

From Pews to Profiles: The Impact of Facebook on Church Attendance

By

Tyler Platz

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Tyler Platz presented on September 29, 2017

Dr. David M. Welsch (Chair)

Dr. Nicholas B. Lovett

Dr. Marc von der Ruhr

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Tyler Platz

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This study utilizes 2012 New Family Structure Survey data to inspect the observed simultaneity of rising social media usage and declining religiosity among US adults. A linear probability model explaining whether or not an individual attends church in a year is estimated by means of an instrumental variable methodology to instrument for social tendencies expected to endogenously affect whether or not an individual has a Facebook account. Results indicate that having an active Facebook account negatively impacts the probability that an individual attends church in a year, potentially highlighting socialization or spiritual substitutability between Facebook usage and religious service attendance. Such insight could prove useful for religious leaders seeking to maximize membership, attendance, and recruitment during a marked downturn in American religiosity.

1. Introduction

The seven-year period between 2007 and 2014 saw an unprecedented cross-demographic decline in religiosity among Americans; simultaneously, social media usage among adults saw rapid growth. To what extent are these trends correlated, and is the decline in religiosity a result of the growth in social media usage? Such an investigation has yet to be conducted, as studying the effects of social media on other social behaviors is in its infancy. While descriptive investigations are able to identify and, to some extent, describe rapidly emerging relationships, studies which attempt to control for unpredictable endogenous effects are critical to understanding the potentially systematic effects social media is having on our social behaviors and institutions.

The recent decline in American religiosity was remarkable given that most demographics, in terms of age, race, and gender, saw declines in observable measures of religiosity. While younger generations are consistently less religious than their elders, even older generations declined in tangible measures of religiosity, such as monthly church attendance. A comparison of the Religious Landscape Surveys conducted in 2007 and 2014 indicates that those born between 1928 and 1945 (the Silent Generation), those born between 1946 and 1964 (the Baby Boomers), and those born between 1965 and 1980 (Generation X) all reported a 1 percentage point decline in monthly church attendance while those born between 1981 and 1989 (Millennials) reported a 2 percentage point decline.¹ However, most strikingly, the 2007 and 2014 Religious

¹ For all age groups, more frequent church attendance, weekly, saw either no change or percentage point declines. Less frequent church attendance, yearly or less often, saw percentage point increases for all age groups.

Landscape Surveys report large, cross-demographic increases in the percentage of individuals who do not believe religion is important, with increases ranging from 1 percentage point in the Silent and Baby Boomer generations to 4 and 6 percentage points in the Generation X and the Millennial generations respectively. The data illustrates both the cross-demographic nature of the shift in religiosity and the inability of simple age-related factors in explaining the larger trend of declining aggregate religiosity.

Within the same time period, individuals have begun interacting with social media platforms in an unprecedented manner. According to the Pew Research Center (2015), in 2015 79% of all US adults who used the internet and 68% of all US adults used some form of social media. This marks a stark increase from 2008 in which roughly 25% of US adults used social media. Theoretically, the socialization utility provided by social media may be competing with the socialization utility provided by attending religious services. Such a hypothesis would explain the simultaneity of rising social media usage and aggregate declines in measures of religiosity. Alternatively, given the lack of insight on such a relationship, social media may be a complement to religious activity by allowing individuals to sustain religious dialogue outside of church.

Following the surface level investigation of descriptive statistics are two approaches to exploring a possible correlation. First, there is the goods approach in which social religious behaviors and online social behaviors are substitute goods for or complement goods to one another. The core of this approach is basic microeconomic utility theory, which states individuals act to maximize their utility functions. In this case, the structure of the religious utility function, would determine whether religious

behaviors and online behaviors act as substitutes or complements. Second, there is the assortative matching process and peer effects approach. These two similarly related theories would predict a dynamic process of agents sorting into groups which best match their initial preferences, preferences which are then augmented by peer effects. The structure and preferences of both individuals and groups, in this context, would be crucial to a sorting process which led to the observed decline in religiosity.

To further understand the emergent trends in the United States, this study analyzes the potential relationship between social media usage and religious service attendance using the substitutes and complements approach developed in prior literature. Instrumental variable methodology attempts to control for the presence of sociability endogeneity in the binary outcome model of church attendance. Primary data is constructed using the 2012 New Family Structure Survey, a cross-sectional dataset derived from a 2011 online survey of approximately 2,000 individuals. Results, absent of the instrumental variable methodology using Ordinary Least Squares estimation, show a significant positive relationship between social media usage and religious service attendance. Once sociability is instrumented for, estimations indicate a significant negative relationship between social media usage and religious service attendance. Based on these results, this study supports the hypothesis that socialization utility and potentially spiritual utility derived from online social networking and socialization or spiritual utility derived from religious service attendance are substitutable.

The structure of the paper is as follows: Section 2 provides background literature relating to the research question and the construction of a theoretical utility framework,

Section 3 contains a review of the data and the defining of the econometric model, Section 4 contains main results, Section 5 discusses the results and implications, Section 6 contains references, and Section 7 contains all tables and figures.

2. Literature Review and Theoretical Model

2.1. Literature Review

Considering the recent development in analyzing religion through an economic lens and the even more recent development of social networking technologies, a summary of past research is crucial to understanding gaps in the current literature. The economics of religion as a field is young; however, there is ample research and theory to provide a substantial base upon which an econometric investigation can be justified.

The theoretical justification for analyzing complementarity or substitutability between religion and social media relies on the specification of an individual's utility function. Azzi and Ehrenberg (1975) first specified the religious utility function including the heterogeneity in utility provided by religious activities. The specification includes both an afterlife consumption motive and a present life consumption motive, acknowledging two significant reasons a particular individual might participate in religious activities. Inclusion of the present life consumption motive in a religious adherent's utility function allows for church activities to include general socialization with other congregation members at non-service religious activities.

While not concerned with social media substitution, the authors were concerned with how individuals chose levels of church participation which maximized their utility

functions. Using the 1954 General Social Survey containing survey responses from 1,504 U.S adults, the authors regress church attendance as a continuous variable onto controls using OLS estimation (Azzi & Ehrenberg, 1975). The results indicated that observable characteristics, including gender and belief in the afterlife, are factors influencing church attendance and cemented the study of religion through the economic lens as legitimate (Azzi & Ehrenberg, 1975).

While economic theory assumes utility functions are heterogeneous among individuals, Iannaccone (1998) concludes that observable characteristics perform relatively well in defining a portion of the function. Similar to Azzi and Ehrenberg (1975) and in an attempt to build on previous work, Iannaccone (1998) characterizes the observed utility function for an individual in a continuous variable model utilizing two metrics: yearly attendance rate and yearly contributions. These estimations ultimately serve to prove that observable characteristics can, to a degree, predict observed religious behavior in an econometric setting with updated General Social Survey data and more observations. More advanced estimations, namely Tobit regressions, were also estimated to accommodate a high number of unaffiliated individuals in the dataset. Iannaccone (1998) followed procedures similar to Azzi & Ehrenberg (1975); however, the author included further observable demographic controls, including race and education. Significant coefficients relating religiosity to being female, being black, being married, and growing older have become staple interpretations in the economics of religion.

Including Iannaccone (1998), other economic analyses have made efforts to define observable components which describe an individual's religiosity. Meyers (1996)

included parental characteristics in his inspection of a national 1980 sample of married individuals, finding parental religiosity significant in characterizing a given individual's religiosity. Iannaccone and Makowsky (2007) utilizes a multi-agent religion simulation, essentially, a computer simulated model explores peer effects through randomly resorting a portion of individuals and determining whether or not they take on regional characteristics. Main results determined that individuals tend to adopt regional religious identities in order to maximize the social component of their utility functions. Taken concurrently, early studies in the economics of religion indicate that observable characteristics in terms of demographics and environmental factors are crucial to identifying equations with a religious component.

Since Iannaccone (1998), researchers studying the economics of religion have become more nuanced in their definitions of religiosity, as observed religiosity is increasingly difficult to characterize quantitatively. Storm (2009) rejects that religion can be described one dimensionally, instead opting for a multidimensional framework. This work aids in properly contextualizing the complexity of religious behavior along various dimensions, opposing the classical view of religion as one dimensional, as was adopted in earlier studies including Iannaccone (1998) and Azzi and Ehrenberg (1975). While neither Iannaccone (1998) or Azzi and Ehrenberg (1975) explicitly recognized the multidimensional framework, Iannaccone (1998) either intuitively or fortuitously specified a model which satisfies the multidimensional framework by including what modern researchers would label proxies for belief, affiliation, and practice. These proxies

are namely controls for religious denomination, as most researchers assume homogeneous belief among denominations.

Relaxing the assumption of one dimensional religiosity introduces mathematical difficulty into estimation procedures. Multinomial dependent variable models allow for such specifications; however, there is the worry of irrelevant categories which cannot be specified in a logical nesting structure. As illustrated in Storm (2009), it may be effective to utilize an approach such as k-density cluster analysis in constructing religiosity scales to avoid violating the independence of irrelevant alternatives assumption present in multinomial models. Storm (2009) uses this semiparametric approach by allowing religiosity data from the Religious and Moral Pluralism Survey to vary in multiple dimensions, and ultimately uses significant clusters to generate relevant categories. The significant drawback in this approach is that it still relies on researcher specification, as weights in the religiosity formula must be specified. The results, that population level differences affect distributions among relevant categories, underscore the necessity of accounting for the multidimensional nature of religious behavior.

While Storm (2009) accounts for the complexity of religious behavior, the most recent batch of research acknowledges the multidimensional framework in denominational controls. These controls are similar to those utilized in Iannaccone (1998), and assume, although arguably it is too great of an assumption, that individuals of the same denomination are relatively similar in unobserved religious dimensions. Miller et al. (2013) utilizes a diverse group of denominational controls, including indicator variables for whether or not a person is Catholic, Mainline Protestant, Evangelical

Protestant, Black Protestant, Mormon, Jewish, other religion, and even agnostic. In their aim to uncover the social implications of religious belief, both Storm (2009) and Miller et al. (2013) are forced to reconcile the modern conception of religion as a multidimensional framework.

Given that the rise of social media is a relatively recent trend, investigations of the link between religious behavior and social media use are in their infancy. Miller et al. (2013) sought to determine the effects of religiosity on social media habits using National Study of Youth and Religion data and a series of logistic regressions. The authors chose two specifications for their dependent variable, one as a binary variable for whether or not a person is a member of a social networking site and the other as a scale from 1 to 6 for social networking site use frequency. Control variables of interest were the those capturing religiosity, and results found a positive correlation between frequent Bible reading and social networking site membership. Other religious behaviors, including finding faith important, attending religious services, and frequency of prayer outside of religious services were found to be insignificant (Miller et al., 2013). When the dependent variable was specified in six categories and estimated using an ordered logistic regression, the only significant religious characteristic was frequency of Bible reading, which again was estimated to be positive.

McClure (2016) considered the opposite direction of the potential relationship, attempting to discover the effects of social media usage and religious pluralism also using National Study of Youth and Religion data. The author specified his dependent variable as an ordered category of three possibilities, including being religiously exclusivist, being

religiously pluralistic, and being secular. The independent variable of interest aimed at capturing online behaviors was specified in two forms, first as a binary variable accounting for membership and second as categorical variable ranging from use several times a day to never using social media. Results from multinomial non-ordered logistic regressions indicate that social media membership increases the likelihood that an individual is religiously pluralistic as opposed to being exclusivist or secular; however, no evidence was found supporting the theory that time spent on social media sites significantly impacted beliefs.

While neither Miller et al. (2013) or McClure (2016) aimed at illuminating causal relationships between social media usage and religiosity, there is reason to believe endogenous effects could have biased their estimates. Both studies are prone to bias through the vehicle of social tendencies. In the context of Miller et al. (2013), social individuals might be more inclined to read the Bible in order to discuss it with others. This would generate estimates that are larger than they should be. In McClure (2016), social tendencies in the error term could bias estimates on church attendance or membership upwards, as a social individual might be more likely to be religiously pluralistic and generally welcoming.

On the contrary, endogenous effects might work in the opposite direction in both works. Understatement of the true effect of Bible reading on whether or not an individual belongs to a social networking site in Miller et al (2013) could stem from the fact that antisocial individuals might read more frequently, concurrently making them more likely to read the Bible and less likely to be a social networking site member. In McClure

(2016), downward biasing could come from social people being confident in their belief system, making them simultaneously more likely to be a social media user and less likely to be pluralistic. So long as social tendency remains unobservable, any empirical analysis of religiosity and social media usage is prone to biased estimates.

In order to conduct the proposed investigation, this study will rely on a modified religious utility function as first specified by Azzi and Ehrenberg (1975) and include controls utilized in Iannaccone (1998). In order to build upon these past works, further attention will be paid to the potential endogeneity issue which may underlie estimates in modern works including Miller et al (2013) and McClure (2016). Where this study will diverge from previous literature is in the usage of instrumental variables techniques in an effort to purge estimates of endogenous sociability effects.

2.2. Theoretical Utility Model

A standard microeconomic utility model explicitly defining an individual's religious utility function is helpful in understanding avenues for interaction between social media usage and religious service attendance. The following two equations denote an individual's religious utility function, U_R :

$$S = f(D_1, D_2, \dots, D_T, U) \quad (1)$$

$$U_R = f[E(S), Z_1, Z_2, \dots, Z_T, P_1, P_2, \dots, P_T, C_1, C_2, \dots, C_T] \quad (2)$$

where S represents the level of salvation an individual receives after death, D_t represents the level of devotion to their religion shown in period t , U represents the amount of uncertainty regarding ultimate salvation an individual has, $E(S)$ represents the salvation an individual expects to receive, Z_t represents the amount of time spent on socialization at religiously related activities, P_t represents the amount of time spent on spiritual activities such as attending religious services or reading the Bible in private, and C_t represents the total time spent on religious activities. Subscript T denotes number of periods which an individual engages in decision making regarding religious behaviors. Equation (1) is a function of internal, or cognitive, association with religion and Equation (2) is the individual's overall religious utility function with internal and external factors included.

Prior to an examination of the theoretical framework, this study proposes several sign restrictions and assumptions. Firstly, Z and P are assumed to enter the utility function as strictly positive real values, while C is assumed to enter the religious utility function as strictly negative real values. Secondly, it is assumed that the marginal benefit of socializing at religious services is greater than the marginal benefit of socializing online under the presumption that face-to-face interaction is preferable for the average person. Thirdly, it is assumed that the marginal benefit of consuming spiritual material is greater at religious services than through social media. Lastly, it is assumed that the time cost of attending religious services, for the purpose of socializing or consuming spiritual material, is greater than the time cost of participating in the same utility generating activities online.

Given the specification of the religious utility model, complementarities or substitutability would enter through the overall religious utility function. External utility generating factors, namely the ability to socialize and consume spiritual material, are provided in both religious services and online. In terms of socialization, individuals socialize with neighbors, the religious leader, and others at religious services.² Social media, as the name suggests, provides an electronic platform for individuals to socialize with one another. The social facet of religion and the intended use of social media allow the two to interact with, and potentially compete with or complement, one another.

The inclusion of spiritual consumption in the religious utility function specification allows for more complex interactions between social media usage and religious service attendance. Spiritual consumption may take many forms, most of which are performed within a religious service setting; however, some activities may be performed online. Listening to sermons, reading religious texts, accessing religious education materials, and even interacting with others of the same religion are all examples of spiritual consumption which are accessible through social media. This spiritual consumption aspect, although typically not considered to be a prominent feature of social media sites, could also allow for substitution and complementarity with religious service attendance.

Working through the theoretical model, substitution between religious service attendance and social media usage is the most likely outcome when individuals attempt to minimize C . Minimizing C in the religious utility function leads to, inherently,

² According to data recorded by the 2014 PEW Religious Landscape Survey, 91% of respondents report believing churches function to bring people together, highlighting the social role religion plays.

individuals choosing the religious or social activity of lowest C . Given the assumptions of the model, these individuals choose to use Facebook or other social media sites.

Individuals, from this choice, consume some spiritual and social benefits; however, they are less than if that individual had decided to partake in the high time cost activity of attending church. Figure 1 depicts such possible substitution effects as individuals begin at point 1.

Conversely, the theoretical model, and the use of social media, could generate complementary effects. Spiritual and socialization benefit maximizers in particular are the most likely individuals to generate these complementarities as they produce a positive feedback loop. When these individuals are faced with the decision of how to maximize their religious utility functions, they will choose to attend religious services in person. Such a decision produces the desired maximized socialization and spiritual benefits; however, these individuals face high time costs in their decision. With little time available, and potentially spiritually inspired by their religious service experience, churchgoers are forced to seek low time cost activities to supplement their socialization and spiritualization maximizing routine. These circumstances allow for the use of social media for religious purposes, an activity which all provides low socialization and spiritual benefits at little to no time cost. Again, either inspired or heavily invested in spiritual or social capital, these individuals seek socialization and spiritual benefit maximization through church related activities, which include service attendance once time becomes available. Figure 2 depicts the theory of complementarity beginning at point 1.

3. Data and Empirical Model

3.1. Data.

The dataset utilized in this study is the 2012 New Family Structure Survey (NFSS), a cross-sectional dataset resulting from an online survey conducted from 2011 to 2012 yielding 1,996 usable observations. The dependent variable, a binary variable for whether or not an individual attended religious services in the last year, is generated from an attendance question stated, “How often, if ever, do you normally attend religious services (not counting weddings, baptisms, and funerals)?” Categories from “Never” at the least to “More than once a week” at the most are collapsed into the binary dependent variable, with those responding “Never” being the only individuals coded as having not attended religious services. Table 1 contains descriptive statistics for all variables, showing 69.98% of the sample attends religious services once or more than once a year.

There are two primary concerns to using this dataset given the collection techniques and intended respondents highlighted in Table 2. First, the response group is stated to be only individuals between ages 18 and 39, resulting in an average sample age of 28.35. Compared to data from the PEW Religious Landscape Survey, a generally accepted random population sample, the average NFSS respondent is 22.77 years younger. Unfortunately, as the study of social media and its effects is relatively new, datasets containing questions relevant in interdisciplinary studies are uncommon. Datasets that do target this type of information are typically aimed at garnering responses from the younger demographics, resulting in young mean ages reported for such surveys. Second, regarding religious affiliation, NFSS respondents self-report being religiously

unaffiliated more often. Additionally, NFSS respondents self-report belonging to religious organizations other than Catholicism or Protestantism with greater frequency. That more respondents report being religiously unaffiliated can be reconciled with the low average age of the sample, as younger Americans are typically less religiously affiliated than older generations. That more respondents report belonging to “Other Religions” is again a common issue with self-reported surveys of religion, as many researcher-classified Protestants do not classify themselves as Protestant. In the NFSS sample, this is apparent given the large difference in Protestant responses, the assumed majority of which responded with “Other Religion” when stating their affiliation.

Independent variables derived from the dataset include age, race, gender, education, income, religious affiliation, region of residence, marital status, whether or not the respondent resides in a metropolitan statistical area, whether or not the respondent has children, the age of the respondent’s mother, whether or not the individual uses Facebook, and whether or not the respondent has access to internet at home. The variable of interest is whether or not an individual uses Facebook and is constructed from a categorical variable collapsed into a binary variable. The original survey question asks respondents the number of Facebook friends they have, with one option being, “I am not on Facebook.” Only respondents who selected this response are coded as not using social media.

In terms of being a good proxy for all social media use, Facebook usage alone can be justified as sufficient given the historical context of the survey. As of 2012, the PEW Research Center finds that Facebook was typically used at twice the rate any other single

social media platform is used (Pew Research Center, 2016), and that 54% of all US adults used Facebook. This is compared to the next most popular platform at the same time, LinkedIn, which 16% of all US adults used. Although one year prior to this survey, and given the upwards trajectory other platforms are experiencing in terms of capturing an audience as large as Facebook, it is likely that in 2011 either an equal or greater share of American adults used Facebook, making it relatively representative of all social media usage at the time.

In addition to the dependent variable and independent variable of interest, two other independent variables are broken down into series of binary variables as well. Education and income in particular are represented as dummy variable series. Education and income were obtained by asking respondents to categorize their educational attainment and income level, resulting in education being comprised of four categories and income being comprised of five categories. In order to avoid parametrically defining any latent functional form, these categories are given their own binary indicator variables to form an indicator variable series, with the reference group being the largest bin in the series. Although this decision results in lower degrees of freedom, the large sample size mitigates this concern.

It is worth noting that, as indicated in Table 1, 85.82% of respondents report being social media users which, although seemingly large, coincides with the 2011 issue of the survey and the low mean age of the sample. Similarly, 91.83% of respondents report having access to home internet, a survey result which is undoubtedly larger than the internet access of the general population; however, given the survey was administered

online, it is expected that a significant proportion of the sample answered the questionnaire using home internet.

Further considerations when theorizing about external validity are found in the descriptive statistics of the control variables. First, the mode of income is lower than expected with the largest bin being the \$20,000 to \$40,000 range. Additionally, 85% of respondents live within a metropolitan statistical area, 73% are female, and only 17% of respondents reside in the northeast. The sample also appears to be more racially and ethnically diverse than the American population, with 63% of respondents reporting as white, 13% as black, and 15% as Hispanic. The low mean sample age may explain some of these statistics, as early adulthood incomes tend to be low and younger generations are more diverse. However, rural individuals, the northeast, and males are undoubtedly underrepresented and must be considered a peculiarity of the sample itself. While a non-representative sample is not preferred, the limited number of surveys which ask questions related to both religion and social media are make it difficult to construct a representative sample with undisputed external population validity.

3.2. Empirical Model

This study utilizes a linear probability model in modeling annual church attendance as a binary variable. Linear probability models are estimated via Ordinary Least Squares, and although they do not force predicted values to lie between zero and one, interpretations of coefficients and implementation of more advanced econometric techniques is simplified.

Inclusion of standard controls in a linear probability model may still be insufficient in identifying the true impact of social media on church attendance due to endogenous effects. As previously noted, an individual's general sociability may bias estimates in an unpredictable manner and thus interpretations of outcomes are inappropriate. One method which attempts to correct for endogenous effects is the instrumental variable approach, which takes the following form:

$$Facebook_i = \theta' X_i + \gamma Internet_i + \mu_i \quad (3)$$

$$Attendance_i = \beta' X_i + \alpha Facebook_i + \varepsilon_i \quad (4)$$

where $Facebook_i$ is the binary variable of interest for whether or not an individual has a Facebook account, $Internet_i$ is a binary variable for whether or not an individual has access to the internet at home, $Attendance_i$ is a binary variable for whether or not an individual attends church in a year, X_i is a vector of controls including a constant, an individual's religious affiliation (Catholic, unaffiliated, or other with Protestant as the reference group), income (less than \$20K, 20K to 40K, 60K to 85K, or greater than 85K with 40K to 60K as the reference group), education (less than high school, high school, or college/greater with some college as the reference group), race (black, Hispanic, or other with white as the reference group), gender, region of residence (northeast, south, or west with Midwest as the reference group), whether or not an individual lives in a metropolitan statistical area, whether or not an individual is married, whether or not an individual has children, age in years, and the age of an individual's mother in years. θ'

and β' are vectors of coefficients, γ and α are coefficients, and μ_i and \mathcal{E}_i are stochastic error terms. Equation (3) represents the 1st stage equation, and Equation (4) represents the 2nd stage equation.

The instrumental variable approach hinges on finding a valid instrument, in this case proposed as Internet, which satisfies the two assumptions of instrumental variable regression. First, the instrument must be correlated with the endogenous variable, Facebook. Second, the instrument must be uncorrelated with the error term in the 2nd stage, ε . In order to implement the instrumental variable approach, predicted values for Facebook from the 1st stage are generated and used in the 2nd stage rather than the raw Facebook data. This process purges any correlation, conditional on the selected instrument being valid, between Facebook and unobservable effects in ε which may affect Attendance.

The unobservable characteristic of concern in the structural equation error term is a person's general sociability; or, in other words, how likely a person is to engage in social behavior. The endogenous variable in this case is whether or not a person owns a Facebook account, the use of which, given it is a form of social media, is clearly positively correlated with a person's general sociability. The chosen instrument, whether or not a person has home internet access, is expected to be uncorrelated with sociability given that home internet serves many purposes unrelated to socialization, from conducting business to consuming news. As for its correlation with whether or not a person owns a Facebook account, we should expect that if an individual has access to home internet, the marginal cost of activating a Facebook account is lower, making

individuals with home internet access more likely to take on the costs associated with owning Facebook account. It is worth noting that while the instrument's correlation with the endogenous variable may be tested for, overidentification tests which determine the instrument's correlation with the error term may not be implemented when the number of endogenous variables equals the number of instruments as in this case.

One potential argument against instrument validity is that individuals who are more social are more likely to purchase internet for the purpose of social networking. Such a relationship would violate the second assumption of instrumentation, that the instrument, whether or not an individual purchases home internet, is uncorrelated with the error term, an individual's sociability. However, the historical context of the internet and social media disagrees with the basis of this argument. When the questionnaire was distributed in 2011, Pew reports that 58% of adults ages 25 to 34, well within the sample range, owned a smartphone (Pew Research Center, 2011). Four years earlier, Facebook launched m.facebook.com, the mobile-friendly version of the social media platform, and one year earlier, Facebook launched the Facebook App, which operated on effectively every smartphone operating system (Mashable, 2013). Essentially, by the year the questionnaire was distributed online in 2011, 58% of young adults did not need home internet access in order to use Facebook. Thus, it is highly likely that 58% of the 91% of sample individuals who purchased home internet did not need to do so if their sole intention was socializing, as they had access via their smartphones instead. These statistics support the theory that there are many uses for the internet outside of socializing behaviors such as engaging in social media.

4. Results

4.1. Control Variable Results

Results from univariate regression of the bivariate measure of annual church attendance on whether or not an individual uses Facebook and the multivariate estimation are presented in Table 2. Initial correlations between bivariate annual church attendance and bivariate Facebook usage are positive and find no evidence of a statistical relationship. The inclusion of controls in the multivariate linear probability model greatly increases model performance, as evident in the increased R-squared and significant F-statistic. Additionally, the estimated coefficient on whether or not an individual uses Facebook becomes statistically significant at the 0.01 level, indicating that factors which explain whether or not an individual uses Facebook are also correlated with yearly church attendance. Controlling for other factors, using Facebook is estimated to increase the likelihood of yearly church attendance for an individual by 7.83 percentage points. These results appear to provide evidence for complementary effects between social media usage and religious service attendance; however, interpretation of these estimates must be cautious. The estimates produced by simply employing OLS did not instrument for the unpredictable effects of sociability endogeneity, and thus are unreliable in terms of indicating the true nature of the relationship.

Other included control variables in the multivariate regression produced results consistent with previous literature. The series of religion indicator variables produced anticipated estimates, with all religious affiliations less likely to attend annual church services when compared to the base group, Protestants. Catholics were estimated to be

5.12 percentage points less likely to attend compared to Protestants and unaffiliated individuals were estimated to be 60.83 percentage points less likely to attend church compared to Protestants at the 0.05 and 0.01 levels of significance respectively. Those belonging to other religions, which may include those researchers consider Protestants, were estimated to be 10.59 percentage points less likely to attend annual church services. This result provides potential insight into this group, indicating that they could, in fact, belong to non-Protestant denominations and religions.

Results for income and education paralleled one another, with individuals earning below \$20,000 estimated to be 6.35 percentage points less likely to attend church than those earning \$40,000 to \$60,000. Those earning slightly higher incomes and in the \$20,000 to \$40,000 range were estimated to be 4.57 percentage points less likely to attend church in a year. Individuals with less education, specifically less than a high school diploma or GED, were estimated to be 7.82 percentage points less likely to attend church than those with some college education. Coefficients on other levels of income and education were all insignificant when compared to the base group.

Demographics, such as being black, being married, and having children, were all estimated to be significantly positive. Being black was estimated, compared to whites, to increase the probability of annual church attendance by 11.37 percentage points at the 0.01 level of significance. Being married was estimated to increase the probability of annual church attendance by 5.58 percentage points and having children was estimated to increase the probability of church attendance by 41.67 percentage points. Controls for age and the attempted proxy for parental religiosity using the age of the mother were both

insignificant; however, this result can be expected given the limited age of the sample and small standard deviations for each variable.

In the 2nd stage of the instrumental variables approach estimations presented in Table 5, the control variables behaved relatively similarly. The effects for religious affiliation were stable in both sign, magnitude, and significance with Catholic differing by one percentage point, unaffiliated by less than a percentage point, and other religion by less than a percentage point. Estimated coefficients on individuals earning an income less than \$20,000, being black, and living in the northeast were all similarly stable. Differences between these two sets of estimations include the coefficient on individuals earning incomes between \$20,000 and \$40,000 and being married becoming insignificant, while the estimated coefficient on having children drastically fell by approximately 35 percentage points. The estimate of the constant between the two estimates more than doubled, from 0.6572 in the multivariate OLS estimate to 1.3878 in the instrumental variables approach.

4.2. Instrument Results

The results for the 1st stage of the instrumental variables approach are presented in Table 4. As previously discussed, the validity of the instrument relies on the satisfaction of two assumptions. Firstly, the instrument must be correlated with the endogenous variable in the 1st stage. Secondly, the instrument must be uncorrelated with the error term in the 2nd stage. In order to test that both these assumptions are correct, the F-test of excluded instruments in the 1st stage equation and an overidentification test in the 2nd

stage equation may be performed where the former tests instrument strength and the latter tests instrument validity.

In this case, only the strength of the instrument may be empirically tested for given that the number of instruments equals the number of endogenous variables. The F-test of excluded instruments, explicitly testing the explanatory power provided by the instruments, yields an F-statistic of 18.55. Staiger and Stock (1997) states an F-statistic greater than 10 indicates that the null hypothesis of a weak instrument is rejected in favor of the alternative, that the instrument is not weak. In the regression itself, whether or not an individual has home internet is statistically significantly correlated with whether or not an individual has Facebook at the 1% level, providing further support for satisfaction of one of two major instrumentation assumptions.

Unfortunately, as only one theoretically justified instrument is utilized in estimation, the second assumption cannot be empirically tested for. The Hansen-Sargan overidentification tests and others rely on the model being overidentified, which this model is not. As far as the performance of the instrument, the only testable hypothesis which can be empirically tested is that the selected instrument, whether or not an individual has access to home internet, is not a weak instrument for sociability endogeneity.

4.3. Main Results

Estimates for the 2nd stage produced using the instrumental variables method are provided in Table 5. The usage of Facebook is estimated to decrease the likelihood of

annual church attendance by 44.68 percentage points controlling for other included factors. This marks a drastic change from the previous results which do not instrument for sociability endogeneity; however, the change in the direction of the relationship is theoretically justified through the presence of substitution or competition for activities which produce religious utility through socialization or spiritualization.

While coefficient estimates of the variable of interest in the primary model are statistically significant at the 0.1 level, of some concern is the magnitude of the estimate; however, this can be explained in other aspects of the model, particularly in the large constant estimated in the 2nd stage, 1.3878. Essentially, the estimated model is predicting that each individual attends church annually before accounting for individual age, gender, race, religious affiliation, and other factors. Once these factors are included, predicted values for yearly church attendance are within reason, with the minimum predicted value being -0.0414 and the largest being 1.435.³

Critics of the linear probability model rightly highlight that these estimates violate the laws of probability, in which predicted values must lie between zero and one. While these critiques can be alleviated through the use of nonlinear models such as logit or Probit binary dependent variable models, advanced econometric techniques, including the instrumental variable approach, are much more easily interpreted in linear probability model settings. Additionally, given the bivariate nature of the endogenous variable, estimation of a linear probability model by ordinary least squares in the 1st stage avoids issues created by misspecification through the use of Probit or logit estimation. Given the

³ Of the 1,996 predicted values, 225 observations were assigned values greater than one (11.27% of all predicted values) and 2 observations were assigned values less than zero (0.01% of all predicted values).

options, estimation of a linear probability model by ordinary least squares is more parsimonious.

In order to allay potential concern over the magnitude and direction of the variable of interest in the primary model, a robustness check is performed using a nonlinear estimator. As a robustness check, this technique serves to provide verification of the magnitude and direction of the estimated coefficient of the variable of interest in the primary model, and serve as a nonlinear estimate of the impact of social media usage on religious service attendance. Additionally, this technique restricts predicted values to obey the laws of probability and lie between zero and one.

The robustness check technique utilizes joint maximum likelihood estimation, a structural process which produces estimates using Conditional Maximum Likelihood Estimation (CMLE). In terms of notation, the structure of CMLE is the same as instrumental variable estimation in that a 1st and 2nd stage equation are identified. The difference follows in estimation, where rather than using a two-step estimator, both equations are simultaneously estimated by maximum likelihood. While this process does provide nonlinear estimation, it assumes multivariate normality and homoskedasticity of the errors in both the 1st and 2nd stage equations, that is:

$$\text{Variance Covariance Matrix} = \begin{bmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & 1 \end{bmatrix} \quad (5)$$

where σ^2 is the variance of the bivariate normal distribution, σ represents the variance for 1st stage and 2nd stage errors, and ρ represents the correlation between 1st and 2nd stage

errors. This estimation technique notably allows for explicit inspection of endogeneity through the estimate of ρ , as endogeneity can be defined as the correlation between error terms. It is worth noting that, although homoskedasticity is assumed to be true of both errors, the robust version of this estimation technique requires only the implementation of standard White-corrected heteroskedasticity robust standard errors in the 2nd stage equation.

As previously stated, this estimation procedure allows for the estimation and inspection of nonlinear effects of social media usage on religious service attendance, results of which are contained in Table 6.

Examination of the coefficient produced by CMLE, which by the nonlinear nature of Probit estimation cannot be interpreted, requires the examination of marginal effects at mean values or representative values. At mean values of the other control variables, CMLE estimates that individuals are 43.32 percentage points less likely to attend religious services in a year if they use Facebook. This robustness check indicates stability in the sign, magnitude, and statistical significance of the estimated coefficient in a nonlinear environment and corroborates the original estimations produced by linear instrumental variable estimation. Regarding the test for endogeneity, the estimate of ρ produced by CMLE finds evidence of endogeneity between the 1st and 2nd stage equations.

5. Conclusion

In an effort to identify a potential emerging relationship between Facebook usage and annual religious service attendance, an empirical model of religiosity was constructed from an underlying religious utility function. Where previous literature did not account for the potential sociability endogeneity which exists in models of religious practice with independent variables related to socialization, this study attempted to instrument for such effects. To satisfy the orthogonality conditions of instrumental variable regression, whether or not an individual has access to home internet was selected as the instrument.

Estimates were produced by the empirical model using 2012 New Family Structure Survey data comprised of 1,996 observations. Specifications in univariate and multivariate models, absent of instrumentation for endogenous sociability effects, indicate either no evidence of effect or support complementary effects between Facebook usage and church attendance. Once sociability endogeneity is instrumented for, results show statistically significant evidence of substitution between Facebook usage and annual religious service attendance at the 0.1 level. Specifically, individuals were estimated to be 44.68 percentage points less likely to attend church in a year if they used Facebook. These results ran counter to the univariate and multivariate linear probability model estimates which did not instrument for sociability endogeneity, indicating that endogeneity bias is present in models which include variables related to socialization on the left and right-hand sides. Further, an F-test of excluded instruments rejected the null hypothesis of a weak instrument, providing evidence in favor of instrumentation which is not weak.

While the estimated effects of social media usage on religious service attendance are admittedly large, a nonlinear robustness check using Conditional Maximum Likelihood Estimation confirmed both the magnitude and directionality of the relationship. The Conditional Maximum Likelihood Estimate on social media usage proved to be statistically significant at the 0.01 level, with marginal effects examined at mean values predicting that individuals who use social media are 43.32 percentage points less likely to attend church in a year. Estimates of the correlation between 1st and 2nd stage errors, by definition a measure of endogeneity, found evidence of endogeneity in the original model and further justify the instrumental variable approach.

With preliminary steps taken in this study to explicitly define and empirically investigate religiosity and the potential effects of social media, further research is crucial to gaining deeper understanding. The avenue through which such studies could be conducted will need to follow three steps in order to accomplish such empirical investigations. First, more thorough data which captures demographic controls, the multiple dimensions of religiosity, social media usage, and which better reflects the population needs to be collected. Although the survey utilized for this study was somewhat sufficient in capturing these characteristics for individuals, both larger sample sizes and more detailed questionnaires will undoubtedly increase the robustness of empirical work in which it is utilized. In addition to the quality of the data collected, panel data collected over a time period could improve estimates and allow for insight into the time dynamics of social media use and religious behavior. Second, future studies need to continue to recognize the potential for endogenous effects to bias estimates in an

unpredictable manner. As religion is a multifaceted, multidimensional behavior and activity, studies need to acknowledge and theoretically or empirically account for these complexities. Last, future work should continue to investigate the current trends in modern American religiosity as it relates to other trends in society. While social media has gained much attention for how it is reshaping social interactions globally, it is unlikely that social media is solely responsible for the decline in religiosity.

In terms of practicality, the results produced by this study could potentially be of use by religious leaders seeking to attenuate membership or attendance declines. In 2014, the PEW Religious Landscape Survey found that 91% of respondents believe religious organizations serve a social purpose. In the context of this finding, the results of this study are logical; individuals believe that religious organizations serve a social function, a function which overlaps and theoretically competes with the purely social connectivity aims of social media sites. If religious leaders can produce a social good through activities designed purely to provide socialization for its members, then churches may compete more effectively with the social reach of Facebook, Instagram, and Twitter. Such activities must be necessarily mindful of where individuals gain utility, namely through spiritual activities, social activities, and minimizing time cost, in order to be successful.

In terms of the broader picture of religion in the United States, and potentially globally, this study paints a bleak picture for the survival of religious organizations in the short term. As social media use has reached its mathematical and theoretical peak among certain demographics, the substitution effects highlighted in this study are likely already

in full effect. If religious organizations are unable to accommodate the preference shift among Americans to interact online at their own discretion, membership and attendance may continue to decline. However, if religious organizations and their leaders can mitigate membership loss, encourage and provide meaningful offline interactions among its members, and potentially utilize social media channels for recruitment to offline religious activities, religious organizations stand a chance of weathering the current downturn in religiosity.

6. References

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7. Appendix

Figure 1: Substitution theory beginning at Point 1.

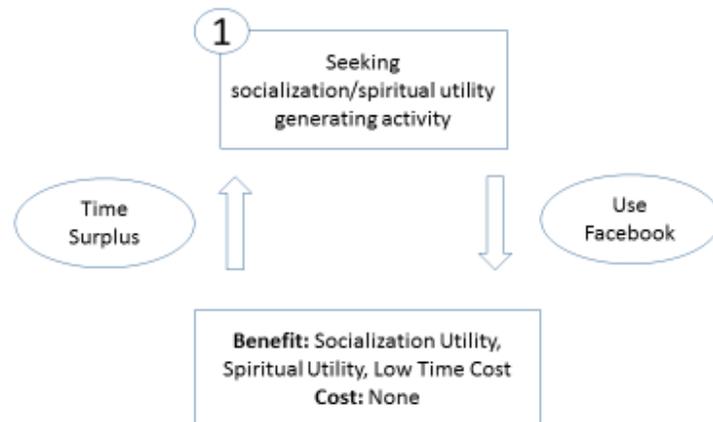


Figure 2: Complementarity theory beginning at Point 1.

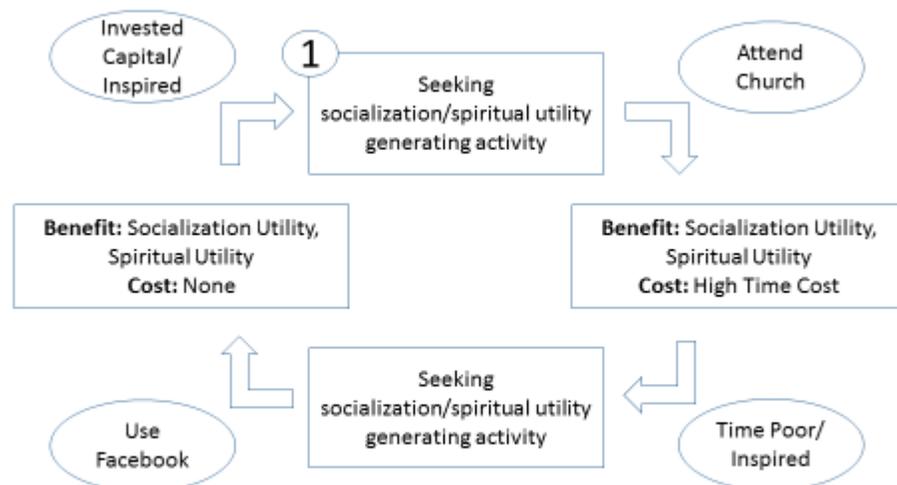


Table 1: Descriptive statistics for all variables.

Variable	Mean	Standard Deviation	Minimum	Maximum
Facebook	0.8582	0.3489	0	1
Internet	0.9183	0.2739	0	1
Attendance	0.6998	0.4584	0	1
Catholic	0.1808	0.385	0	1
Unaffiliated	0.261	0.4393	0	1
Other Religion	0.2074	0.4055	0	1
Protestant ^a	0.3507	0.4773	0	1
Income <\$20,000	0.2319	0.4221	0	1
Income \$20,000-40,000	0.253	0.4348	0	1
Income \$40,000-60,000 ^a	0.1828	0.3866	0	1
Income \$60,000-85,000	0.1584	0.3618	0	1
Income >\$85,000	0.1773	0.3821	0	1
Less than High School	0.0621	0.2414	0	1
High School	0.1813	0.3854	0	1
Some College ^a	0.4003	0.4901	0	1
College or greater	0.3562	0.4789	0	1
Black	0.1327	0.3394	0	1
Hispanic	0.1533	0.3603	0	1
Other Race	0.0786	0.2692	0	1
White ^a	0.6352	0.4814	0	1
Female	0.7304	0.4438	0	1
Northeast	0.1492	0.3564	0	1
South	0.3507	0.4773	0	1
West	0.2394	0.4268	0	1
Midwest ^a	0.2605	0.439	0	1
MSA	0.8562	0.3509	0	1
Married	0.4148	0.4928	0	1
Children	0.5155	0.4998	0	1
Age	28.3537	6.2985	18	39
Mother Age	53.8757	8.5018	32	120

^a Denotes the reference group for the indicator variable series.

Table 2: New Family Structure Survey descriptive statistics and Pew Religious Landscape Survey descriptive statistics.

Variable	2014 Pew RLSS	2012 NFSS
Catholic	20.53%	18.08%
Protestant	47.3%*	35.07%
Unaffiliated	21.54%	26.1%

Other Religions	9.71%	20.74%
Mean Age	51.12	28.35

* From the 2007 Pew Religious Landscape Survey

Table 3: Results from univariate and multivariate regressions estimated by OLS.¹

Variable	Univariate OLS (Dependent Variable= Attendance)	Multivariate OLS (Dependent Variable= Attendance)
Facebook	0.0497 (0.0302)	0.0783*** (0.0247)
Internet		
Catholic ^a		-0.0512** (0.0231)
Unaffiliated ^a		-0.6083*** (0.0234)
Other Religion ^a		-0.1059*** (0.0016)
Income <\$20,000 ^b		-0.0635** (0.0286)
Income \$20,000- 40,000 ^b		-0.0457* (0.0265)
Income \$60,000- 85,000 ^b		-0.0457 (0.0286)
Income >\$85,000 ^b		-0.03 (0.0274)
Less than High School ^c		-0.0782* (0.0404)
High School ^c		-0.0268 (0.0251)
College or greater ^c		0.0125 (0.0207)
Black ^d		0.1173*** (0.0265)
Hispanic ^d		0.0316 (0.0262)
Other Race ^d		0.0251 (0.0318)
Female		0.0195 (0.0195)

Northeast ^e		-0.0686** (0.0295)
South ^e		-0.0065 (0.0243)
West ^e		-0.0379 (0.0243)
MSA		-0.0152 (0.0245)
Married		0.0558*** (0.0208)
Children		0.4167** (0.0201)
Age		0.0007 (0.0021)
Mother Age in 2012		-0.0011 (0.0016)
Constant	0.6572*** (0.0282)	0.8623*** (0.0769)
R-Sqaure	0.0014	0.357
F-Statistic	2.96	48.94***
Observations	1,996	1,996

¹ Numbers in parentheses represent heteroskedasticity robust standard errors

^a The reference group is Protestant

^b The reference group is \$40,000-60,000

^c The reference group is Some College

^d The reference group is White

^e The reference group is Midwest

* Significance at the 0.1 level

** Significance at the 0.05 level

*** Significance at the 0.01 level

Table 4: Results from instrumental variables approach, 1st stage only.¹

Variable	1 st stage (Dependent Variable= Facebook)
Internet	0.1558*** (0.0361)
Catholic ^a	-0.0184 (0.0251)
Unaffiliated ^a	0.0122 (0.0203)
Other Religion ^a	0.0021 (0.0216)
Income <\$20,000 ^b	0.0083

	(0.0243)
Income \$20,000-40,000 ^b	0.0266 (0.0229)
Income \$60,000-85,000 ^b	0.0038 (0.0271)
Income >\$85,000 ^b	-0.0177 (0.0282)
Less than High School ^c	-0.0124 (0.0346)
High School ^c	0.0162 (0.0212)
College or greater ^c	0.0221 (0.0192)
Black ^d	-0.0189 (0.0244)
Hispanic ^d	-0.0746*** (0.0261)
Other Race ^d	0.0023 (0.0287)
Female	0.0587*** (0.019)
Northeast ^e	-0.0214 (0.0268)
South ^e	0.0355* (0.0198)
West ^e	0.0102 (0.0231)
MSA	-0.0003 (0.0227)
Married	-0.0403** (0.0186)
Children	0.023 (0.0192)
Age	-0.0046** (0.002)
Mother Age in 2012	-0.0011 (0.0014)
Constant	0.8517*** (0.0744)
R-Sqaure	
F-Statistic	
Observations	1,996

¹ Numbers in parentheses represent heteroskedasticity robust standard errors

- ^a The reference group is Protestant
^b The reference group is \$40,000-60,000
^c The reference group is Some College
^d The reference group is White
^e The reference group is Midwest
* Significance at the 0.1 level
** Significance at the 0.05 level
*** Significance at the 0.01 level

Table 5: Results from instrumental variables approach, 2nd stage only.¹

Variable	2 nd stage (Dependent Variable= Attendance)
Facebook	-0.4468* (0.2328)
Catholic ^a	-0.0621** (0.0273)
Unaffiliated ^a	-0.6002*** (0.0262)
Other Religion ^a	-0.1063*** (0.0257)
Income <\$20,000 ^b	-0.0685** (0.0312)
Income \$20,000-40,000 ^b	-0.0341 (0.0291)
Income \$60,000-85,000 ^b	-0.0427 (0.0323)
Income >\$85,000 ^b	-0.0395 (0.0311)
Less than High School ^c	-0.0932** (0.0466)
High School ^c	-0.0238 (0.0274)
College or greater ^c	0.0237 (0.0235)
Black ^d	0.099*** (0.0307)
Hispanic ^d	-0.0101 (0.0343)
Other Race ^d	0.0229 (0.0348)
Female	0.0492** (0.025)
Northeast ^e	-0.0786** (0.0327)

South ^e	0.0109 (0.0249)
West ^e	-0.0345 (0.0274)
MSA	-0.0112 (0.0276)
Married	0.0377 (0.0243)
Children	0.0494** (0.0228)
Age	-0.0016 (0.0027)
Mother Age in 2012	-0.0016 (0.0019)
Constant	1.3878*** (0.2513)
R-Sqaure	0.202
F-Statistic	38.45***
Observations	1,996

¹ Numbers in parentheses represent heteroskedasticity robust standard errors

^a The reference group is Protestant

^b The reference group is \$40,000-60,000

^c The reference group is Some College

^d The reference group is White

^e The reference group is Midwest

* Significance at the 0.1 level

** Significance at the 0.05 level

*** Significance at the 0.01 level

Table 6: Estimates for Joint Maximum Likelihood Estimation.¹

Variable	CMLE (Dependent Variable= Attendance)
Facebook	-1.5505*** (0.5846)
Catholic ^a	-0.2591*** (0.0997)
Unaffiliated ^a	-1.4631*** (0.2915)
Other Religion ^a	-0.3863*** (0.1095)
Income <\$20,000 ^b	-0.2104** (0.1074)
Income \$20,000-40,000 ^b	-0.0992

	(0.1019)
Income \$60,000-85,000 ^b	-0.1252 (0.1123)
Income >\$85,000 ^b	-0.1154 (0.1055)
Less than High School ^c	-0.28** (0.1367)
High School ^c	-0.0821 (0.091)
College or greater ^c	0.081 (0.0769)
Black ^d	0.3426** (0.1465)
Hispanic ^d	-0.0392 (0.1092)
Other Race ^d	0.0869 (0.1105)
Female	0.1665** (0.0725)
Northeast ^e	-0.2556** (0.1055)
South ^e	0.0367 (0.0847)
West ^e	-0.1033 (0.0931)
MSA	-0.0242 (0.0945)
Married	0.1092 (0.0901)
Children	0.1583** (0.0756)
Age	-0.0052 (0.0086)
Mother Age in 2012	-0.0058 (0.0058)
μ	
ρ	0.6218** (0.1832)
Constant	2.7189*** (0.4749)
Observations	1,996

¹ Numbers in parentheses indicate heteroskedasticity robust standard errors

^a The reference group is Protestant

^b The reference group is \$40,000-60,000

^c The reference group is Some College

^d The reference group is White

^e The reference group is Midwest

* Significance at the 0.1 level

** Significance at the 0.05 level

*** Significance at the 0.01 level