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Examining the Effect of Religion on Economic Growth:

A Partial Replication and Extension

AN HONORS THESIS

College of Saint Benedict/Saint John's University

In Partial Fulfillment

of the Requirements for Distinction

in the Department of Economics

by

Sophia Korman

May 2015

Examining the Effect of Religion on Economic Growth: A Partial Replication and Extension

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I.   Introduction

Economic growth is the fundamental measurement that assesses a country's productive capacity in terms of goods and services. It is conventionally estimated using the percent rate of increase in GDP per capita and is correlated with numerous factors in society, among which include quality of life. For example, one application of GDP per capita is as a primary indicator of standard of living. However, although GDP per capita is a reliable determinant of the level of development in a country, it is certainly not the only way to measure well-being. For instance, it fails to capture many important aspects of human welfare including health, education, and culture.

Religion is a prominent dimension of culture that can be a significant factor in one's quality of life. However, it is often overlooked as a potential determinant of economic growth. Economists have been trying to fill this gap. In the early 1970's, Simon Kuznets, winner of the Nobel Prize in Economics in 1971, wrote an article highlighting his findings and reflections of modern economic growth. Of the six characteristics of modern economic growth that he recognized, secularization was cited as a means of changing ideology in society over time and thus as an indirect cause of economic growth (Kuznets 1973). In this case, secularization is a separation of a society from religious or spiritual values or influence. A result is the restriction of the role of religion in modern societies.

This project comprises an exploration of the relationship between monthly attendance at church services and economic growth across several countries. The goal of my research project is to partially replicate the findings of two leading authors in this field, Robert J. Barro and Rachel M. McCleary (2003). I will also extend their work to cover the time period from 1999-2012, as they examined data from 1981 to 1999.

II.   Background

A. *Contemporary Literature*

Barro and McCleary (2003) begin with the observation that economic growth has usually been explained by a narrow set of economic variables. They argue that a more successful explanation of economic growth would include broader social and cultural dimensions. As a significant factor of culture, they note that religion influences character traits such as honesty and willingness to work. Thus, their purpose was to analyze religion as it relates to rates of economic growth. More specifically, the authors quantified this relationship using two main measures of religiosity: religious beliefs, represented by beliefs in heaven and in hell, and religious belonging, measured by monthly attendance at church services.

Barro and McCleary studied a dataset on a broad panel of countries that contained an array of economic, political, and social indicators. They also gathered data on measures of religiosity primarily from the *World Values Survey.* As for their empirical framework, the dependent variable in their regression model was the growth rate of GDP per capita over three separate four- to five-year time periods, while the independent variables included numerous social, economic, and political indicators, in addition to their measures of religiosity. Focusing on a sample of 41 countries, the authors found that while religious beliefs affect economic growth positively, church attendance produces the opposite effect. The first relationship is shown in *Figure 1* and *Figure 2*, which depict religious beliefs in heaven and hell, respectively.[1] According to Barro and McCleary, "Growth depends on the extent of believing relative to belonging" (2003, p.760). In accordance with their original hypothesis, they see that because greater religious beliefs instill productivity-enhancing aspects of individual behavior in a

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[1] Figures 1-4 were taken from Barro and McCleary (2003).

person, growth is stimulated. According to the authors, since religious beliefs in general tend to influence personal traits, such as honesty and willingness to work, economic performance is enhanced.

Figure 1[2]

Growth Rate and Belief in Heaven

Figure 2

Economic Growth and Belief in Hell

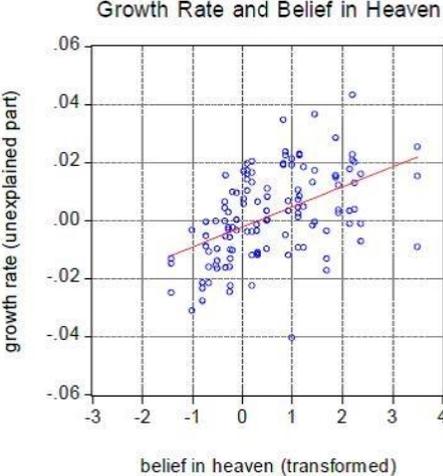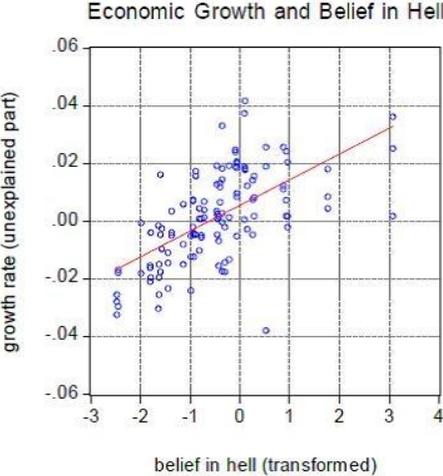[2] One may look at the horizontal axis and wonder how beliefs in heaven or hell can be negative. The authors simply transformed the x-axis by normalizing the values to have a zero mean.

Barro and McCleary's second finding, that economic growth reacts negatively to monthly church attendance, is shown in *Figure 3* and *Figure 4*. In their regressions, Barro and McCleary hold the variables denoting belief in heaven and belief in hell constant.[3] In theory, as church attendance increases, economic growth decreases, and vice versa. The authors reason that growth is depressed by increased church attendance because of their fundamental view of the market for religion. While beliefs can be considered the output of the religion sector, higher church attendance signifies a larger use of religious resources, as attendance measures the inputs in this sector.

Figure 3

Economic Growth and Church Attendance
(belief in hell included)

Figure 4

Growth Rate and Church Attendance
(belief in heaven included)
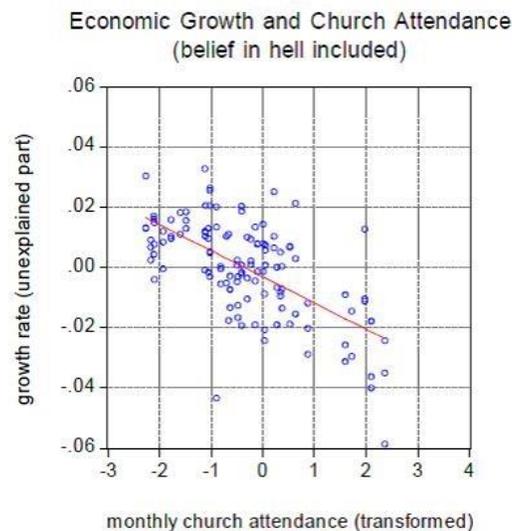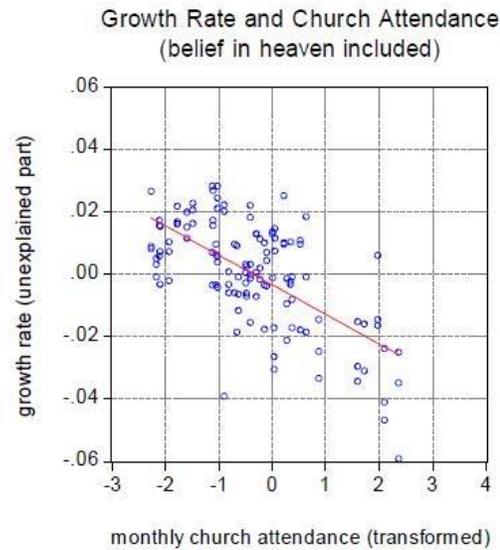
However, there arises an unresolved issue in thinking about the religion sector this way. Religious individuals could argue that beliefs are the input in the religion sector, while church attendance acts as the output—the reverse of what Barro and McCleary believe. More specifically, an individual could self-develop certain religious beliefs and then wish to foster them through attendance at church. There are many purposes of religious services, especially depending on culture and religious denomination, but certainly one basic, common objective is to help grow one's beliefs and values.

As clarification, Torry (2014, p. 55) broadly describes "a 'sector' as a way to categorize organizations." In light of this definition, one can think of the religion sector as encompassing all religious organizations, or churches. Recognizing that it may be more accurate to categorize organizations based on their purpose, Mullins (2005) claims that there are five distinct categories of organizations, including economic, protective, associative, public service, and religious

organizations. Therefore, religious organizations occupy their own category because they are clearly defined in that worship is their core purpose.

McCleary and Barro (2006) is an extension of their previous work in the sectors of religion and economics. The importance of this paper lies its examination of religion as both a dependent and an independent variable. When considering religion as a dependent variable, McCleary and Barro noted: "a central question is how economic development and political institutions affect religious participation and beliefs" (2006, p. 49). Thus, the theories are divided into demand-side and supply-side models. The secularization hypothesis is the historically popular demand-side view, arguing that economic growth negatively affects religion by reducing religious beliefs as well as participation in religious services. Regarding the supply-side, the religion market model explains that the nature of the religion product is affected by government regulation and competition among religion providers.

As the independent variable, McCleary and Barro (2006) describe religion as fostering personality traits that influencing economic outcomes, as mentioned in Barro and McCleary (2003). Therefore, a greater degree of religiosity could encourage economic growth. They went on to quantitatively analyze their same theories from 2003 in order to study the various relationships between religion and rates of economic growth. Both of their papers enabled me to gain greater insight as to how the former influence the latter as well as the implications this relationship has in the broader context of the everyday world. However, it was also critical to more clearly understand an even more extensive aspect of the subject of religion and economic growth—that is, its fundamental origin.

B. Weber & The Protestant Ethic

The genesis of capitalism has had implications over time. As noted by Weber (2009), German economic historian Werner Sombart distinguishes two important principles by which economic history has evolved. The first is the satisfaction of needs, which he explains this as corresponding to economic traditionalism (Weber 2009). Furthermore, Parsons (1928) says that these human needs are fixed for each individual, based on one's social status. Sombart's second principle was acquisition. This concept played a significant role in the understanding of the spirit of capitalism. That is, in early capitalist societies the leading principle was that the acquisition of money was considered an end in itself.

Asceticism is a lifestyle that is characterized by: "the practice of the denial of physical or psychological desires in order to attain a spiritual ideal or goal" ("Asceticism…" 2013, p.1). Through this lens, the pursuit of wealth is inherently bad. On the other hand, Protestants believed in an "inner-worldly" asceticism, or: "the concentration of human behavior upon activities leading to salvation within the context of the everyday world" (Elton 1963). Weber says, "It refers basically to the idea that the highest form of moral obligation of the individual is to fulfil his duty in worldly affairs" (2005, p. xii). Weber (2009) also explains that it is not religion, per se, that affects economic activity, but this worldly asceticism of Protestants. He continues, saying that asceticism characterized by traditionalism and habit does not stimulate capitalism. Since the fulfillment of obligations on Earth was the primary way to prove religious merit, capitalism became more widely accepted and began to lose its notoriety as solely a ceaseless quest for profit (Weber 2009).

Weber adds, "capitalism's relationship to the religious powers could have been exactly parallel—namely, a coalition between capitalism and religious belief tended to burst asunder the old economic traditionalism" (2009, p. 85). This stemmed from Weber's observation that

northern Europe and America experienced a significant level of economic prosperity a century ago primarily because of the work ethic of those that were followers of Protestantism. Goldstone (2000), however, attributes this phenomenon to the establishment of a Newtonian culture in England, which promulgated a mechanical view of the world. He claims, "Only in Protestant Europe was the entire corpus of classical thinking called into question…And only in England, for at least a generation ahead of any other nation in Europe, did a Newtonian culture—featuring a mechanistic world-view, belief in fundamental, discoverable laws of nature, and the ability of man to reshape his world by using those laws—take hold" (Goldstone 2000, p. 184).

Nevertheless, the Protestant ethic is defined in sociological theory as: "the value attached to hard work, thrift, and efficiency in one's worldly calling, which, especially in the Calvinist view, were deemed signs of an individual's election, or eternal salvation" ("Protestant Ethic…" 2015, p. 1). Barro and McCleary reference this concept when they state that religious beliefs positively affect economic growth. Protestant values influence traits associated with one's work life, thereby enriching economic performance. This caused a growing rationalization through which the supernatural was no longer necessary in explaining the world because science could (Gill 2001). Goldstone references this occurance in his explanation of the rise of the West, stating, "Only by the late seventeenth century in England could the entire elite culture agree that 'the ancient understanding of the natural world bears little or no relation to our own'" (2000, p. 183). Norris and Inglehart (2004) also allude to this Weberian claim regarding the rationality of belief systems, suggesting that this trend ultimately led to the decline in the strength of religious organizations. However, Barro and McCleary recognize the problem of reverse causation in their study, saying, "To isolate the effects of religiosity on economic growth, we have to deal with the possibility of reverse effects from economic development to religion" (2003, p. 760). They do

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this through the use of various instrumental variables for religion, namely the presence of a state religion, state regulation of religion, and religious pluralism. These variables will be explained in more depth in the data portion of this paper.

C. Other Theories

The common view of the relationship between religion and economic growth thus became summarized by the "secularization hypothesis." This states that as societies progress in terms of modernization and rationalization, religion loses its significance in aspects of social life and governance. In other words, economic growth has a negative effect on religion. Weber cites Germany as an example, noting that "wherever a relationship between business activity and religious belief exists, it turns out to be a negative one… People who are saturated by the capitalist spirit today tend to be indifferent, if not openly hostile, to religion" (2009, p. 83). Although this powerful theory has prevailed over time, it is being challenged as of late.

Several other authors contribute competing theories regarding the relationship between religion and economic growth. One such hypothesis, expanded by Chaves & Cann (1992), involves state regulation of religion. Measuring this empirically, they claimed that greater state regulation of religion, which was primarily measured by whether the government appoints or approves church leaders, decreased the efficiency of religion providers. Consequently, church attendance decreased as well. In summary, the conclusion of this theory is that state involvement tends to interfere with church activities and, in a broad sense, decreases religion.

It is important to note that based on relevant literature, this "efficiency" seems to be largely open to interpretation. According to Salvatore and LeVine (2005), the efficiency of a religion provider could be described through the delivery of public goods. They view voluntary religious organizations, or those not regulated by the state, "as efficient providers of local public

goods in the absence of government provision." Similarly, Shah, Larbi, and Batley (2007) attempt to explain the efficiency in terms of serving the public. In comparison to similar for-profit and governmental services, they say: "Religious providers hired qualified workers more cheaply and were more likely to provide pro-poor services and to charge lower prices, with similar quality of care" (Shah, Larbi, and Batley 2007, p. 13). In general, religion providers' efficiency is measured by their provision of public services, and more specifically, in terms of output per unit of input. Although it is not commonly stated in the literature, one could intuitively believe that efficiency could also depend on the quality with which the duties of the provider are conducted. The challenge, however, lies in quantitatively measuring such a factor.

Another theory, inspired by Adam Smith, involves religious pluralism and focuses on market or supply-side forces and competition among providers of religion.[4] Under the assumption that the notion of supply-side is broadly defined as the quantity and/or quality with which goods and services are produced, the stimulation of growth, in this case, involves how religious products (primarily church services) are provided. This theory claims that a greater diversity of religions promotes greater competition in the religion market. This creates a better quality "religion product," as Barro and McCleary (2003) put it, and thus leads to greater religious participation and beliefs.

III.   Partial Replication and Extension

A. Data

The data used in this study came from two main sources: the World Bank and the World Values Survey (WVS).[5] The latter database allowed me to retrieve data from surveys conducted

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[4] Aside from Smith (1791), other authors also contributed to this concept, including (Stark and Bainbridge 1987), (Finke and Stark 1992), (Iannaccone 1991), and (Finke and Iannaccone 1993).

[5] This is an organization that uses a common questionnaire to evaluate various values, especially religious values, and their effect on the social and political lives of people across the world.

to explore dimensions of religiosity by country. I used one of the measures (church attendance) that Barro and McCleary employed.

Unlike these authors, I did not consider religious beliefs as a variable affecting economic growth in this study because of the lack of consistency with which the questions were asked in the World Values Survey. For example, in Wave 4, questions were asked about both church attendance and religious beliefs in heaven and in hell. In the next wave that covered the time period from 2005-2009, however, the survey did not ask a question about one's belief in heaven or in hell. Furthermore, while the survey in Wave 6 did ask about attendance at religious services and belief in hell, it left out the question regarding belief in heaven. This left several gaps in my dataset that would have been very difficult to try and reconstruct from different sources.

It was important to analyze three waves of the World Values Survey because the objective of this project is to examine how these variables affected economic growth across time. Hypothetically, one might suggest omitting this wave because it did not include data on religious beliefs. However, this omission would cause discontinuity in the dataset. It was also beneficial to use data covering a 16-year time period (Waves 4, 5, and 6) rather than an 11-year time period (Waves 4 and 6 only). If only considering Waves 4 and 6, still only church attendance and belief in hell could be used as measures of religiosity because there is no question regarding belief in heaven in Wave 6. Without belief in heaven, belief in hell is not an adequate way to gauge one's religiosity. For example, different religions believe many different things regarding an after-life. Although a similar argument could be made regarding church attendance, this variable is more telling than one's belief in hell.

The measure of religiosity, monthly church attendance, came from the WVS. One question in the survey regarded the frequency with which one attends religious services. The

responses that could be selected ranged from "more than once a week" to "never/practically never." Therefore, I combined the percentages from the "more than once a week," "once a week," and "once a month" categories for each respective country and labeled that sum as monthly church attendance.

There have been six different "waves," or time periods, during which the survey has been conducted, beginning in 1981 and ending in 2014. Because Barro and McCleary studied the information gathered from the first three waves, I analyzed data from the last three waves of the survey, with my data extending from 1999 to 2012 and covering 12 different countries.

The WVS does not report responses year-by-year. That is, the data is gathered over certain ranges of time: 1999-2004, 2005-2010, and 2011-2014. In other words, the survey was conducted over a series of time periods. This created a problem in aligning the dependent variable in the present study, which was the log of GDP per capita, with the independent variables that were set up in panel data format. As a solution, I assumed the same value of monthly church attendance for each respective country for each year in a given time period. As an example, the average monthly church attendance in Argentina during the 1999-2004 time period was 42.8%. Therefore, I made the presumption that it was 42.8% in 1999, 2000, 2001, 2002, 2003, and 2004, and did the same for each of the 12 countries in the sample. These countries were Argentina, Chile, China, India, Japan, Mexico, Peru, South Africa, Spain, Sweden, Turkey, and the United States. Because of this issue, I created two dummy variables (*wave1* and *wave2*) to account for time in my estimation. Therefore, *wave1* signifies the time period from 1999-2004, *wave2* signifies the time period from 2005-2010, which leaves the third wave to cover 2010-2012. Other dummy variables were those denoting religious shares of the

population, including Hinduism, Judaism, Islam, Orthodoxy, Protestantism, and an "Other" category.

Two instrumental religion variables included were dummy variables for the presence of a state religion and state regulation of religion. For clarification, the instrumental variable approach, according to Woolridge, "leaves the unobserved variable in the error term, but rather than estimating the model by OLS, it uses an estimation method that recognizes the presence of the omitted variable" (2013, p. 513). In other words, it is used to estimate causal relationships and provides a way to obtain consistent parameter estimates. Barro and McCleary (2003) theorized that the former lowered religious pluralism and thus resulted in decreased religious participation. The latter, they believed, interfered with religious activity and generated lower rates of church attendance. Another instrumental variable I used represented religious pluralism, based on Herfindahl[6] indexes for shares of religion. Because the authors shared the values of these variables in their paper, I used them in order to most closely imitate their study.

The economic and demographic measures were gathered from the World Bank and served as my independent variables. Because it's one of the variables of most interest in this research, GDP per capita was among them. Life expectancy at birth and the urbanization rate were used because as Barro and McCleary (2003, p. 2) state: "Development typically features not only rising per capita incomes but also higher levels of education[7], urbanization, and life expectancy, and lower levels of fertility." Next, the shares of the population under age 15 and over age 65 were relevant because Barro and McCleary (2003, p. 2) went on to say: "The

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[6] The Herfindal index is the sum of the squares of the population fractions belonging to each religion. It can be interpreted as the probability that two randomly-selected persons in a country belong to the same religion.
[7] Due to a lack of data on educational attainment age 25+ for 1999-2012 from the World Bank, this variable was omitted from my model.

combined effects from higher life expectancy and lower fertility imply a shift in the age structure toward the old and away from the young."

B. Model

In a section of their paper, Barro and McCleary state: "As a prelude to our analysis of the effects of religion on economic growth, we estimated panel systems in which the dependent variables are country-averages of answers to survey questions about attendance at religious services and religious beliefs" (2003, p. 765). Using their research as a guideline, I first ran various regressions to obtain partial correlations to help understand how monthly church attendance co-varies with the explanatory variables. Essentially flipping the position of the dependent and independent variables, I then ran the main regression of my research, with GDP per capita as the former and church attendance, among other measures, included in the latter. This allowed me to understand the effect that monthly attendance at religious services on GDP per capita across the countries in this study.

I employed a cross-national panel estimation method. Including both a cross-sectional and a time series dimension, my data allowed me to observe the behavior of the same multiple countries over a period of time. The basic advantages of using panel data was that one can control for characteristics certain variables that cannot be observed. It also allows for the study of lags in behavior or in the effects of decision-making. However, a significant disadvantage of panel data concerns difficulty in data collection. As Woolridge explains, "Because panel data require replication of the same units over time, panel data sets… are more difficult to obtain than pooled cross sections" (2013, p. 11). This issue explains the small number of countries studied in this project.

The general model for more than two time periods is as follows:

Equation 1

$$y_{it} = \delta_1 + \delta_2 d2_t + ... + \delta_k dk_t + \beta_1 x_{it1} + \beta_2 x_{it2} + ... + \beta_k x_{itk} + a_i + u_{it} \quad , \quad i = 1,2,..,I \text{ and } t = 1,2,..,T$$

where i stands for the country, t stands for the time period, $d2_t$ is a dummy variable that

equals one when $t = 2$ and zero when t equals anything other than 2 (it does not change across i

), a_i is a variable that captures all unobserved time-constant factors that affect y_{it}, and u_{it} is the

idiosyncratic error term that represents unobserved factors that change over time and affect y_{it}.

Given this, my models were as follows:

Equation 2

$$
\begin{aligned}
church = {} & \delta_1 + \delta_2 wave1 + \delta_3 wave2 + \beta_1 \lg dppercap + \beta_2 urban + \beta_3 \exp ect \\
& + \beta_4 pop\_15 + \beta_5 pop\_65 + \beta_6 staterel + \beta_7 statereg + \beta_8 plural + \beta_{15} \arg entina \\
& + \beta_{16} chile + \beta_{17} china + \beta_{18} india + \beta_{19} japan + \beta_{20} mexico + \beta_{21} peru + \beta_{22} south\_africa \\
& + \beta_{23} spain + \beta_{24} sweden + \beta_{25} turkey + \beta_{26} united\_states + v
\end{aligned}
$$

Equation 3

$$
\begin{aligned}
church = {} & \delta_1 + \delta_2 wave1 + \delta_3 wave2 + \beta_1 \lg dppercap + \beta_3 \exp ect \\
& + \beta_4 pop\_15 + \beta_5 pop\_65 + \beta_{15} \arg entina + \beta_{16} chile + \beta_{17} china + \beta_{18} india \\
& + \beta_{19} japan + \beta_{20} mexico + \beta_{21} peru + \beta_{22} south\_africa + \beta_{23} spain \\
& + \beta_{24} sweden + \beta_{25} turkey + \beta_{26} united\_states + v
\end{aligned}
$$

where *wave*1 marks the time period 1999-2004, *wave*2 marks the time period 2005-2010,

lgdppercap is the log of GDP per capita, *urban* is the urbanization rate (as a percentage of total

population), *expect* is the life expectancy at birth (in years), *pop_*15 is the share of the

population under age 15 (as a percentage of total population), *pop_*65 is the share of the

population over age 65 (as a percentage of total population), *staterel* is a dummy variable for

the presence of a state religion, *statereg* is a dummy variable for state regulation of religion,

plural represents religious pluralism, *Argentina* through *United _ States* are dummy variables

representing the countries in the sample, and v is the composite error (where $v_{it} = a_i + u_{it}$).

These variables can also be referenced in *Table 1* below.

Table 1

Variable Name	Definition
wave1	Time period 1999-2004
wave2	Time period 2005-2010
lgdppercap	Log of GDP per capita
urban	Urbanization rate (as a percentage of total population)
expect	Life expectancy at birth (years)
pop_15	Share of the population under age 15 (as a percentage of total population)
pop_65	Share of the population over age 65 (as a percentage of total population)
staterel	Dummy variable for the presence of a state religion
statereg	Dummy variable for state regulation of religion
plural	Degree of religious pluralism, based on Herfindal Index
Argentina through *United_States*	Dummy variables for the countries in the sample
v	Composite error (where $v_{it} = a_i + u_{it}$)

IV.   Empirical Results

A. *Dependent Variable: Church Attendance*

I first obtained the summary statistics of the variables, shown in *Table 2*. The means and

standard deviations were comparable with those obtained by Barro and McCleary (2003). The

variables that saw the greatest change in terms of the mean were GDP per capita and monthly

church attendance. This variation could be due to the fact that I had to include fewer countries in

my analysis than Barro and McCleary because of lack of available data. In turn, the authors were

included more countries that had higher levels of GDP per capita, further affecting the mean.

Table 2

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
church	156	.411	.213	.031	.748
lgdppercap	156	1.360	.144	.978	1.559
urban	156	.717	.180	.276	.919
expect	156	73.939	7.785	51.557	83.096
pop_15	156	.243	.067	.131	.342
pop_65	156	.098	.055	.027	.244
staterel[8]	156	.333	.473	0	1
statereg	156	.417	.495	0	1
plural[9]	156	.257	.228	0	1

The cross-national panel estimations from *Equation 2* and *Equation 3* yielded the results

found in the following table:

Table 3

Dependent Variable: *church*

Independent variables	[1]	[2]
lgdppercap	.167	.238*
	(.145)	(.144)
urban	.540**	-
	(.005)	
expect	-.005	-.007
	(.235)	(.005)
pop_15	.772	.411
	(.484)	(.465)
pop_65	-.009	.093

---

[8] The minimum and maximum values for *staterel* and *statereg* range from 0 to 1 because they are dummy variables.
[9] The minimum and maximum value for *plural* ranges from 0 to 1 because this variable is based on an index with values between 0 and 1.

	(.117)	(.110)
staterel[10]	0	-
statereg	0	-
plural	0	-
wave1	.081***	.075***
	(.016)	(.016)
wave2	.027**	.023**
	(.010)	(.010)
Intercept	-.044	.417
	(.509)	(.475)
Observations	156	156
R²		
within	.447	.426
between	.020	.473
overall	.031	.422
corr(u$_i$, Xb)	-.288	.449

*=significant at the 10% level
**=significant at the 5% level
***= significant at the 1% level

In the estimation of the first regression (*Equation 2*), three variables were statistically

significant. These were *urban* (significant at the 10% level), *wave1* (significant at the 1% level),

and *wave2* (significant at the 10% level). In considering the coefficient on *lgdppercap*, I found

that there was a positive relationship between monthly church attendance and GDP per capita

across countries, as Barro and McCleary had found as well. Furthermore, as can be seen in *Table*

3, the errors were negatively correlated with the regressors by a value of .288. This indicates that

there is an endogeneity problem within this model. It is also important to note that the variables

staterel, *statereg*, and *plural* were omitted from the *Equation 2* due to multicollinearity.

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[10] *staterel*, *statereg*, and *plural* were omitted because of multicollinearity.

In *Equation 3*, *staterel*, *statereg*, and *plural* were again omitted for the above reason. Furthermore, *urban* was excluded from the equation in order to see the change that would result after omitting the most significant variable (besides the dummy variables for time: *wave1* and *wave2*). One consequence of doing this is that the equation likely suffers from omitted variable bias. Nonetheless, *Equation 3* was simply a test to see the change as a result of the omission of *urban*. As a result, *lgdppercap* became statistically significant at the 10% level. The variables *wave1* and *wave2* remained significant at their respective levels. Moreover, the coefficient on *lgdppercap* rose by a small amount, now meaning that a one-unit increase in GDP per capita increases monthly church attendance by approximately 23.8 percentage points, given that this is a log-level model. Finally, the correlation between the error and the regressors became positive (0.449). While this interpretation and the other correlations in the analysis are useful, they do not imply any direct causations.

B. Estimation Concerns

Multicollinearity is defined as high, but not perfect, correlation between two or more independent variables. Therefore, the estimation in this study does not violate Assumption MLR.3, which is the requirement that there is no perfect collinearity, or no exact linear relationships among the independent variables (Woolridge 2013). A usual sign of multicollinearity is an R^2 value that is close to one. One common cause of this issue is improper dummy coding. Another possible cause of multicollinearity is using the same or nearly the same variable twice. This doesn't seem to be the problem because although the presence of a state religion and state regulation of religion are variables that are similar in concept, they are not the same measurement.

In this case, the relatively small sample size (156 observations) in this study could have caused the large sampling variance $(Var(\hat{\beta}_j))$. The best way to reduce variances of unbiased estimators is to collect more data. Unfortunately, data limitations disallowed this as a possibility in this case. Other independent variables from the model could have been dropped in an attempt to minimize the issue, but this could, in turn, have led to omitted variable bias. This arises in the estimators as a result of omitting a relevant variable from a regression equation (Woolridge 2013). This problem of underspecifying the model generally causes the estimators to be biased.

A closely related error to this is functional form misspecification. According to Woolridge, "A multiple regression model suffers from functional form misspecification when it does not properly account for the relationship between the dependent and the observed explanatory variable" (2013, p. 304). In other words, this occurs when a model has omitted functions of the explanatory variables (such as quadratics), or uses the wrong functions of either the dependent variable or some explanatory variables. One way to check if certain explanatory variables should appear as squares of higher-order terms is by manually testing whether such terms can be excluded from the regression. Otherwise, the general test for functional form misspecification is the Ramsey regression specification error test (RESET). However, this specific test is not compatible with panel data.

A second common issue in regression analysis is heteroskedasticity. Violating Assumption MLR.5, this occurs when the error does not have the same variance given any values of the explanatory variables. In theory: $Var(u \mid x_1,...,x_k) \neq \sigma^2$ (Woolridge 2013). As a result, the estimators remain unbiased and consistent because to prove this only requires MLR.1 – MLR.4. However, as a consequence of heteroskedasticity, the estimators are no longer the best, linear, unbiased estimators (BLUE) because they are no longer efficient.

Among the several methods for testing heteroskedasticity, the Breusch-Pagan (BP) test was used in this study:

$$H_0 : Var(u \mid x_1,...x_k) = \sigma^2$$
$$H_A : Var(u \mid x_1,...x_k) \neq \sigma^2$$

$$F = \frac{\dfrac{0.0873}{10}}{\dfrac{1 - 0.0873}{156 - 10 - 1}} \approx 1.387$$

$$c = 1.83$$

Because $F < c$, null hypothesis was not rejected at the 5% level of significance. This indicates that there was not a heteroskedasticity problem in the first regression corresponding to _Equation 2_, as an example, according to the BP test. Furthermore, if heteroskedasticity depended only upon certain independent variables in this case, the BP test could have been modified. There are several tests for heteroskedasticity and modifications of these tests to check for this issue during the post-estimation process.

C. Dependent Variable: GDP per capita

The main regression of this study is depicted in _Equation 4_. In this model, GDP per capita is the dependent variable and church attendance was among the independent variables.

Equation 4

$$\lg dppercap = \delta_1 + \delta_2 wave1 + \delta_3 wave2 + \beta_1 church + \beta_2 urban + \beta_3 \exp ect + \beta_4 pop\_15 + \beta_5 pop\_65$$
$$+ \beta_6 staterel + \beta_7 statereg + \beta_8 plural + \beta_9 hindu + \beta_{10} jew + \beta_{11} mus\lim + \beta_{12} orthodox + \beta_{13} other$$
$$+ \beta_{14} protes\tan t + \beta_{15} \arg entina + \beta_{16} chile + \beta_{17} china + \beta_{18} india + \beta_{19} japan + \beta_{20} mexico + \beta_{21} peru$$
$$+ \beta_{22} south\_africa + \beta_{23} spain + \beta_{24} sweden + \beta_{25} turkey + \beta_{26} united\_states + v$$

This estimation in this study produced the results:

Table 4

Dependent variable: *lgdppercap*

Independent variables	
church	-.414
	(.562)
urban	.945
	(.551)
expect	-.010
	(.005)
pop_15	-1.056
	(.662)
pop_65	.154
	(.120)
staterel	5.761
	(4.012)
statereg	-1.399
	(.771)
plural	9.214
	(6.294)
wave1[11]	0
wave2	-.011
	(.008)
hindu	.040
	(.033)
jew	-.040
	(.041)
muslim	-.034
	(.021)

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[11] The variable *wave1* was omitted because of multicollinearity.

orthodox[12]	0
other	0
protestant	0
Intercept	-4.002
	(3.765)
Observations	36
R² within between overall	.874 1.000 .994

V. Discussion

A. Conditions

Before discussing my results and comparing with those of Barro and McCleary, I will first describe the circumstances under which this analysis was conducted. As a disclaimer, this analysis purposefully does not exactly parallel the authors'. First, in order to determine the effect that religion has on economic growth, these authors studied two main religious measures: monthly church attendance and religious beliefs (both in heaven and in hell). Due to difficulty in obtaining data on religious beliefs for the latest three waves of the World Values Survey, the present analysis considers only monthly attendance at religious services.

Barro and McCleary ran three sets of two regressions. For example, in their first they focused on the variables that described church attendance and belief in hell and the effect they had on GDP per capita. This model included the variables denoting religious shares of the population (Hinduism, Judaism, Islam, Orthodoxy, Protestantism, and an "Other" category) among other economic variables mentioned previously in this paper. They focused on the same

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[12] The variables *orthodox, other, and protestant* were also omitted because of multicollinearity.

variables in the second regression, but omitted the compositions of the population by religion. Their third and fourth regressions were similar in form, but focused on church attendance and belief in hell. In their fifth and sixth regressions they included all three of their measures of religiosity: church attendance, belief in hell, and belief in heaven. As can be gathered above, Barro and McCleary did not run a regression involving church attendance as the sole measure of religiosity. This is important to note because the regression analysis in my study only included this variable.

B. *Results and Comparison with Barro and McCleary (2003)*

Upon initial review, one can notice the sign of the coefficient on *church* in my analysis corresponded with that of Barro and McCleary's in all of their regressions. This means that we both found monthly attendance at church services to have a negative effect on economic growth measured by GDP per capita. However, the magnitude of the coefficient differed between our analyses in that my result was much larger (-.414) than Barro and McCleary's (which ranged from -.009 to -.016). The interpretation of this result says that if the share of the population in a country that goes to church monthly increases by one percentage point, the growth rate of GDP per capita is expected to decrease by approximately 41.4%, given that this is a log-level model. However, this result is unrealistic. Considering the standard error of the coefficient on church attendance, one can see that it's larger than the coefficient itself. In other words, besides having no statistical significance, church attendance has no economic significance either. Therefore in this replicated study, church attendance is not important in explaining economic growth.

In this statistical analysis, however, the most interesting result involved the degree of religious pluralism across countries over time. This is a substantial factor in explaining per capita GDP, as represented by the magnitude of the coefficient on the instrumental variable for

religious pluralism. A similar explanation applies for the variable representing the urbanization rate. However, because the present study mainly focuses on measures of religiosity, this would be an area to consider in future research. McCloskey and Ziliak (1996) explain that many economic papers fail to discuss the size of the coefficients and if the magnitudes are scientifically reasonable and important. So in this case, although the religious pluralism result was not statistically significant, it does have important implications in terms of economic significance.

In short, Barro and McCleary explain religious pluralism as the degree of diversity within the religion market, or a measurement of "the diversity of adherence among major religions" (2003, p. 36). They note two key indicators of religious pluralism in their study: the presence of a state religion and regulation of the religion market. Barro and McCleary use Scandinavia as an example because this country has an established state church and therefore a low degree of religious pluralism (2003). The authors created measures of pluralism based on Herfindal indices for shares of religion. They explain that this type of index "can be interpreted as the probability that two randomly selected persons in a country (among those adhering to some religion) belong to the same religion" (Barro and McCleary 2003, p. 764). Barro and McCleary's pluralism index, which is equal one minus the Herfindal index, is an indicator of religious diversity because it represents the probability that two people belong to different religions. Since the authors' calculated measures were not time-dependent, they were used in this analysis.

Religious pluralism has several implications as it relates to economic growth. In a study by Florida (2014), there is a correlation between religious diversity and economic productivity and competitiveness across many nations. Interestingly, he discovers, "Pluralism is tied up with the broad shift to a post-industrial knowledge-based economy, as it is positively correlated with

the share of workers in the creative class" (Florida 2014, p. 1). Moreover, this author goes on to note that pluralism is correlated with both total factor productivity (TFP) and entrepreneurship. Therefore, this link implies that religious diversity loosely translates into a diversity of ideas. This positively influences factors such as TFP and innovation, thus having a positive effect on economic growth in turn.

Ashraf and Galor (2011) discover a similar pattern that involves religious pluralism and economic growth. They state: "the interplay between cultural assimilation and cultural diffusion has played a significant role in giving rise to differential patterns of economic development across the globe" (Ashraf and Galor 2011, p. i). In other words, a broad definition of diversity, which includes religious diversity, tends to spur economic growth among countries. A significant question, however, is whether or not this broad definition is sufficient. The answer to this has important consequences for this argument. Regardless, this idea challenges the common counterargument that diverse populations migrate towards wealthier areas of high productivity and economic growth rates (Florida 2011). It also tests the concept of the Protestant ethic. While Weber believes that the Great Divergence, or the phenomenon in which Europe and the Americas surpassed the rest of the world in terms of economic development, was instigated by Protestants' work ethic and beliefs, Florida credits "a relative openness to other cultures" by these leading countries (2011, p. 1). Their most significant conclusion was that: "Proximity, openness, and diversity operate alongside technological innovation and human capital as the key engines of economic prosperity" (Florida 2011, p. 1).

As a driver of growth, cultural diversity inspires a heightened awareness of differences which could contribute to creativity and progressiveness, specifically with respect to industrialization, as Ashraf and Galor (2011) suggest. Furthermore, diversity signals a wider

range of ideas and intellectualism. Therefore, this has important implications for religious diversity because religion is a principal dimension of culture. In short, religious pluralism should behave similarly in affecting economic growth because the same principles apply. A diversity of religions instills this same sense of openness and thus contributes to productivity via creativity in innovation.

C. *Estimation Concerns Associated with Barro and McCleary (2003)*

According to Young, "A high degree of model uncertainty typically besets statistical research" (2009, p. 380). This seems to be especially true with regard to religion and economic growth, as Young presents a passionate critique of model uncertainty in sociological research with a focus on Barro and McCleary (2003). The author does this by also attempting to replicate their results.[13] This led him to discover: "Small, sensible changes in their model specification produce large changes in the results: the results are inconsistent across time, and the instrumental variables strategy suffers from a weak instrument set" (Young 2009, p. 380).

Throughout the paper, he emphasizes the problem of reverse causation between religiosity and economic growth that Barro and McCleary encounter. The latter claim that this is accounted for through the use of the instrumental variables in their model. They state, "Specifically, our study of religiosity suggest plausible instrumental variables that can be used to pin down the direction of causation from religion to economic performance, rather than the reverse" (Barro and McCleary 2003, p. 4). Young agrees with these authors in making an important distinction that a reliable instrument must influence religiosity without having an inherent correlation to economic growth. However, he also says that in their study, state religion and state regulation of religion are stronger as instrumental variables than religious pluralism.

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[13] He does this to the best of his ability. Young admits that he procured the dataset directly from Barro and McCleary because his attempts to recreate it from public sources ultimately proved unsuccessful.

Young argues that the latter actually is influenced by economic growth, mainly due to the fact that "rich countries tend to 'import' religious diversity from the poorer regions of the world" (Young 2009, p. 387). In other words, because people from countries with a low level of GDP per capita tend to migrate to wealthier nations, a variety of different religions often accompanies the influx of immigrants. Therefore, religious diversity can be caused by economic growth, making it a weaker instrumental variable. Regardless, the interesting role that religious pluralism plays in this unique analysis has been illustrated.

Verhagen and Wagenmakers explain issues with replication in general. They explain that it's unwise to base the success of a replication attempt solely on the comparison of p-values between the results because, "a difference in significance does not always indicate that the difference is significant" (2014, p. 2).[14] While their overall aim is to raise awareness of proper statistical methods for drawing conclusions from data, they advocate a Bayesian test as one of the best ways to quantify the results of a replication attempt, specifically it success or failure. The authors explain: "Given that the original experiment showed a significant effect, this test addressed the question, 'Is the effect from the replication attempt comparable to what was found before, or is it absent?'"(Verhagen and Wagenmakers 2014, p. 3). This is important because, among other advantages, it enables a researcher to consider the significance of a result in greater depth.

Durlauf, Kourtellos, and Tan (2012) add that while Barro and McCleary's study is fairly replicable, the results are not statistically robust. According to Woolridge, "a robust regression estimator is relatively insensitive to extreme observations" (2013, p. 334). In other words, it signifies the degree to which an estimator is resistant to outliers in the data. "In particular," the

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[14] Verhagen and Wagenmakers (2014) credit this conclusion to (Gelman and Stern 2006) and (Nieuwenhuis, Forstmann, and Wagenmakers 2011).

authors determine, "we find no evidence that religious beliefs play a significant role in enhancing growth outcome. There is little evidence of a religion/growth nexus. At best, our findings suggest that there may be weak evidence for a negative effect of religious participation on growth" (Durlauf, Kourtellos, and Tan 2012, p. 1060). The partial replication in my research produced similar results in that the estimators were not robust and that there was only a weak relationship between attendance at church services and rates of economic growth across countries. The authors state that one of the problems in making a claim as significant as Barro and McCleary made is that the strength of the claim is usually not exhaustively analyzed. While some aspects of the claim are accurate, others many not have been looked into as thoroughly. In other words, there is not a very strong explanation for the results they received. In the case of Barro and McCleary, church attendance's negative influence on economic growth seems to be framed as an aside, at best.

D. Criticisms of Barro and McCleary (2003)

To recall, Barro and McCleary believe that "growth depends on the extent of belief relative to belonging" (2003, p. 760). In other words, regular attendance at religious services increases an attendee's beliefs and religious values, which in turn positively affects economic growth. These beliefs could promote traits such as honesty, loyalty, and hard work, each of which contribute to the productivity of a society, and even more, a nation. However, both the authors and I found that church attendance in itself has a negative impact on economic growth. There seems to be a variety of somewhat undeveloped reasons for this specific outcome. For example, Barro and McCleary admit: "organized religion—and, more specifically, attendance at religious services—would affect economic performance mostly indirectly, that is, through influences on the religious beliefs" (2003, p. 23). In other words, their theory for church

attendance's net negative effect on economic growth is largely dependent how this variable affects religious beliefs.

Therefore, a plausible, direct inference for the negative relationship between attendance and growth could involve the importance of organized religion in society, as Barro and McCleary briefly mention. They say, "For example, organized religion might influence laws and regulations that affect economic incentives. Adverse examples would be restrictions on credit and insurance markets and more general discouragement of the profit motive" (Barro and McCleary 2003, p. 772). This implies that the negative influence of church attendance on growth is has to do with the particular beliefs and values that are proclaimed at religious services. A last, and weaker hypothesis is that time spent at religious services takes time away from economic activities. This is not as strong an argument because a religious service is not that long in itself, relatively speaking. To put it another way, as a percentage of one's day, religious services generally do not consume as much time as the time that a person spends at work, for example. In short, Barro and McCleary argue: "higher church attendance uses up time and resources, and eventually runs into diminishing returns. The 'religion sector', as they call it, can consume more than it yields" ("God, man and…" 2003, p. 1).

VI.   **Further Direction**

In light of this, one direction one could take in extending this study is to solely focus on religious diversity as a potential determinant of economic growth. Similarly, as mentioned previously in this paper, one could look at the intriguing effect that the urbanization rate seems to have on GDP per capita. Moreover, Barro and McCleary (2003) suggest that more measures of religiosity should be included in such an analysis of economic growth. They encourage considering other variables in the World Values Survey, such as the degree to which one

considers him or herself a religious person, or whether or not someone is a member of a church or religious organization. One could also look at how much time people spend praying outside of church or on religious activities. This could help understand to what degree this time takes away from economic activities. Another interesting variable is the meaning of religion to a person. The question in the World Values Survey tries to gauge if it's more about following religious tradition, or if it's to acquire religious and moral values that we've already seen can influence economic growth.

More generally, the strength of similar studies in the future should be examined more closely to determine their accuracy. That is, one might consider employing Verhagen and Wagenmaker's (2014) Bayesian test to quantify the results of replication attempts. In addition, individual variables should be examined so one can ensure that his or her model is as accurate as possible. For instance, Young (2009) emphasizes the importance of instrumental variables as they relate to reverse causation between two variables. Both of these are important steps to take in ensuring the accuracy of a statistical analysis. However, one of the most important ideas is that of the difference between statistical and economic significance. The former primarily involves the decision-making process that leads one to either reject or fail to reject his or her null hypothesis, based on the p-values from one's statistical analysis. On the other hand, the latter refers to the substantive and practical, or "real-world," implications of a statistical result. McCloskey and Ziliak (1996) study this topic closely, unfortunately finding that economics textbooks and journals alike often fail to distinguish between statistical and economic significance. There is often much more emphasis placed on the former, leading to one-sided conclusions in many studies (McCloskey and Ziliak 1996). Therefore, this is an important issue

because ignoring the economic significance of a statistical result can have significant real-world consequences.

VII. Conclusion

To conclude, this study was a partial replication and extension of Barro and McCleary's (2003) research on the relationship between religion and economic growth. The results of the statistical analysis showed that monthly attendance at church services has a negative effect on economic growth, which was measured by GDP per capita. However, this result was neither statistically nor economically significant, unlike that of Barro and McCleary. Additionally, religious pluralism seems to have important implications for economic growth, as revealed by the magnitude of the coefficient on this variable. In the discussion between statistical and economic significance, this is an important thing for which to look because it implies significance of the latter form—something that is often overlooked in heavy statistical analyses but can have important implications in the broader context of the everyday world. It is hypothesized that the religious pluralism is loosely connected to GDP per capita through a causation chain involving a sense of openness, creativity, and innovation. All in all, this is a complex area of study that requires a very close examination of religiosity measures that have the potential to influence economic growth rates across countries and time.

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