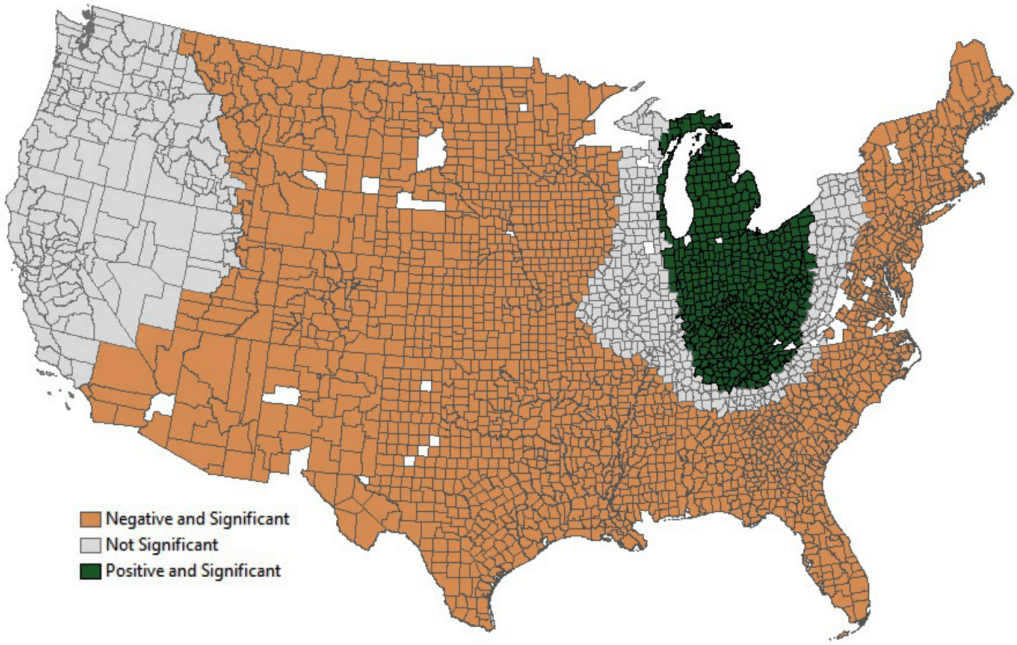
Now consider the impact of congregational concentrations on income growth. From the global parameter estimators, classic regression analysis suggests a significant negative relationship, but the spatial estimators suggest the relationship is not statistically significant. The diff-criterion estimate from the GWR estimator suggests that the global parameter estimates may not be reliable as there is evidence that the underlying relationship varies over space. Again, ranking the GWR estimated parameters from smallest to largest, the lower quartile is -0.0099 but the upper quartile is 0.0114 with a median of 0.0011 and a mean of 0.0019. By mapping the individual significance levels, a relatively complex spatial pattern between concentrations of congregations and income growth becomes apparent (Figure 2). For much of the U.S., the GWR estimated parameters are statistically insignificant (again, at the 0.05 threshold), but there are regions where the

Table 1: Core Growth Model Results for Aggregate Measure of Religion

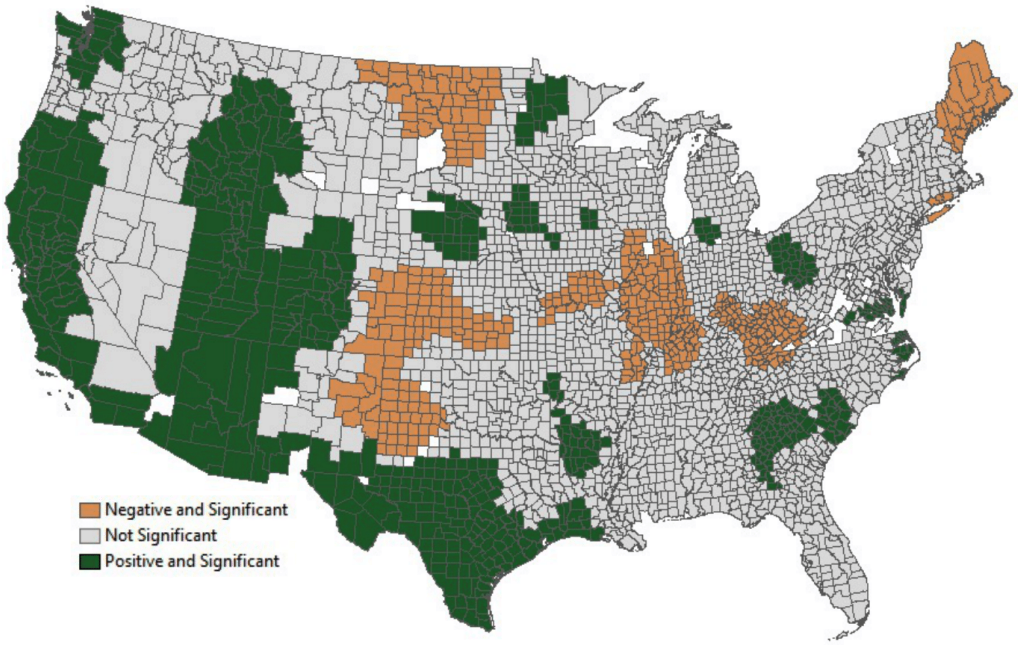
	GWR					OLS[a]		SAR[b]		SEM		SDM[b]	
	Lower Quartile	Median	Mean	Upper Quartile	DIFF of Criterion								
Concentration of All Congregations													
Growth in Population	-0.0127	-0.0045	-0.0059	0.0018	42.092	-0.0405	*	-0.0021		-0.0035	**	0.0010	
						(0.0529)		(0.1336)		(0.0002)		(0.7277)	
Growth in Employment	-0.3525	-0.2452	-0.1789	-0.2010	-398.818	-0.1005	***	-0.0133	***	-0.0112	***	-0.0093	**
						(0.0001)		(0.0001)		(0.0001)		(0.0406)	
Growth in Per Capita Income	-0.0099	0.0011	0.0019	0.0114	-438.515	-0.0688	**	0.0041		0.0019		-0.0035	
						(0.0410)		(0.2345)		(0.3697)		(0.4985)	
Religion Diversity													
Growth in Population	-0.0007	-0.0002	-0.0004	0.0002	114.738	-0.0452	**	-0.0001		-0.0001		-0.0003	*
						(0.0017)		(0.2481)		(0.5304)		(0.0634)	
Growth in Employment	-0.0006	-0.0008	-0.0002	0.0001	-21.784	-0.0104		-0.0002		-0.0001		-0.0002	
						(0.6870)		(0.1884)		(0.4253)		(0.4245)	
Growth in Per Capita Income	0.0013	0.0016	0.0017	0.0020	-421.236	0.0462	*	0.0005	**	0.0008	***	0.0006	*
						(0.0769)		(0.0161)		(0.0001)		(0.0547)	

Marginal significance or p-values in parentheses.
***: Significant at 99.9%, **: Significant at 95.0%, *: Significant at 90.0%.
Control variables not reported to conserve space.
a: Standardized coefficients, heteroscedasticity consistent standard errors.
b: Total effects.

Map 1: Total Congregation Concentration on Employment Growth: 2010 to 2018

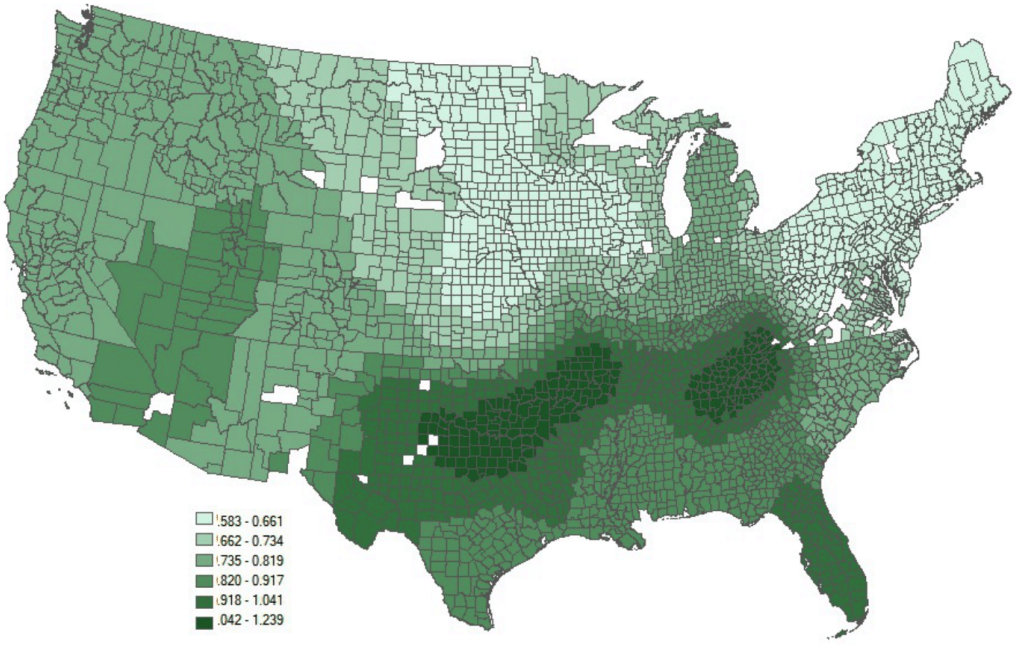


Map 2: Total Congregation Concentration on Per Capita Income Growth: 2010 to 2018



relationship are both positive and negative. In much of Texas, Arizona, north to the Idaho-Montana border region, the Pacific coast and the Seattle region the relationship is positive. There are other smaller pockets around the Atlanta metro region and parts of South Carolina, very northern Minnesota, and others that reveal a statistically significant positive relationship. There are also pockets of the U.S., such as Illinois, eastern Kentucky and western West Virginia, North Dakota, Maine, and the panhandle region of Texas going north into the western parts of Kansas where the relationship is negative.

Map 3: Religious Diversity on Income Growth: 2010 to 2018 (Estimated Parameters)



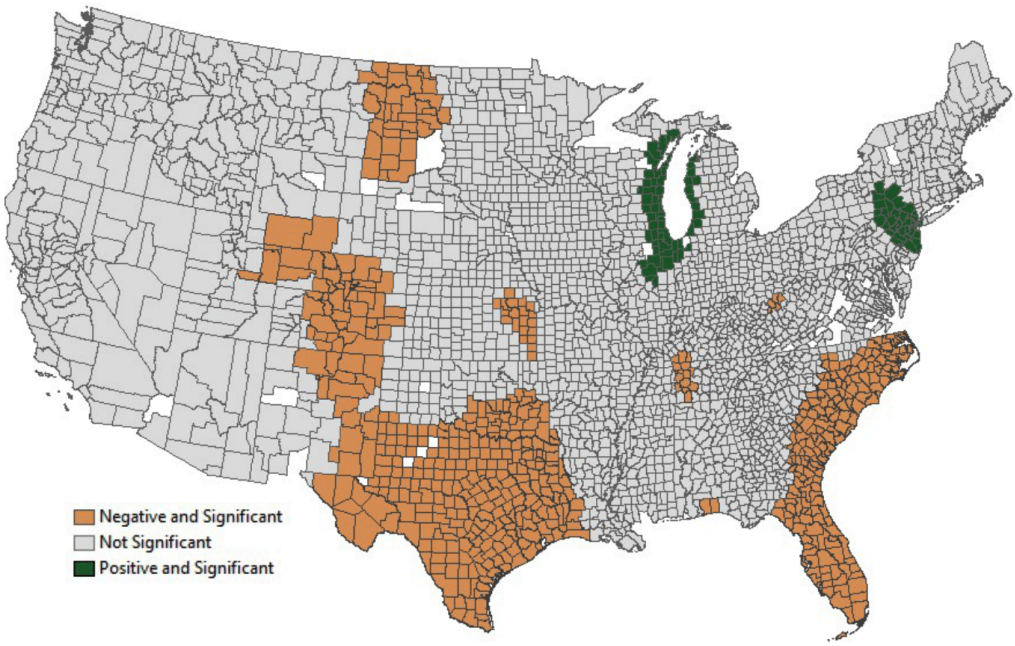
Now consider the spatial variation in the underlying relationship between the diversity of religious traditions and economic growth (Table 1). The global parameter estimates appear to be appropriate for the population model, but unsuitable for both the employment and income models. For the employment model, a mapping of the t-statistics reveals that religious diversity does not have any statistically meaningful associated with employment growth. Thus, while the GWR estimates are preferred over the global parameter estimates, the implication of no relationship remains in place. The results on income growth reinforces the positive relationship identified with the four global parameter estimators. Indeed, a mapping of the t-statistics for this model reveal that the relationship is positive and statistically significant across the U.S. A mapping of the estimated parameters (Figure 3) suggests that there are spatial patterns in the underlying relationship. Specifically, the relationship is the strongest in a wide range between West Virginia and northern Texas as well as much of Florida and the weakest in the northeastern U.S. and large parts of the Great Plains. One way to interpret this result is that regions of the country that tend to be dominated by one religion appear to be at a comparative disadvantage in terms of income growth.

From these two broad measures of religion, we can draw two general conclusions. First, a higher concentration of congregations has a mixed and not completely intuitive relationship to population and income growth. For large parts of the U.S. the relationship is statistically insignificant, but for other parts the relationship is positive and for other parts it is negative. Other than one pocket in the central part of the U.S. (Michigan south into Tennessee) higher concentrations have a negative effect on employment growth. Second, religious diversity has no connection to population and employment growth but has a strong consistent positive association with income growth across the whole of the U.S. This is consistent with the results of Deller, Conroy and Markeson (2018) who found that a higher level of religious diversity is associated with higher rates of business formation, suggesting that entrepreneurship may be one path through which religiosity effects incomes and the broader economy. The practical policy implication at the local level is to

foster religious diversity and interaction across different congregations to facilitate building stronger bridging social capital.

The results for the analysis examining the concentrations of individual types of religions are provided in Table 2. A cursory review of the results points to three observations: (1) the results tend to be unstable (non-robust) across different estimators, (2) the pattern, if statistically significant, tends to suggest economic growth is lower in places with higher concentrations, and (3) the global parameters are suitable for employment and income growth, and to a large extent population growth. For the latter, the population result does appear to vary spatially for Catholics and Evangelicals. But a mapping of the significance of the Catholic result on population reveals that the level of statistical significance is weak which would be consistent with the statistical insignificance of the global parameter estimators. We do provide a mapping of the significance levels for the Evangelical and population relationship in Figure 4. For much of the U.S. the relationship is statistically insignificant, but there are pockets where the relationship is negative and significant including the Texas region and small parts northwest of Texas, and the Atlantic coastal region from the Carolinas south through Florida. There are a few pockets (around Lake Michigan and lower New York) where the relationship is positive and significant but this represents only a small handful of counties. The negative pattern is partially a reflection of where many Evangelical congregations are concentrated. For example, there are relatively few Evangelical congregations in the Pacific Northwest.

Map 4: Evangelical Congregation Concentration on Population Growth: 2010 to 2018



When all of these results are taken together, we can sympathize with the conclusion of de Jong (2011)'s review of the literature who noted that the relationship is at best perplexing and inconclusive. Our results, however, do not allow us to conclude that religion does not influence economic growth. Rather, other than higher levels of religious diversity being associated with higher rates of income growth, the preponderance of the evidence is that a higher concentration of religious congregations tends is associated with lower economic growth. There is, however, sufficient evidence that the relationship varies over space. In many parts of the U.S. the religion and economic growth relationship is statistically insignificant yet in some place the relationship is negative and others positive. This spatial variation is lost to most traditional research methods that have studied the religion and economic growth interaction, and as such, helps explain the conclusion in de Jong (2011). Clearly the question about how religion influences economic growth remains an open question worthy of additional investigation.

Table 2: Growth Model Results for Religion by Tradition

	GWR					OLS[a]		SAR[b]		SEM		SDM[b]	
	Lower Quartile	Median	Mean	Upper Quartile	DIFF of Criterion								
Growth in Population													
Evangelical	-0.0117	-0.0044	-0.0119	0.0020	-26.284	-0.0207		-0.0001		-0.0029	**	0.0009	
Black Protestant	-0.0528	-0.0150	-0.0431	0.0697	16.719	-0.0680	***	-0.0175	*	-0.0251	***	0.0009	
Catholic	-0.0482	-0.0154	-0.0742	0.0076	-25.703	0.0258		0.0058		-0.0018		0.0243	
Mormon	-0.0173	0.0433	-0.1663	0.1150	32.578	-0.0104		-0.0199	**	0.0009		-0.0136	
Muslim	-0.1753	0.1566	-0.4216	0.7384	42.106	-0.0091		0.1106		0.0643		-0.4736	
Jewish	-0.2350	0.1016	0.4262	0.9029	53.811	-0.0189	**	-0.0385		0.0608		-0.6264	
Eastern Tradition	-0.0389	0.1920	0.2777	0.4294	44.355	0.0258	***	0.0728		0.0337		0.2442	*
Growth in Employment													
Evangelical	-0.0459	-0.0459	-0.0459	-0.0459	0.048	-0.0667	**	-0.0137	**	-0.0127	**	-0.0091	
Black Protestant	-0.1267	-0.1266	-0.1266	-0.1265	0.017	-0.0426	**	-0.0264		-0.0224		-0.0523	
Catholic	-0.0384	-0.0382	-0.0382	-0.0380	-0.095	-0.0121		-0.0075		-0.0009		-0.0181	
Mormon	-0.0296	-0.0295	-0.0295	-0.0295	0.002	-0.0173		-0.0248	*	-0.0110		-0.0053	
Muslim	-1.8792	-1.8782	-1.8769	-1.8769	0.053	-0.0285	**	-0.8235	*	-0.5414		-0.2053	
Jewish	-0.8838	-0.8817	-0.8811	-0.8793	0.064	-0.0153		-0.2154		-0.0057		-1.6914	**
Eastern Tradition	-0.1211	-0.1201	-0.1202	-0.1192	0.036	0.0071		0.0420		0.0483		-0.0395	
Growth in Per Capita Income													
Evangelical	-0.0033	-0.0030	-0.0029	-0.0024	-2.070	-0.0490		0.0072		0.0060	*	-0.0099	
Black Protestant	0.0144	0.0164	0.0158	0.0173	-0.045	-0.0178		0.0422	**	0.0336	**	0.0071	
Catholic	0.0000	0.0000	-0.0001	0.0000	0.090	-0.0527		-0.0281	**	-0.0230	**	-0.0243	
Mormon	0.0263	0.0268	0.0270	0.0278	0.066	0.0539	**	0.0215		0.0093		0.0445	**
Muslim	0.0000	0.0000	0.0000	0.0000	0.000	-0.0279	*	-0.0094		0.4145	*	-2.1089	*
Jewish	-0.0828	-0.0245	0.0044	0.0887	-1.804	0.0084		0.1277		0.1879		-0.9918	
Eastern Tradition	-0.0077	-0.0026	0.0032	0.0100	0.319	0.0070		-0.0605		-0.0550		0.5739	**

***: Significant at 99.9%, **: Significant at 95.0%, *: Significant at 90.0%.
Control variables not reported to conserve space.
a: Standardized coefficients, heteroscedasticity consistent standard errors.
b: Total effects.

6 Discussion and Conclusions

Economists are starting to accept that culture plays an important role in economic performance. The norms of a community and their determinations of acceptable behavior help define culture which in turn impacts the economy. Attitudes around risk taking, networking and personal responsibility, among others, are driven by the culture of a community. For many societies, including the U.S., religion has played, and continues to play, a fundamental role in shaping culture. This influence has played out in at least three ways: (1) institutionally, or through both formal and informal rules, (2) through the structure of social capital and the resulting networks and flows of information, and (3) in attitudes toward work which influence rates of entrepreneurship.

While the role of religion in economic outcomes has been the focal point of social scientists for decades, it was a series of studies by Barro and McCleary (Barro and McCleary 2003; McCleary and Barro 2006) that explicitly introduced the notion of religion and economic growth. While their original work has been widely challenged (e.g., Young, 2009; Durlauf et al., 2012), their basic conclusion seems to remain: higher levels of religion activity tends to be associated with lower levels of economic growth. Ruck et al. (2018), for example, find that a rise in secularization generally has preceded economic growth over the past century. The research also finds that religious traditions matter and that some traditions are more conducive to growth, some hinder growth and yet others appear to have no influence on growth. Such findings have led some researchers, such as de Jong (2011), to observe that the relationship is at best perplexing and inconclusive.

We add to this modest but growing literature by building on Rupasingha (2009) and adapt a partial equilibrium adjustment model that is widely used within regional economics to U.S. county level data. In this way, we move beyond modeling economic growth through the narrow lens of income which is the focal point of Barro-type growth models and expand to employment and population. We pay attention to the spatial patterns in the data by employing a family of spatial estimators including a spatial lag (SAR), spatial error (SEM) and spatial Durbin models (SDM) along with the Geographically Weighted Regression (GWR) estimator. We do this for two reasons. First, county boundaries, the unit of observation for which the data are collected and reported, do not coincide with functioning economic areas. A simple examination of commuter patterns reveals that people commonly cross county boundaries for a variety of reasons beyond work. Thus, there are spatial spillover effects from one county to another. Without accounting for this spatial dependency within the data, traditional estimation methods will provide biased, inconsistent, and inefficient estimates.

Second and more fundamental, traditional estimation methods, including the SEM, SAR and SDM models, provide global parameter estimates where the underlying relationship of interest is explicitly assumed to be the same across space. In other words, the role of religion is the same across the whole of the study space. Within the U.S. the role of religion varies across space. For example, religion is much more prevalent in the "Bible Belt" than in New England or the Upper Midwest. To presume that the underlying relationship is the same across such regions is a potential source of significant error. To provide the greatest flexibility in allowing the parameters of interest to vary across space, we use GWR.

We find that religion, measured by the concentration of congregations, can help us understand differences in economic growth across the U.S., but not necessarily in a straightforward and easy to interpret way. The influence on population growth appears to be negative, but the result is not robust across different estimators. This same variable, the concentration of congregations, appears to have no role in income growth. For employment growth, using just the estimators that provide a global parameter estimate it appears that higher concentration of congregations has a negative impact. The Geographically Weighted Regression estimator, however, suggests that the relationship is not constant across space. Indeed, while the negative relationship holds for much of the U.S., there is a positive relationship between congregation concentrations and employment growth in a region from Michigan south into Tennessee.

We also find that higher levels of religious diversity do not explain employment growth, have a weakly negative relationship to population growth, and a strong and consistent positive association with income growth. This latter result is particularly intriguing because it helps shed light on how religious diversity influences the economy. When looking through the theoretical lens of social capital, having numerous different religious traditions in a community could have both positive and negative influences. On the one hand, many religions have conflicting perspectives on beliefs and norms of behavior. Rather than positive

bridging social capital, these conflicts can break down bridging social capital introducing economic friction hindering economic growth. On the other hand, the cross fertilization of traditions, norms, and ideas through strong bridging social capital can lead to innovation which is at the heart of economic growth. This is similar to the logic of having an ethnically diverse community: diversity can be a seedbed of innovation. Our results suggest religious diversity is more likely conducive to strong bridging capital and contributes to positive economic growth.

When we explore the concentrations of individual religious faiths, results are not robust and, thus, it is difficult to draw any meaningful inferences. One could suggest that a higher concentration of Black Protestant congregations places downward pressure on population growth and upward pressure on income growth, but the results are not stable across estimators and hence not robust. Similarly, there is weak evidence that growth is higher in places with Eastern Tradition religions, but the results are again not stable and hence not robust. Unlike Rupasingha (2009), we are hesitant to draw any solid conclusions on how individual religious traditions influence economic growth within the context of the U.S.

Our most important finding, however, is the large spatial variation in these relationships. The positive or negative relationship identified by the OLS, SAR, SEM and SDM models need not hold true for all parts of the U.S. From GWR we find that the results on Evangelical and Black Protestant congregations per capita, for example, vary across space. We find the relationship between the concentration of all religious congregations and income growth varies significantly across the U.S. with some geographic clusters suggesting a positive relationship, while other geographic clusters suggest a negative relationship. In some large parts of the U.S., the relationship is statistically insignificant. For regions where we identify a positive (negative) statistically significant relationship there are other regions where the relationship is the opposite. For example, one could draw a logical inference that higher concentrations of Evangelical congregations have negative impacts on population growth in many parts of the Southern U.S., but no impact on most of the U.S. Because so many prior studies do not allow for spatial variation in the underlying relationships, the strong evidence that we find that such variation exists, at least in a U.S. context, hints to one potential source of the inconsistencies within the relevant literature.

We can conclude from our analysis that religion can be a helpful way to think about culture and how culture in turn influences economic performance. This can be through behavioral norms, how formal laws or informal rules of behavior are established, how people interact with each other (social capital), or how one approaches work and the role of entrepreneurship. Clearly, other theoretical mechanisms have been identified and must be explored. Religion is too ingrained into society to not have an influence, either directly or indirectly, on economic growth. But great care must be taken in terms of broad generalities: yes, religion matters, but in subtle and complex ways.

From a purely economic growth and development perspective, local religious institutions have the potential to be a valuable asset. First, through the lens of social capital, churches or other religious based gathering places, provide opportunities to not only network and share information, but can also be an invaluable resource in identifying community level issues. Ministers, priests, rabbis and imams often have a unique perspective on the economic issues affecting their members that can help inform economic growth and development policies at the local level. Second, different religious traditions can help inform economic growth and development policies about potential ways forward. For example, while Islam encourages self-sufficiency and self-employment, it discourages taking on debt. Thus, in communities with a larger Islam population efforts to promote entrepreneurship may be viable, but financing of those entrepreneurial activities can be a challenge. Third, some churches have a strong tradition of providing community-wide services, such as Catholic Social Services, which can become invaluable partners in community economic growth and development efforts. Care, however, must be taken that religious doctrine of those partners does not overwhelm the values and goals of the larger community.

Clearly much additional work is required. For example, the simple concentration of the number of congregations is but one measure of religion that does not take into account the size of the congregation. One mega church that can hold services for thousands of people at one time is treated the same as a small church with only a handful of members. In addition, while we purposely do not use the adherence rates or congregation size data from the decennial Religious Congregations and Membership Study, future research should explore these data. These data could help better identify the magnitudes of difference between people who attend services regularly and those that attend sporadically. As noted with Catholic Social

Service programs, some religious traditions have a stronger presence in their communities through non-church services than other religions. The breath and depth of these types of programs are ignored in this analysis. Further, the post-Great Recession period examined could be troublesome because of the severe spatial heterogeneity in recovery rates. Many rural areas, for example, have yet to return to pre-Great Recession levels.

Future work on the relationship between religion and community or regional economic performance will be increasingly complicated due to the growing breakdown between spirituality and membership in formal religions (e.g., Trollinger (2021)). Within the U.S. a growing number of people are non-affiliated with a formal church yet claim that their beliefs are influenced by spirituality. A recent Gallup survey (Jones, 2021) found that for the first time in over 80 years of tracking church membership the percent of people in the U.S. reporting formal membership in a church (or temple, synagogue, or mosque) fell below 50%. Based on the Gallup tracking, the rate of non-membership in formal churches is accelerating. Within the context of the U.S. this growing disconnect between spirituality or religious beliefs and church membership may help explain the somewhat inconsistent results found in this study. At a minimum, this growing disconnect will complicate our ability to explore how religion influences economic growth.

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Appendix

Appendix 1: Base Model Results

	Population Growth				Employment Growth				Per Capita Income Growth			
	OLS[a]	SAR[b]	SEM	SDM[b]	OLS[a]	SAR[b]	SEM	SDM[b]	OLS[a]	SAR[b]	SEM	SDM[b]
Population 2010	0.0723 **	0.0002 **	0.0001 ***	0.0003 **	—	—	—	—	—	—	—	—
	(0.0094)	(0.0028)	(0.0001)	(0.0099)								
Growth in Population 2000-2010	0.6378 ***	0.5492 ***	0.3226 ***	0.4739 ***	—	—	—	—	—	—	—	—
	(0.0001)	(0.0001)	(0.0001)	(0.0001)								
Employment 2010	—	—	—	—	0.0732 **	0.0005 **	0.0004 **	-0.7592	—	—	—	—
					(0.0008)	(0.0109)	(0.0017)	(0.8465)				
Growth in Employment 2000-2010	—	—	—	—	0.3446 **	0.4026 ***	0.2960 ***	1.2970	—	—	—	—
					(0.0021)	(0.0001)	(0.0001)	(0.7117)				
Per Capita Income	—	—	—	—	—	—	—	—	0.0840 *	0.0314 ***	0.0298 ***	0.0262 ***
									(0.0597)	(0.0001)	(0.0001)	(0.0001)
Growth in Per Capita Income 2000-2010	—	—	—	—	—	—	—	—	-0.3186 ***	-0.2333 ***	-0.1642 ***	-0.1578 ***
									(0.0001)	(0.0001)	(0.0001)	(0.0001)
Education Index	-0.1890 ***	-0.0326 ***	-0.0216 ***	-0.0236 ***	-0.1513 ***	-0.0433 ***	-0.0360 ***	-0.2209	-0.0947 **	-0.0105	-0.0033	-0.0155
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.8062)	(0.0003)	(0.1144)	(0.4126)	(0.1118)
Unemployment Rate	-0.1067 ***	-0.4380 ***	-0.2444 ***	-0.2968 **	0.1013 *	0.3761 **	0.2993 **	2.0761	0.0877 ***	0.6988 ***	0.7095 ***	0.7391 ***
	(0.0001)	(0.0001)	(0.0001)	(0.0008)	(0.0901)	(0.0011)	(0.0016)	(0.7121)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Population Density	0.0184	0.0001	0.0001 ***	0.0001	0.0259	0.0001	0.0001 **	-0.5126	0.0545 **	0.0001 *	0.0001 ***	0.0001 ***
	(0.1855)	(0.2853)	(0.0001)	(0.8554)	(0.2079)	(0.2714)	(0.0013)	(0.8444)	(0.0014)	(0.0627)	(0.0001)	(0.6253)
Social Capital Index	-0.0062	-0.0009	-0.0027 **	0.0064 **	-0.0759 **	-0.0101 **	-0.0094 **	0.0036	0.0569 **	0.0061 *	0.0014	0.0036
	(0.7525)	(0.5374)	(0.0033)	(0.0346)	(0.0189)	(0.0024)	(0.0002)	(0.7115)	(0.0461)	(0.0591)	(0.4707)	(0.4885)
Ethnic Diversity Index	0.0550 **	0.0516 **	0.0288 ***	0.0347 **	0.0507 **	0.0381 **	0.0455 **	0.0595	0.1358 ***	0.1856 ***	0.1898 ***	0.1252 ***
	(0.0002)	(0.0001)	(0.0001)	(0.0127)	(0.0104)	(0.0267)	(0.0009)	(0.7081)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Age Index	-0.0515 **	-0.0070 **	-0.0051 **	-0.0120 *	-0.0597 **	-0.0133 **	-0.0096 **	-0.1589	0.0309	0.0055	0.0044	0.0003
	(0.0020)	(0.0076)	(0.0002)	(0.0875)	(0.0407)	(0.0241)	(0.0214)	(0.7643)	(0.1298)	(0.3455)	(0.1701)	(0.9834)
Economic Diversity Index	0.0536 ***	0.3418 ***	0.3092 ***	0.1165	0.0993 ***	1.1870 ***	1.0924 ***	1.3892	0.1252 **	2.1174 ***	1.1715 ***	2.9012 ***
	(0.0004)	(0.0009)	(0.0001)	(0.6232)	(0.0001)	(0.0001)	(0.0001)	(0.7118)	(0.0022)	(0.0001)	(0.0001)	(0.0001)
Spatial Lag Parameter	—	0.4760 ***	0.6250 ***	0.6069 ***	—	0.3070 ***	0.3250 ***	0.3120	—	0.4650 ***	0.4650 ***	0.4610 *
		(0.0001)	(0.0001)	(0.0001)		(0.0001)	(0.0001)	(0.3845)		(0.0001)	(0.0001)	(0.0849)
R2	0.5498	0.5484	0.6814	0.5665	0.2165	0.2198	0.2667	0.2338	0.1426	0.1197	0.2379	0.1483

Marginal significance or p-values in parentheses.
***: Significant at 99.9%, **: Significant at 95.0%, *: Significant at 90.0%.
Control variables not reported to conserve space.
a: Standardized coefficients, heteroscedasticity consistent standard errors.
b: Total effects.