Effect of Religious Diversity on Growth

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Abstract

I examine the influence of the religious concentration of a country on its growth rate per capita using cross-country data from 87 countries in 1960. Using the proportion of a country's population belonging to one of seven major religious denominations, I seek to determine the effect of increased religious factionalization on economic growth. Does a religious plurality spur economic growth? Or, does competition between uniformly distributed religious divides improve the quantity of religious activities and the quality of social capital? To answer this question, I attempt to estimate the effect of religious balance, measured by the Herfindahl index and Shannon entropy, on economic growth. I find that a 0.1 unit increase in the average of these two metrics implies 0.8% higher average growth with significance at a level of less than 1%.

1 Introduction

As a component of culture and society, religion has a significant effect on economic growth. The degree to and manner in which a society participates in religion sculpts the institutional and cultural factors govern the market interactions that determine economic activity and well-being. My objective is to measure the specific effects of the diversity, plurality, or distribution of religious denominations on economic growth through these institutional mechanisms. I find that there is a significant and robust positive effect of religious diversity on growth.

Economists have a long history of applying economic models to the structure and formation of religion. Formally, religions impose incentive structures that correspond to a moral system. Hull and Bold (1998) compare state-sponsored religions to market monopolies, noting that moral enforcement is weaker in the face of a religious plurality. In fact, societies with concentrated religions have lower levels of participation (Iannaccone, 1998). Correspondingly, Barro and McCleary (2003) hold that just as innovation improves in a competitive market, so does the quality of religion, or strength of adoption, increase in a more diverse society.

Likewise, there is an increasingly broad literature applying religious determinants to economic growth models. Religious values and ethics tend to influence the social capital, the networks, norms and social trust necessary for regular business activities. Many economists argue that religious organizations facilitate social capital and contribute positively to economic growth (Deller et al., 2018). Specific behavior changes induced by religious incentive structures are often the topic of empirical studies: Barro and McCleary (2003) study church-going behavior as a determinant of economic conditions, while Campante and Yanagizawa-Drott (2015) investigate the negative effect of fasting on growth in Muslim countries during Ramadan. Naylor and Florida (2003) make the theoretical claim that the "melting pot" effect of religious diversity is similar to the positive economic effects introduced by other forms of cultural exchange. Religious fractionalization, on the other hand, erodes social trust and slows growth.

Few empirical studies combine these two lines of investigation to measure the effects of religious concentration on growth by means of social capital theory. Rupasingha and Chilton (2009) include a proxy for religious diversity in their study of the growth effects of religious adherence, but concentrate only on county-level data in the U.S, and use a simplistic measure of religious diversity. The religious diversity index in their specification is negative and statistically significant at 1 percent, rejecting the "melting pot" theory of religion and social capital.

Fortunately, there are many quantitative economic measures of concentration and competition between firms, especially with respect to market share. The Herfindahl index is one such metric, used to measure firm size relative to market size and estimate market power (Black et al., 2017). Shannon entropy, or the Shannon diversity index, is another popular method for measuring diversity in datasets, most commonly used in ecology but also applied to many corporate diversity analyses (Hill, 1973).

By estimating the causal effect of these diversity and competition metrics on nation-level economic growth, I hope to elucidate the interplay between religious factionalization and the social determinants of economic growth. Can nations with state-sponsored religions (religious plurality) expect less growth than nations with more religious freedoms? My results indicate that there is a noticeable effect of religious diversity on growth. Nations with a religious plurality can expect lower growth rates than those without, according to regressions on the Herfindahl index, Shannon entropy, and an average of the two. My results contradict Rupasingha and Chilton (2009), who find that religious diversity has a statistically significant *negative* impact on income growth for counties in the U.S.

2 Economic Model

2.1 Determinants

I will construct two independent variables to serve as a proxy for aspects of religious diversity using the fraction of participation in one of six major belief systems: Buddhism, Islam, Confucianism, Protestantism, Hinduism, and Catholicism. Since there is data for Orthodox Catholicism, I separate Catholicism into two denominations, Western Catholic and Orthodox.

To account for other belief systems, I include an eighth category, "other", where $r_i \in \{r \mid r \text{ is one of } n \text{ major belief systems}\}$:

$$other = 1 - \sum_i^n r_i$$

The Herfindahl index (HHI), also known as Simpson's index, measures market concentration of firms by summing the squares of their market shares. The index approaches zero as the market becomes more competitive, and approaches 1 as the market becomes monopolized. Likewise, if there is perfect religious unification, HHI approaches 1; conversely, HHI approaches $1/n$ as the religions become evenly distributed. There may be more relevant measures for describing the balance of concentrations, such as Shannon entropy. If f is the religious fraction and n is the number of religions, then the HHI H is as follows:

$$H = \sum_i^n f_i^2 \tag{1}$$

Thus the measure of diversity D_H is as follows (Rupasingha and Chilton, 2009):

$$D_H = 1 - H = 1 - \sum_i^n f_i^2$$

The Shannon entropy function measures the dispersion across categories with a weighted logarithm. The more uneven the distribution of religious denominations, the larger the geometric mean of f_i, and the smaller the entropy (when there is only one type, a monopoly, the entropy is zero).

$$D_S = S = \ln(\frac{1}{\prod_{i=1}^{n} f_i^{f_i}}) = -\sum_i \ln(f_i^{f_i})$$

Using the unified notation proposed by Hill (1973), the diversity index D_i, where $D_H = D_2$ and $D_S = \ln(D_1)$, is calculated as follows:

$$D_q = (\sum_{i=1}^{n} f_i^q)^{\frac{1}{1-q}}$$

I also use a combination of both measures, which matches the distributions of both individual diversity metrics, as shown in Figure 1:

$$D = \frac{\ln(D_1) + D_2}{2}$$

2.2 Model

I will use an ordinary least squares (OLS) multiple regression model with robust standard errors to estimate the causal effect of religious diversity on economic growth. After regression, I will assess the significance of each regression coefficient using a two-sided t-test and report the p-values.

To perform multiple regression with OLS, I make several key assumptions. First, I assume that $(\forall X_i)E(u_i|X_i) = 0$ (zero conditional mean). This assumption is likely to be true so long as no elements of the error term are correlated with the determinants. Including the correct controls to remove omitted variables bias will assist this assumption, as possible covariates in the error term are included as covariates in the regression. If there are any terms left unaccounted for, this assumption is violated. I also assume that all variables included in my specifications are independent and identically distributed (i.i.d.). If the samples are not collected independently, this assumption is violated. However, this dataset has a reliable history of peer-reviewed statistical inference (Barro, 1996).

Finally, I observe two technical conditions. First, I assume that outliers are unlikely for all variables. Histogram analysis of my calculated determinants reveals a skewed distribution, but no significant outliers (see Table 1). Likewise, the control variables used are merely skewed and have few, if any, outliers. Finally, I assume that the data does not hold any perfect multicollinearity. Since my calculated determinants are non-linear, there is no perfect multicollinearity. There is some imperfect multicollinearity, but VIF analysis on my baseline specification reveals no VIF scores above 10. Imperfect multicollinearity may occur in the alternative specification with the introduction of interaction terms and non-linear effects, but cannot be avoided since the regressors cannot be dropped or combined without sacrificing the purpose of alternative specification. Instead, I use robust standard errors and adjusted r-squared to account for the effects of multicollinearity and drop less significant control variables if necessary.

The OLS estimators are not efficient relative to alternatives like weighted least squares because I do not assume homoskedasticity. In fact, my baseline specification exhibits slight heteroskedasticity, as illustrated in Figure 2. Once again, I use robust standard errors to account for this effect, though the large sample size of my dataset ensures the estimator is still unbiased and consistent.

2.3 Baseline Specification

In my baseline specification, I include several controls likely to cause an omitted variables bias: religious intensity *relint*, ethno-linguistic fractionalization $elfract$, public education spending as a share of GDP *pubedu*, political rights *prights*, GDP at the beginning of the period measured, civil liberties *civlib*, degree of capitalism, and higher education in 1960. I find that GDP in 1960, the degree of capitalism, and higher education have insignificant individual effects on growth. Likewise, an F-test reveals an insignificant joint effect on these

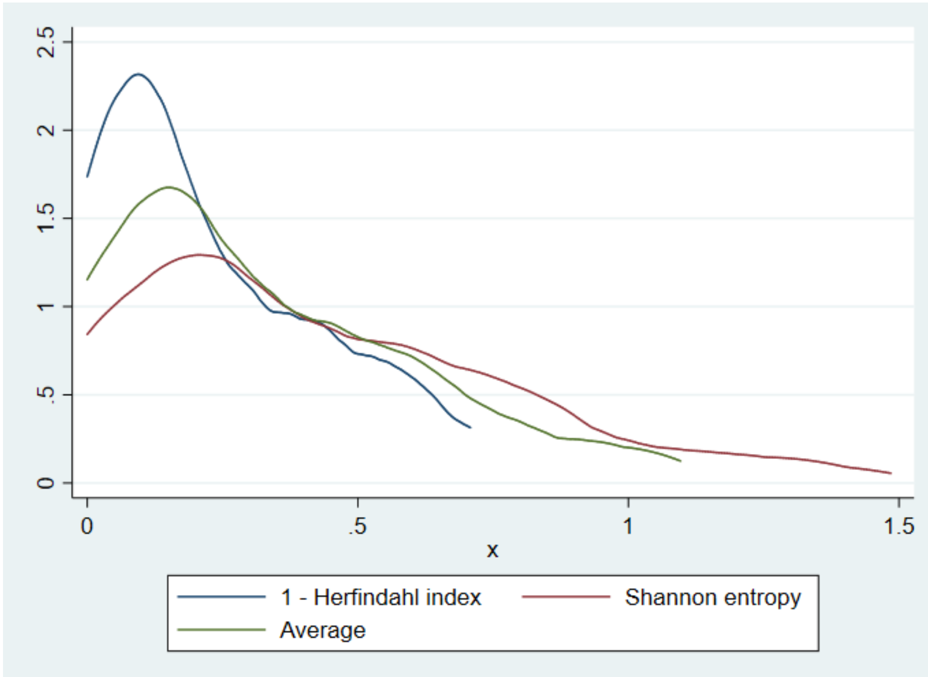

Figure 1: Averaged diversity metric distributions.

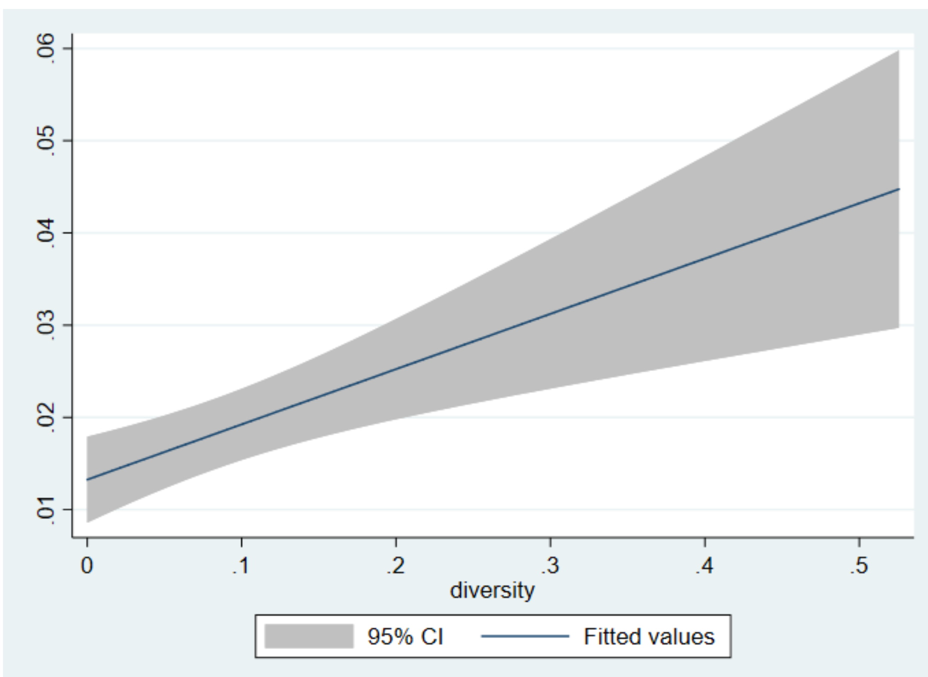

Figure 2: Slight heteroskedasticity in the baseline specification.

controls at the 5% level, so these variables are dropped from the specification. After dropping these controls, the specification proves significant at levels less than 1%. Religious intensity is a very important control, as it seems to be a source of negative omitted variables bias; without it, the coefficient on diversity is drops drastically.

I include three versions of the specification, varying the proxy variable used to represent religious diversity (Equation 2). The improvements made to my baseline specification above hold true for all three versions. In the last version, I combine the two indices into a single diversity metric. I cannot include both indices at once, as they are highly multicollinear, with VIFs greater than 30 when regressed together.

$$\forall X_i \in \{H, S, D\},$$
$$\widehat{growth} = \beta_0 + \beta_1\hat{X} + \beta_2\widehat{relint} + \beta_3\widehat{elf} + \beta_4\widehat{pubedu} + \beta_5\widehat{prights} + \beta_6\widehat{civlib} \tag{2}$$

2.4 Alternative Specifications

I conduct alternative specifications to assess the robustness and sensitivity of the baseline specification. The first alternative introduces an exponential term to account for non-linear effects (Equation 3). In the non-linear model, I exclude the least significant control variable, religious intensity, to mitigate multicollinearity and obtain more meaningful results. The second alternative introduces an interaction term between religious diversity and religious intensity - theoretically, the effects of religious diversity should be exacerbated by an increase in religious intensity as values are strengthened and religious behaviors are more frequent (Equation 4). The interaction term adds some emergent multicollinearity, but the joint effect is still significant for all three determinants and both alternatives.

$$\widehat{growth} = \beta_0 + \beta_1\hat{D} + \beta_2\widehat{elf} + \beta_3\widehat{pubedu} + \beta_4\widehat{prights} + \beta_5\widehat{civlib} + \beta_6\hat{D}^2 \tag{3}$$
$$\widehat{growth} = \beta_0 + \beta_1\hat{D} + \beta_2\widehat{relint} + \beta_3\widehat{elf} + \beta_4\widehat{pubedu} + \beta_5\widehat{prights} + \beta_6\widehat{civlib} + \beta_7\hat{D} * \widehat{relint} \tag{4}$$

3 Description of Data and Results

I use cross country data consisting of nearly 100 variables observed for a sample of 87 countries (Barro, 1996). Growth is measured by average growth in GDP per capita at purchasing power parities between 1960 and 1996. Religious factionalization is measured by the proportion of the country participating in a particular denomination. Table 1 displays summary statistics for the growth variable, each religious fraction, the calculated diversity indices, and control variables included in my specifications. Note that the Herfindahl index is bounded at 0.29 and 1.00, which is mathematically consistent with Equation 1. There are no perfectly even distributions. Both indexes display a skew towards concentrated distributions, those countries in which one religion dominates.

The regression results for the baseline (Models 1-3) and alternative (4-5) specifications are displayed in Table 2. Both the Herfindahl index and Shannon entropy have highly significant ($p < 0.001$) effects on growth. For each 0.1 unit increase in the Herfindahl index (market power of the dominant religion), average growth decreases by 1.00%. Likewise, for each 0.1 unit increase in Shannon entropy (evenness), average growth increases by 0.61%. With respect to the average diversity metric, an increase of 0.1 denotes an 0.8% increase in growth.

When a nonlinear term is included in the specification, the partial effect of diversity is as follows, where the coefficient on D is significant at 1%:

$$\frac{\partial \hat{growth}}{\partial \hat{D}} = 0.262D + 0.001$$

The non-linear specification fits the data less well per the decrease in adjusted r-squared, but the significant positive effect remains. Likewise, the partial effect when an interaction term with religious intensity is included is as follows:

$$\frac{\partial \hat{growth}}{\partial \hat{D}} = 0.081 - 0.001 * relint$$

The coefficient on *relint* is not significant, but the joint effect of the diversity covariates is highly significant. Further, the coefficient on D barely changes, suggesting that the baseline results are not sensitive to interaction effects with religious intensity.

Conclusion

Considering the range of possible values for the diversity metric and the large economic impact of small changes in growth, religious diversity has a considerable impact on economic growth. If religious diversity is a proxy for sociocultural capital, my results affirm the "melting pot" theory that religious competition or diversity improves economic growth through an increase in social capital. If my model is externally valid, my results also suggest that other forms cultural diversity are beneficial to economic growth, and that countries with religious or other demographic pluralities can improve growth with an increase in diversity.

To extend my model, I would consider the specific distributions that compose the diversity index for specific countries. Do combinations of particular religious factions create higher growth than others? Are some religions more likely to dominate others - if so, what aspects of those religions deter growth? I would also like to account for the slight heteroskedasticity of my data with a weighted least squares model, and test out other nonlinear effects with less multicollinearity. I suspect the relationship between the diversity metric and growth is non-linear due to the non-linear, since there are likely to be decreasing returns at the tail ends of the diversity distribution. I would also control for other institutional demographic distributions - as it stands, my results are most meaningful when interpreted in a social capital context. To isolate the specific effects of religion as a form of social capital, I must quantify the benefit that comes from diversity in general.

Table 1: Summary Statistics

	mean	sd	min	max
Growth	0.018	0.019	-0.03	0.07
Buddhism	0.039	0.153	0.00	0.95
Islam	0.150	0.298	0.00	0.98
Confucianism	0.016	0.080	0.00	0.60
Protestantism	0.137	0.286	0.00	0.99
Hinduism	0.026	0.123	0.00	0.81
Western Catholicism	0.312	0.417	0.00	1.00
Orthodox Catholicism	0.019	0.099	0.00	0.83
Herfindahl Index	0.775	0.203	0.29	1.00
Shannon Entropy	0.422	0.345	0.00	1.48
Diversity	0.324	0.273	0.00	1.10
Religious Intensity	0.785	0.190	0.32	1.00
Ethnolinguistic Fract.	0.348	0.303	0.00	0.89
Education Spending	0.024	0.010	0.00	0.05
Political Rights	3.838	2.003	1.00	7.00
Civil Liberties	0.508	0.327	0.00	1.00
Observations	87			

Table 2: Regression Results

	(1) GR6096 b/se	(2) GR6096 b/se	(3) GR6096 b/se	(4) GR6096 b/se	(5) GR6096 b/se
relint	0.079**	0.081***	0.087**		0.087
	(0.03)	(0.02)	(0.03)		(0.06)
elf	-0.016*	-0.017**	-0.016**	-0.019**	-0.016**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
pubedu	0.378*	0.274*	0.312*	0.331*	0.312*
	(0.15)	(0.13)	(0.14)	(0.15)	(0.13)
prights	-0.006***	-0.006***	-0.006***	-0.006**	-0.006***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
civlib	-0.028**	-0.025**	-0.026**	-0.027**	-0.026**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
H	-0.100***				
	(0.02)				
S		0.061***			
		(0.01)			
D			0.080***	0.001	0.081
			(0.02)	(0.01)	(0.07)
D^2				0.161**	
				(0.05)	
D * relint					-0.001
					(0.15)
constant	0.066***	-0.038	-0.042	0.048***	-0.043
	(0.01)	(0.03)	(0.03)	(0.01)	(0.06)
RMSE	0.014	0.014	0.014	0.014	0.014
Adj. R-Squared	0.424	0.475	0.464	0.430	0.457
Observations	88	87	87	87	87
Joint p (determinants)	0.0000426	0.00000204	0.00000578	0.000688	0.00000184
Joint p (all)	1.02e-09	4.32e-11	1.44e-10	2.66e-09	3.88e-12

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Joint p-values calculated with an F-test of $H_0 : (\forall \beta_i)(\beta_i = 0)$.

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