Review of Religious Research
https://doi.org/10.1007/s13644-019-00379-w

RESEARCH NOTE

Measuring Christian Religiosity by Google Trends

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Received: 30 May 2018 / Accepted: 28 April 2019

Abstract
This work proposes a new method to construct a measure of religiosity by utilizing information obtained from Google Trends. The proposed measure, named Christian Religiosity Revealed by Search, is built upon ten comparisons between religious and non-religious topics, and is shown to perform better than the frequently used Gallup Poll and World Values Survey religiosity scores in explaining some economic and political indicators.

Keywords Christianity · Google trends · Religiosity

Introduction

Religion is an important element of our civilization. It has not only formed the foundation of the ethics of our civilization, but also guided our behaviors. In the literature, religiosity is often measured by survey responses. Their accuracy is dependent on the honesty of subjects. Others rely on behaviors of subjects, for example, by using church attendance as a proxy. It may not be an reliable measure since many have ceased to attend congregations but still regard themselves sincere believers. This paper proposes an alternative measure that relies on the search volumes of religious topics on Google. This measure is arguably more accurate because it not only relies on the actual search behavior but also benefits from the use of big data. The measure is mainly build upon searches of topics related to Christianity and religion in general, but the same methodology may actually be used to construct intensity scores of other cultural values.

I am grateful to Jeal-Paul Azam, Mario Ferrero, the audience of the 2017 Meeting of European Public Choice Society held in Budapest, three anonymous reviewers and the Editor for their comments.

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Published online: 09 May 2019

Discussion on Existing Measures

More than a hundred measures of religiosity are present (Hill and Hood 1999). Most of them rely on interviews and surveys. In the discipline of Economics and related research, two country-level measures are frequently mentioned and used. One is the Gallup World Poll computed by the Gallup Organization. The poll was done by telephoning subjects and asking them questions in the main local language. The questionnaire asks, "Is Religion an Important Part of Your Daily Life?" Kahneman and Deaton (2010) showed with the information of the poll that religious belief is positively correlated with reported happiness and negatively with stress. Diener et al. (2011) constructed a national ranking of religiosity based on the Gallup World Poll from 2005 to 2009 which sampled 455,104 individuals from 154 countries.

Another frequently employed dataset is the World Values Survey (Inglehart et al. 2014), which collected religious attitudes of subjects in six waves up to 2014 (Norris and Inglehart 2011; Barro and McCleary 2003; McCleary and Barro 2006; Noland 2005). The survey asked several questions related to religious beliefs and also church attendance. The two measures are often compared side-by-side. For example, Heinemann and Schneider (2011) employed both Gallup and WVS as measures of religiosity in a study of shadow economy. Besides, the World Christian Encyclopedia by Barrett et al. (2000) documented the numbers of affiliated believers of worlds major religions, which is also frequently employed alongside with the mentioned surveys.

The disadvantages of questionnaire method are well-known. The accuracy of survey data relies very much on the honesty of subjects. They may feel pressed to report a religious option in a very religious country, or the opposite in a secular society, even if it is a self-monitored questionnaire. Subjects may not truly disclose the truth and they may have their own interpretations of the semantic meanings of the questions. Interestingly, Bjørnskov (2010) compared Gallup and WVS in the measurement of life satisfaction (not limited to religiosity) and found that they generated rather different results. He questioned the degree to which the two surveys measured the same concept. Meanwhile, church attendances are also often used to measure religiosity. However, it is not as precise as many believe. Should we accept that church attendants without corresponding behaviors are more religious than those do not go to church but absorb and act the Christian values in their daily life? As no measure is perfect, proposals for alternatives are worth discussing.

Why Online Searches?

Any measures come with errors. Even if the measure is constructed by what subjects behave and what subjects respond verbally, researchers cannot rule out the possibility that those explicit or observable responses perfectly reflect the implicit or unobservable values. A correct question to ask is how large is the error. Could we accept the measure based on a general evaluation of costs and benefits? For example, the construction of a measure based on surveys assumes that subjects are honest, or at least most of the subjects are honest and those dishonest or insincere responses do not significantly contaminate the final output. A step back, researchers are willing

to accept errors, given that errors are randomly distributed among subjects and the relative ranking of the aggregate measure is unaffected. For example, if researchers want to rank nations by their citizens happiness, they implicitly assume that insincere subjects are minority and their relative proportions are roughly the same across nations so that errors do not put an unhappy nation above a happy one.

While the academia generally accepts that interviews and surveys are useful and accurate ways to measure intangible concepts and minds, questions are raised concerning the possibility of utilizing data of online behaviors. A frequently exploited mining field is Google Trends. Google Trends is an official spin-off project of Google Search (an online search engine) that gathers all records of online searches by users since 2004. Users can input a term, specify the region and time and then collect a time series of Google Trends scores. The use of Google Trends for social sciences research is actually not new. Vosen and Schmidt (2011) introduced an indicator based on Google Trends and found that it performed better in predicting private consumption than the often-mentioned University of Michigan Consumer Sentiment Index. Choi and Varian (2012) used the data from Google Trends to successfully forecast the sales of automobiles, unemployment claims, travel destination, and consumer confidence. Preis et al. (2012) constructed a future-orientation index by contrasting the volume of searches in a specified year, say, 2010, of the previous year, 2009, and that of the coming year, 2011. They found that the future-orientation index is strongly correlated with Gross Domestic Product per capita. Stephens-Davidowitz (2014) provided a measure of racial animus of the United States by the information of searches of some sensitive racist terms on Google. He found that the racial animus had cost Obama four percentage points of the national popular vote in both 2008 and 2012 elections. Da et al. (2014) proposed the use of FEARS (Financial and Economic Attitudes Revealed by Search) to measure investor sentiments. They found that mainly negative terms were able to explain the past variation of returns. Their measures are acceptable since the assumption that people search because they care works fine for those circumstances. Measuring a cultural or religious value may be more problematic. This work is not going to defend that the proposed measure of this paper is bulletproof. Instead, this work is an exploration of the possibility that online search behaviors can be used to measure values. The following sections attempt to evaluate costs and benefits of the proposed measure from a conceptual perspective, together with a comparison with two other frequently used indexes by their statistical explanatory power.

Costs of Using Online Search Data

Costs are equivalent to disadvantages or errors. What users search online may not be what you actually intend to do. For instance, a researcher in terrorism search hundreds of related terms online but is not radicalized or a terrorist. By the same logic, any hostile searches would contaminate the construction of the measure. This error may be large dependent on the term searched, but is decreasing in the number of people searching the term. In other words, as long as the sample size is sufficiently

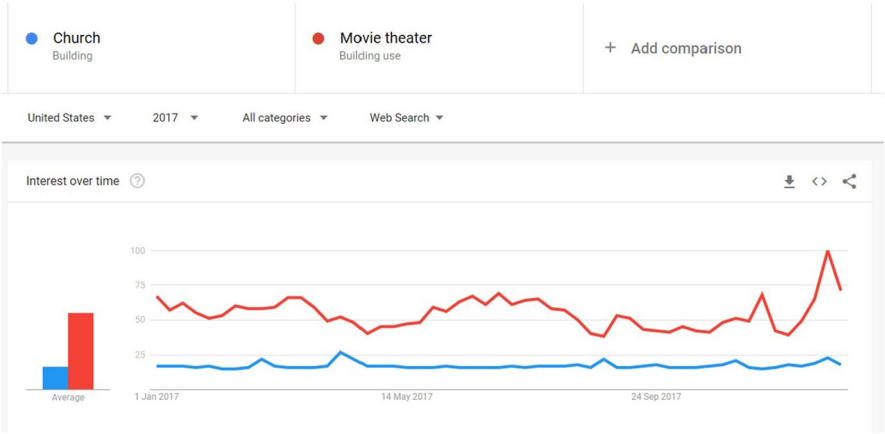

Fig. 1 Church versus movie theater in the US in 2017

large, this error goes away given that "hostile" agents are not numerous, and that religious people are more likely to search religious terms.

Another problem is due to the limitation of Google Trends. No exact search amounts are given by Google Trends. It is constructed as a relative measure. For clarity, I reproduce the exact explanation posted on the website of Google Trends:

> Google Trends adjusts search data to make comparisons between terms easier. Search results are proportionate to the time and location of a query by the following process:
>
> - Each data point is divided by the total searches of the geography and time range it represents to compare relative popularity. Otherwise, places with the most search volume would always be ranked highest.
> - The resulting numbers are then scaled on a range of 0–100 based on a topic's proportion to all searches on all topics.
> - Different regions that show the same search interest for a term don't always have the same total search volumes.

Therefore, each value should be interpreted relative to the highest value (100) of the same time series. For example, Church is input (as a building) in Google Trends and the query is limited to the United States in the Year 2017. It gives a value of 60 during the week 5–11 February and 100 during the week 9–15 April, meaning the search proportion adjusted by the total search amounts of all topics during the former period is 60% of the search proportion of the latter period. If two terms are input together in one query, each value should be interpreted relative to the highest value (100) of the two time series. Figure 1 helps illustrate this. The peak of the time series of "Church" is still found during the week 9–15 April, but the value is no longer 100, but 27. The reason is the time series has been adjusted so that the "Movie Theater" scores 100 during the week 24–30 December when the search proportion

was the highest among all weeks of both topics. The values say that the search proportion of "Church" during the week 9–15 April is 27% of that of "Movie Theater" during the week 24–30 December. Although the adjustment is indeed necessary, it makes comparison between queries meaningless. Moreover, Google Trends does not allow generating scores for multiple countries or regions in one query. Users cannot input "Church" and generate a ranking of nations. This work proposes a methodology to circumvent this problem.

Benefits of Using Online Search Data

An obvious advantage of the proposed methodology is the use of big data. Google has gathered all records of searches on its search engine, that certainly involves billions of people. The overall sample size is undoubtedly gigantic. Its flexibility is also helpful. Researchers can generate indexes on a wide range of topics on a day, in a month, or across several years. On the other hand, traditional surveys are costly, limited in scale, and could not be done too frequently.

The benefit or the usefulness of any measure should also be evaluated by its explanatory power, given that the actual object of interest could never be observed. In "CRRS and Comparisons with Others" section, the proposed measure is compared along with two other frequently used measures of religiosity in terms of their explanatory power of countries' political governance quality and economic freedoms.

Weighing the costs and the benefits, this work employs a strategy to best amplify the benefits and to minimize the costs. The following section helps readers better digest the proposed strategy.

Construction of the Index

Two Worlds in Conflicts

As mentioned above, Google Trends is a relative index. While comparing a term to itself of another point of time is not very useful, a reference point, i.e. a secular term, is needed so that we can interpret the index as a measure of religiosity relative to the secular world. An implicit assumption is that we are living in a dichotomous world. Christianity often portraits a sinful earth and a sacred place not in this physical world. In Christian tradition, humans have been fallen into sin and thus separated from God. Since then humans have been living in an on-going conflict between two worlds, namely the material world we dwell and the heavenly world Christians envision. Paul the Apostle stressed several times in the Bible that flesh and spirit are in opposition and we cannot satisfy them all at the same time with the same mind:

> "Those who live according to the flesh have their minds set on what the flesh desires; but those who live in accordance with the Spirit have their minds set on what the Spirit desires." Romans 8:5 New International Version

> "Do not conform to the pattern of this world, but be transformed by the renewing of your mind. Then you will be able to test and approve what God's will is–his good, pleasing and perfect will." Romans 12:2 New International Version
>
> "For the flesh desires what is contrary to the Spirit, and the Spirit what is contrary to the flesh. They are in conflict with each other, so that you are not to do whatever you want." Galatians 5:17 New International Version
>
> "Whoever sows to please their flesh, from the flesh will reap destruction; whoever sows to please the Spirit, from the Spirit will reap eternal life." Galatians 6:8 New International Version

Christianity, at least for some denominations, tend to promote ideas of leaving our earthly and sinful life, and of focusing on heavenly things. Conflicts are inevitable and thus being religious is an action and also a preference over the two conflicting worlds. This dualism provides a basis on which Google Trends can be used to construct a religiosity index. Google Trends is built upon relativity, so do Christian beliefs. If we accept that religious people tend to search more frequently religious terms with respect to non-religious or secular terms, Google Trends is an excellent tool for us to understand religions and beliefs. In short, it is a market of attention. If subjects spend more time and attention on their religious lives, they have less time to spend on other aspects of their lives.

What is Religiosity?

"Religiosity" is defined in the Oxford Dictionary as a "strong religious feeling or belief". "Religious" as an adjective is defined as "relating to or believing in a religion", and "religion" is defined as "the belief in and worship of a superhuman controlling power, especially a personal God or gods". In short, religiosity is attached with a belief in a superhuman power. Beliefs are not observable, but could be revealed by actions or by truthful disclosure. Some beliefs can be easily characterized by simple questions. For examples, "Do you believe in the existence of God?", "Do you pray to your God or gods in case of danger?" and etc. Each question may reveal a certain dimension of religiosity, but not the whole picture. Therefore, composite measures are created by combining questions or items (see Hill and Hood 1999). This work also proposes a composite index so that measurement errors in a particular dimension would not significantly affect the overall index. The proposed approach is similar to asking subjects, "Do you search term X (religious) more frequently than term Y (non-religious)?" and expecting no verbal answers but actual search behaviors. In other words, "religiosity" in this work is defined by a set of preferences that lead to online searches of religious topics. A challenging question is that what are the terms or topics searched online that relate to religious beliefs. Assumptions, as we discussed before, have to be made and the religious topics chosen have to be generally accepted as correct. "The Ten Dimensions" section will discuss the topics chosen to measure religiosity.

The Christian Religiosity Revealed by Searches (CRRS)

Google Trends does not give the actual numbers of searches. Instead, Google Trends only reports a score adjusted by leveling the highest value over the specified period to 100. We face two problems when using the index. First, it makes comparisons across countries problematic. Although Google Trends allows users to retrieve the index of the World and shows the top 20 countries where the searches are more frequent, we cannot collect the scores of all countries in one query. Second, the proportions of searches are affected by searches of other terms. For example, we expect search of Pope soars when the Pope visits the corresponding country and meanwhile drags down the proportion of search of "Bible". But it is incorrect to say "Bible" is now less frequently searched and people become less religious.

To solve the mentioned problems, this paper proposes the following method. Ten cleavages, or dimensions, are selected between the (Christian) religious world and the non-religious world. A religiosity score is then computed by contrasting the scores given by Google Trends. For each dimension, two topics are contrasted (not simply terms but topics defined by Google Trends) each representing either the religious world or the non-religious. Google Trends allows users to select search the inputs as "terms" or "topics". The former refers to the exact match of alphabets, while ignoring differences of upper and lower cases. For example, if "Religion" is input in the query field as a term and the geographical sphere is set to "Finland", Google Trends will only count the searches of any searched items that include "Religion" or "religion" in Finland but ignoring "Uskonto" (Finnish), "Religião" (Portugese), "Religia" (Polish) and all other translations. Moreover, it also includes the searches not related to the religious use of "Religion". If "Religion" is input as a topic, Google Trends filters out searches unrelated to the religious use of "Religion" and encompasses "Religion" in all languages.[1] Therefore, it is important to stress that the index is built upon the volumes of topics but not terms. By doing this, we avoid the problems of language differences and irrelevant searches. Figure 2 shows an example of comparing "Religion" as a topic and "Religion" as a term in Finland in 2015. "Religion" as a topic always ranks above "Religion" as a term. It is reasonable, though not necessarily true in all cases, since a query of a topic includes also other searched items closely related to religion.

To avoid seasonal fluctuations and complications due to unexplained spikes or slumps over the year and also some zeros, we compute a yearly score by adding up the weekly scores of a topic. As all values are generated relative to the highest value of the period, the weekly score is addable and the added values are comparable between two topics of the same query. Precisely, the relative score of two topics x_i and y_i country i is as follows:

$$R_{x_i y_i}(n) = \frac{\sum_{t=1}^{52} s_{x_i}(t,n) - \sum_{t=1}^{52} s_{y_i}(t,n)}{\min\left(\sum_{t=1}^{52} s_{x_i}(t,n), \sum_{t=1}^{52} s_{y_i}(t,n)\right)}, \tag{1}$$

[1] Google traces also the destinations of all search queries and thus is able to sort searches by topics.

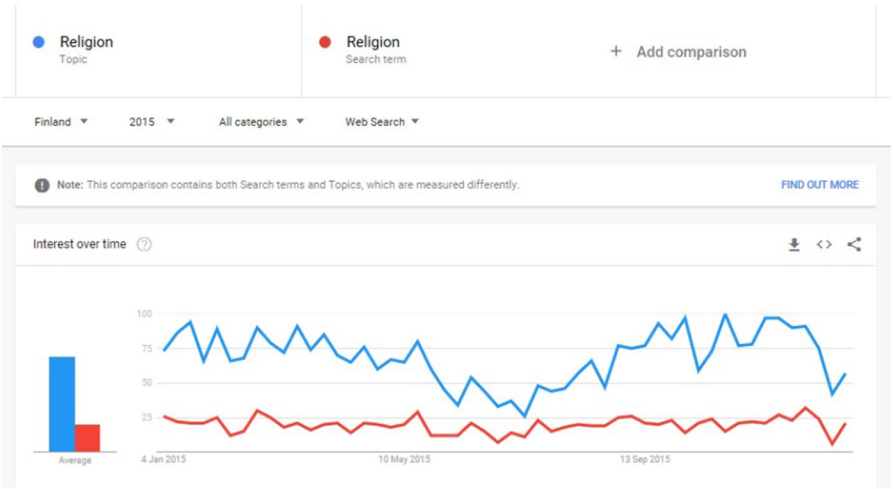

Fig. 2 "Religion" as a topic and "Religion" as a search term (Finland, 2015)

where x_i refers to the topic of the religious world $x_i \in X$ of dimension $i \in \{1, 2, \ldots, 10\}$, and y_i refers to the topic of the non-religious world $y_i \in Y$ of dimension i. The week t score of topic x_i of country n is denoted by $s_{x_i}(t, n)$.

Putting the minimum value of the two raw scores in the denominator is to make the magnitude of the relative score symmetric. For example, if $\sum_{t=1}^{52} s_{x_i}(t, n) = 100$ and $\sum_{t=1}^{52} s_{y_i}(t, n) = 300$, $R_{x_i y_i}(n)$ is therefore 2, meaning that the search popularity of y_i is 200% more than that of x_i. If $\sum_{t=1}^{52} s_{x_i}(t, n) = 600$ and $\sum_{t=1}^{52} s_{y_i}(t, n) = 200$, $R_{x_i y_i}(n)$ is -2, saying that the search popularity of x_i is 200% more than that of y_i.

The relative score is positive when the religious topic on average ranks higher than its worldly counter-party, and is thus interpreted as a religiosity score. By doing so, we solve the problems that searches may be affected by idiosyncratic spikes or slumps and that Google Trends cannot generate comparisons across nations.

The yearly scores are then normalized to having an average of 0 and a standard deviation of 1, eliminating any systematic dimension-specific effects. For example, the comparison of Google Trends scores between a particular pair of topics could be so large that it overwhelms the other nine pairs. The normalization corrects this bias by assigning an equal weight to each dimension. The adjusted scores of the ten dimensions are then summed up and the sum is multiplied by 10, generating the Christian Religiosity Revealed by Searches (CRRS).

The Ten Dimensions

The ten dimensions are briefly discussed before showing readers the computed index. The paper aims not to argue that these ten dimensions and the related 20 topics are the definite choices, which could be improved and refined. Note that the choices of religious terms are more restrained than those of secular terms. The latter could be any random secular terms completely unrelated to their religious

counterparts. The number one principle is the variations of two terms are not positively related. Considering that the final aim is to produce a ranking of countries, as long as the reference point of each dimension (the secular topic) is identical across countries, the choices of the secular topics are of secondary importance. Still, this work tries to compare more relevant pairs of topics so as to produce more pronounced, or more useful (in terms of explanatory power), results.

1. Religion or Science
   Religion (as a "Topic") versus Science (as a "Discipline")
   This pair compares the general interest in "Religion" relative to "Science".
2. Academic Interest
   Theology (as a "Discipline") versus Philosophy (as "Field of Study")
   Theology is the study of religions and Philosophy appeals to rationality. By contrasting these two disciplines, we may see the preferences of prospect university students and also curious ordinary Internet users.
3. Interests concerning History (a period)
   Crusades (as a "War") versus Age of Enlightenment (as a "Topic")
   The former concerns both the Catholic and the Protestant faith, while the latter is the milestone of rationalism. They constructed our civilization in different stages of the history.
4. Interests concerning History (a person)
   Martin Luther (as a "Professor") versus Immanuel Kant (as a "Philosopher")
   Martin Luther was a reformer who transformed Christianity, while Kant is widely regarded as a leading figure in rationalism in the European Continent.
5. Interests concerning Music
   Hymn (as a "Type of Music") versus Pop Music (as a "Musical Genre")
   Hymn refers to all types of religious music, while pop music is broadly defined as the most popular genre of music of the time.
6. Interests concerning Books
   Bible (as a "Sacred text") versus Harry Potter (as "Novel series")
   Bible is the sacred text for both Catholic and Protestant faith, while Harry Potter is arguably the most influential novel series of the past decade.
7. Interests concerning Acts
   Virtue (as a "Topic") versus Wealth (as a "Topic")
   Religious people tend to live for virtue rather than wealth.
8. Fear concerning Future Punishment
   Hell (as "Religion") versus Prison (as "Topic")
   When people are afraid of the consequences of committing a crime, they may want to know more about the hell if they believe in a religious underworld, or prisons if they are more concerned with the earthly life.
9. Sunday Activities
   Church (as "Building") versus Movie Theatre (as "Building")
   If someone spends time in a church on Sundays, they may lose the opportunity to go watch a movie elsewhere. On the other hand, more religious people may stay away from cinemas to avoid "pollution" by the movies.

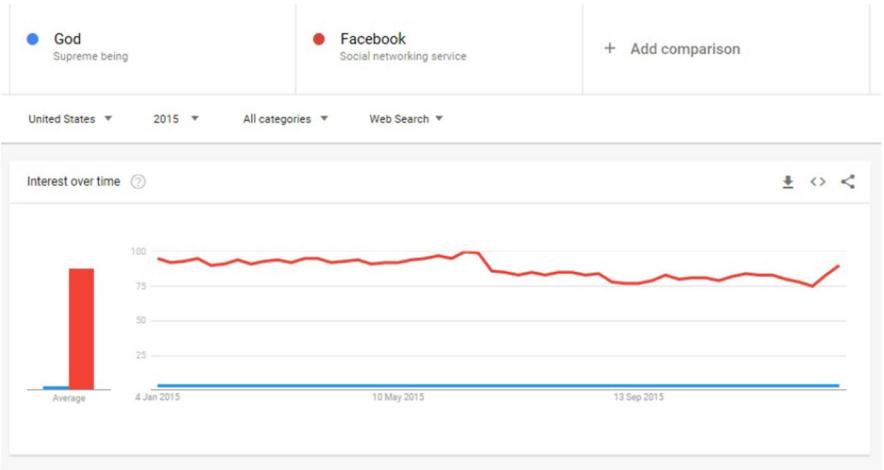

Fig. 3 God versus Facebook (United States, 2015)

10. God versus Humans
    God (as a "Supreme being") versus Human (as a "Primate")
    It compares the general interest in God relative to our human race.

There may be better matchups but the choices are limited for at least two reasons. Firstly, the religious topics cannot be too general because the assumption that religious agents are more likely to search the topic might be wrong. Secondly, the contrast of the two topics cannot be too large that diminishes the variation of the series. For instance, God cannot be compared to Facebook because the huge volumes of searches of the latter will limit the variations of the former, as shown by Fig. 3. This problem will be magnified if someone wants to apply the proposed method to compare changes of cultural values of multiple years.

CRRS and Comparisons with Others

The Index and Correlations with Gallup and WVS

This paper reports the score of the year 2015. Table 1 list the CRRS of 58 countries along with the corresponding Gallup (Diener et al. 2011) and World Value Survey indexes (Inglehart et al. 2014). The larger is the number, the higher is the measured religiosity. Figure 4 plots the correlations between CRRS and Gallup, and between CRRS and the latest (the Sixth Wave) WVS index (V_9: Percent saying religion is "very important" in life).

The proposed measure passes the first hurdle as a valid religiosity index; it positively correlates with two existing country-level religiosity measures. The correlations are roughly 0.56. CRRS certainly ranks countries according to some dimension of the Christian belief, but may not be superior than Gallup and WVS. The

Table 1 CRRS, Gallup and WVS

Country	CRRS	Gallup	WVS
Albania	− 6.92	35	27.5
Argentina	24.26	64	24.1
Australia	− 17.23	32	14.1
Austria	7.34	53	
Belarus	7.7	33	15.9
Belgium	− 57.82	39	
Bosnia and Herzegovina	19.65	69	34
Brazil	36.59	88	51.5
Bulgaria	5.61	35	18.4
Canada	− 17.25	45	31.8
Chile	49.17	69	23.8
Croatia	8.58	69	25.7
Cyprus	11.49	76	51.1
Czech Republic	16.26	26	9
Denmark	− 8.69	19	
El Salvador	86.81	88	86.5
Estonia	− 19.03	17	7.6
Finland	− 31.2	28	17.6
France	− 43.69	27	13
Germany	− 17.71	41	13.1
Greece	1.85	71	
Hong Kong	10.24	23	12.1
Hungary	− 37.18	41	17.1
Iceland	− 21.92	39	
Ireland	− 26.17	57	
Italy	2.77	73	34
Latvia	20.1	36	12.2
Lithuania	− 44.74	41	13.1
Luxembourg	7.42	40	
North Macedonia (FYROM)	2.85	80	47
Malta	17.97	90	
Mexico	9.79	68	58.4
Moldova	− 3.7	75	31.7
Netherlands	− 68.68	33	10.7
New Zealand	7.21	35	18.7
Norway	− 20.21	22	10.5
Paraguay	66.55	92	
Peru	56.36	83	49.9
Philippines	2.97	96	85.9
Poland	21.23	75	45.7
Portugal	− 31.5	73	
Romania	7.47	84	50.5
Russian Federation	− 55.04	32	14.3

Table 1 (continued)

Country	CRRS	Gallup	WVS
Serbia	2.75	53	25.3
Singapore	− 11.09	60	43.1
Slovak Republic	37.49	48	23.7
Slovenia	− 52.29	43	11.2
South Africa	34.01	85	55.8
Korea, Rep.	61.93	42	25.7
Spain	2.92	43	10.7
Sweden	− 54.22	16	7.9
Switzerland	− 19.69	43	17.2
Taiwan	34.5	44	17.7
United Kingdom	− 34.93	30	20.7
Ukraine	− 23.16	43	26.3
Uruguay	− 11.03	42	20.3
United States	− 7.92	66	40.4
Venezuela, RB	61.15	77	63.8
Correlation with Gallup	0.5648	1	0.8711
Correlation with WVS	0.5614	0.8711	1

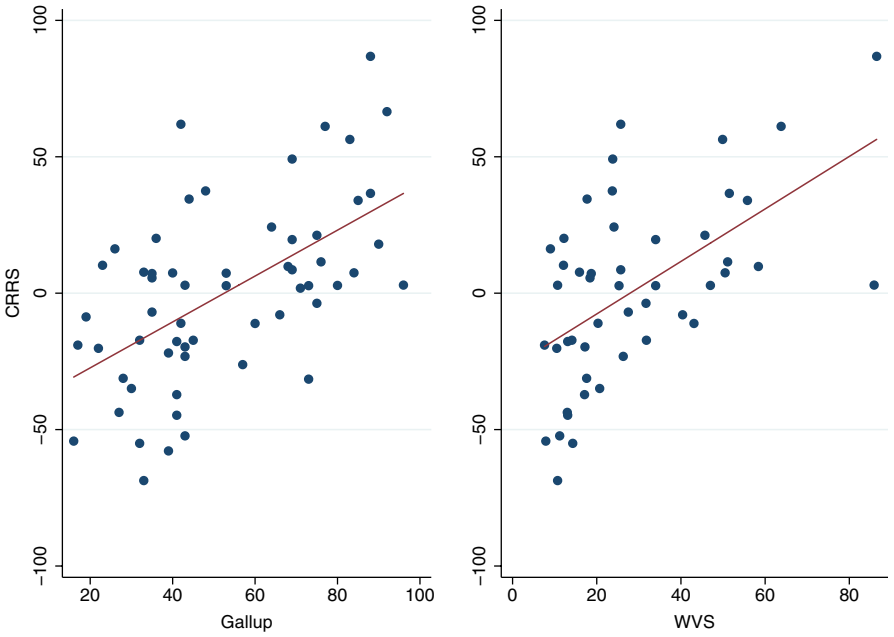

Fig. 4 Correlations (Left: CRRS and Gallup; Right: CRRS and WVS)

Table 2 Explaining governance indicators: CRRS

	(1) Corruption	(2) Efficiency	(3) Stability	(4) Regulatory	(5) Rule of law	(6) Voice
CRRS	− 0.00433*	− 0.00411**	0.000850	− 0.00257	− 0.00458*	− 0.00154
	(− 1.81)	(− 2.17)	(0.39)	(− 0.99)	(− 1.93)	(− 0.69)
GDPpc	0.885***	0.711***	0.547***	0.636***	0.817***	0.505***
	(10.99)	(11.18)	(7.47)	(7.30)	(10.21)	(6.68)
Constant	− 8.033***	− 6.195***	− 4.958***	− 5.417***	− 7.302***	− 4.226***
	(− 10.10)	(− 9.87)	(− 6.85)	(− 6.30)	(− 9.23)	(− 5.66)
N	57	57	57	57	57	57
AIC	94.40	67.40	83.60	103.3	93.72	87.09
R^2	0.759	0.771	0.546	0.576	0.736	0.524

t Statistics in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

correlation between Gallup and WVS is 0.87, reflecting the similarity of the questions being asked. The following section compares the three measures according to their usefulness in explaining some political and economic indicators.

Comparisons in Terms of Explanatory Power

Governance Indicators

Although the correlation between Gallup and WVS is stronger than that between CRRS and each of them, its usefulness should not rest upon how similar they are. Linear regressions are performed to check if CRRS is a better predictor of other political and economic indicators while controlling for the log of Gross Domestic Product per capita. Table 2 shows the Ordinary Least Square (OLS) results of regressing national governance performance of the same year (2015) measured by the World Bank Governance Indicators (WGI) on the three religiosity scores separately, without limiting to the same sample. This relationship has been explored by Lipset (1995), Al-Marhubi (2004) and North et al. (2013) among others. As the World Bank Governance Indicators are not the focus of this work, this work only discusses these indicators in brief. Readers are encouraged to check the official documentations.[2] The indicators consist of six dimensions of political governance of over 200 countries, including Control of Corruption, Government Effectiveness, Political Stability, Regulatory Stability, Rule of Law, and Voice and Accountability. The indicators are composite measures that involve more than 30 data sources (Kaufmann et al. 2011).

[2] Interested readers are encouraged to official documentations of the World Bank Governance Indicators at http://info.worldbank.org/governance/wgi.

Table 3 Explaining governance indicators: Gallup

	(1) Corruption	(2) Efficiency	(3) Stability	(4) Regulatory	(5) Rule of law	(6) Voice
Gallup	− 0.00722*	− 0.00696**	− 0.00147	− 0.00485	− 0.00662*	− 0.000201
	(− 1.95)	(− 2.39)	(− 0.43)	(− 1.21)	(− 1.78)	(− 0.06)
GDPpc	0.863***	0.689***	0.519***	0.617***	0.806***	0.524***
	(10.25)	(10.40)	(6.74)	(6.77)	(9.54)	(6.58)
Constant	− 7.436***	− 5.610***	− 4.598***	− 4.969***	− 6.839***	− 4.405***
	(− 7.87)	(− 7.55)	(− 5.33)	(− 4.86)	(− 7.21)	(− 4.93)
N	57	57	57	57	57	57
AIC	93.87	66.43	83.56	102.8	94.24	87.59
R^2	0.762	0.775	0.546	0.579	0.734	0.520

t Statistics in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Table 4 Explaining governance indicators: WVS

	(1) Corruption	(2) Efficiency	(3) Stability	(4) Regulatory	(5) Rule of law	(6) Voice
WVS	− 0.00440	− 0.00424	− 0.00572	− 0.00346	− 0.00792	− 0.00379
	(− 0.88)	(− 1.09)	(− 1.32)	(− 0.63)	(− 1.58)	(− 0.80)
GDPpc	0.894***	0.735***	0.486***	0.652***	0.801***	0.473***
	(8.82)	(9.35)	(5.53)	(5.85)	(7.91)	(4.92)
Constant	− 7.983***	− 6.271***	− 4.204***	− 5.449***	− 6.913***	− 3.820***
	(− 7.48)	(− 7.58)	(− 4.55)	(− 4.65)	(− 6.48)	(− 3.78)
N	47	47	47	47	47	47
AIC	85.36	61.38	71.85	94.13	85.24	80.33
R^2	0.720	0.747	0.541	0.534	0.698	0.461

t Statistics in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

The coefficients are not standardized and the *p*-values are provided in the parentheses below the coefficients. Asterisks indicate that the coefficients are statistically significantly different from zero at either 10%, 5% or 1% significance level.

Tables 2, 3 and 4 report the regression results.[3] The dependent variable is one of the governance indicators, which is explained by one of the three religiosity measures and the log of GDP per capita. We also report the Akaike information criterion (AIC) and R-squared for model comparison. As shown in Table 2, CRRS is significant in explaining control of corruption (negative), government efficiency (negative) and rule of law (negative). Meanwhile, as shown in Table 3,

[3] Taiwan has been dropped because GDP per capita is not avaliable from the same source.

Table 5 Explaining governance indicators: comparison

	Corruption	Efficiency	Rule of law
	CRRS versus Gallup		
	J-Test		
CRRS	0.449	0.290	0.371
Gallup	0.353	0.405	0.296
	Cox–Pesaran test		
CRRS	0.123	0.035**	0.081*
Gallup	0.058*	0.102	0.040**
	CRRS versus WVS		
	J-Test		
CRRS	0.865	0.703	0.400
WVS	0.224	0.246	0.278
	Cox–Pesaran test		
CRRS	0.422	0.311	0.097*
WVS	0.002***	0.007***	0.030**
	Gallup versus WVS		
	J-Test		
Gallup	0.620	0.584	0.692
WVS	0.236	0.165	0.563
	Cox–Pesaran test		
Gallup	0.324	0.306	0.325
WVS	0.033**	0.017**	0.245

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Gallup is also significantly correlated with the same governance indicators. Given the assumption that there is strong theoretical relationship between religiosity and political governance, a more accurate measure should perform well in improving the goodness of the fit (higher R-squared). In that sense, CRRS is a better measure than Gallup for rule of law, but a worse one for control of corruption and government efficiency. On the other hand, WVS does not significantly explain any of the governance indicators, as shown in Table 4.

As the regressions are done with different subsets of countries, direct comparison of the three religiosity measures is impossible. The next step is to compare two of them at a time by homogenizing the sample. Davidson and MacKinnon non-nested J-test (Davidson and MacKinnon 1981) and Cox–Pesaran test (Cox 1961, 1962; Pesaran 1987) are performed to check if one measure is significantly better than the other in terms of explanatory power. A rejection of the test is an evidence against the model in favor of the other. But we may not be able to draw a conclusion if the test does not reject either model, or reject both models. Table 5 reports the results. For clarity, we discard the results associated with those governance indicators not being significantly explained by any of the religiosity measures; it is very likely that a theoretical relationship is nonexistent. Based on the comparison between CRRS and Gallup, no clear-cut winner is found. J-tests do not reject one of them in all three cases, while Cox–Pesaran tests reject both

Table 6 Index of economic freedom

Index of economic freedom	
Rule of law	Government size
Property rights	Fiscal freedom
Freedom from corruption	Government spending
Regulatory efficiency	Market openness
Business freedom	Trade freedom
Labor freedom	Investment freedom
Monetary freedom	Financial freedom

measures once. Given that WVS is not significant in any of the regressions as shown in Table 4, CRRS is a better measure than WVS as Cox–Pesaran tests reject the latter twice in three cases. Gallup arguably performs as well as CRRS.

Economic Freedom

The relationship between religions and economic prosperity is a hotly researched field (Barro and McCleary 2003; McCleary and Barro 2006). While some are interested by the relationship between religious freedom and economic growth (Alon and Chase 2005; Jong 2008), religion as a determinant of economic freedom is not widely recognized. Elgin et al. (2013) found that the proportion of population believing in afterlife is negatively correlated with government spending at country-level. Dincer (2008) found that religious polarization and corruption are positively related. The main index of Economic Freedom is divided into 4 sub-fields and in total 10 components. Each component measures a defined dimension of economic freedom, as listed in Table 6. This paper is not going to discuss the indexes in details and interested readers are encourage to visit the official website and refer to Dialga and Vallée (2018).[4] In short, a higher score refers to a better or freer economy.

As shown in Tables 7 and 8, CRRS is significant in explaining government integrity, government spending, business freedom, and trade freedom, while Gallup is significant only for government integrity and business freedom. In terms of R-squared and AIC, CRRS is the better measure in three of the four cases. WVS is only significant in explaining government spending and business freedom, as shown in Table 9.

Next, J-test and Cox–Pesaran test are used to evaluate the explanatory power of the three religiosity measures after homogenizing the sample. Refer to Table 10, CRRS performs better than Gallup Index in three out of four cases according to the

[4] The official website of the Index of Economic Freedom (https://www.heritage.org/index/) provides definitions and other documents of the index. In 2019, the index has been modified and some components are renamed. This work follows the new terminology.

Table 7 Explaining economic freedom by CRRS

	(1) Property	(2) Integrity	(3) Tax	(4) Spending	(5) Business
CRRS	− 0.0372	− 0.0888*	0.0599	0.325***	− 0.130***
	(− 0.56)	(− 1.82)	(1.21)	(3.54)	(− 3.14)
ln GDPpc 2015	21.52***	16.10***	− 7.745***	− 5.195*	7.667***
	(9.65)	(9.82)	(− 4.64)	(− 1.68)	(5.51)
Constant	− 149.9***	− 100.8***	148.6***	98.66***	0.195
	(− 6.81)	(− 6.23)	(9.01)	(3.23)	(0.01)
N	57	57	57	57	57
AIC	472.9	437.8	440.1	510.2	419.3
R^2	0.688	0.720	0.383	0.314	0.551
	(6) Labor	(7) Monetary	(8) Trade	(9) Investment	(10) Financial
CRRS	− 0.0417	− 0.0117	− 0.0491**	0.0213	0.0346
	(− 0.60)	(− 0.32)	(− 2.11)	(0.28)	(0.52)
ln GDPpc 2015	4.258*	2.164*	1.668**	11.30***	9.445***
	(1.83)	(1.77)	(2.13)	(4.37)	(4.24)
Constant	20.25	57.04***	68.45***	− 39.42	− 29.62
	(0.88)	(4.71)	(8.86)	(− 1.54)	(− 1.35)
N	57	57	57	57	57
AIC	477.6	404.7	353.6	490.0	472.9
R^2	0.0947	0.0767	0.223	0.289	0.269

t Statistics in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

Cox–Pesaran test results, J-test also rejects using Gallup in explaining government spending. On the other hand, CRRS is a better measure than WVS as Cox–Pesaran tests reject using WVS in three occasions. For government spending, although Cox–Pesaran test gives us no conclusion, J-test rejects using WVS. However, Gallup and WVS are not better than one another.

To briefly conclude, CRRS and Gallup perform equally well in explaining some governance indicators, but the former is the better one in explaining economic freedom. Meanwhile, WVS performs poorly in almost all comparison criteria. Note that the superiority of CRRS and Gallup over WVS is not due to the better data availability as the sample has been homogenized before the comparison.

Discussion

Religiosity is a value, which is difficult to measure. To compare the accuracy of various measures, this paper proposes to compare their explanatory power. If there exists a theoretical relationship between religiosity and other indicators, a more accurate measure should deliver a more robust and significant correlation that

Table 8 Explaining economic freedom by Gallup index

	(1) Property	(2) Integrity	(3) Tax	(4) Spending	(5) Business
Gallup	− 0.109	− 0.136*	− 0.0268	0.213	− 0.222***
	(− 1.07)	(− 1.80)	(− 0.34)	(1.37)	(− 3.53)
ln GDPpc 2015	20.80***	15.79***	− 8.895***	− 7.341**	6.951***
	(8.95)	(9.16)	(− 5.01)	(− 2.07)	(4.85)
Constant	− 137.0***	− 90.49***	161.3***	108.4***	19.02
	(− 5.25)	(− 4.68)	(8.09)	(2.73)	(1.18)
N	57	57	57	57	57
AIC	472.1	437.9	441.4	520.1	417.0
R^2	0.692	0.720	0.368	0.183	0.568
	(6) Labor	(7) Monetary	(8) Trade	(9) Investment	(10) Financial
Gallup	− 0.150	0.0165	− 0.0510	0.00248	− 0.0470
	(− 1.42)	(0.29)	(− 1.38)	(0.02)	(− 0.46)
ln GDPpc 2015	3.129	2.518*	1.774**	11.03***	8.419***
	(1.30)	(1.96)	(2.11)	(4.05)	(3.59)
Constant	39.28	52.69***	70.12***	− 36.89	− 17.06
	(1.46)	(3.65)	(7.43)	(− 1.21)	(− 0.65)
N	57	57	57	57	57
AIC	475.9	404.7	356.1	490.1	472.9
R^2	0.121	0.0764	0.187	0.288	0.268

t Statistics in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

provides a more solid evidence of the relationship. One problem of this check is that we are not sure if the measure is in fact a measurement of the subject in which we are interested but not something else. To respond to this criticism, GDP per capita is included in the regression so that we are confident that any significant correlation is isolated from the national economic development. Another criticism is that the act of search is endogenously determined. Only those who have access to Internet can search on Google. One may expect that in some countries of limited Internet connection, the results tend to bias to the preference of the more affluent and younger population. If affluent and young people are less religious, CRRS would underestimate the degree of religiosity in those countries of limited Internet access. But limited Internet penetration is mainly a problem of poorer countries. That means the bias lowers the score for poorer countries, but they are highly ranked in the chart of CRRS. Either the bias is in fact absent, or it only drags the poorer countries closer to the richer countries while not affecting the ranking.

The construction of the measure has been carefully designed, but not impeccable. Christianity is a very diverse religion. This work attempted to choose topics

Table 9 Explaining economic freedom by WVS

	(1) Property	(2) Integrity	(3) Tax	(4) Spending	(5) Business
WVS	− 0.0734	− 0.0577	− 0.0109	0.477**	− 0.152*
	(− 0.54)	(− 0.58)	(− 0.12)	(2.63)	(− 1.84)
ln GDPpc 2015	21.39***	16.86***	− 7.437***	− 2.598	8.630***
	(7.76)	(8.36)	(− 3.96)	(− 0.71)	(5.16)
Constant	− 146.2***	− 105.8***	147.0***	62.19	− 4.342
	(− 5.04)	(− 4.98)	(7.44)	(1.61)	(− 0.25)
N	47	47	47	47	47
AIC	395.7	366.4	359.7	422.8	348.8
R^2	0.659	0.691	0.313	0.216	0.540
	(1) Labor	(2) Monetary	(3) Trade	(4) Investment	(5) Financial
WVS	− 0.00977	− 0.0123	− 0.0756	− 0.0714	0.0669
	(− 0.08)	(− 0.16)	(− 1.50)	(− 0.44)	(0.48)
ln GDPpc 2015	4.407	2.094	1.535	10.40***	10.32***
	(1.68)	(1.34)	(1.50)	(3.19)	(3.67)
Constant	20.36	57.76***	71.78***	− 28.93	− 39.37
	(0.74)	(3.51)	(6.68)	(− 0.84)	(− 1.33)
N	47	47	47	47	47
AIC	391.4	342.5	302.4	411.6	397.7
R^2	0.0807	0.0572	0.167	0.260	0.263

t Statistics in parentheses

*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$

as general as possible but "Martin Luther" may be more associated with Protestant than Catholic faith. A more challenging criticism concerns whether the proposed measure is a true measure of religiosity. The whole measure is built upon a crucial assumption that religious people are more likely to search some particular terms than non-religious people. For example, regular church-goers may not search "Church" frequently since they do not need to search for church in their neighborhoods.[5] However, their tendency to search for church-related buildings, events, news or people is very widely accepted to be higher than non-religious people. Some topics may be too general, sharing by some other religions. For example, "Hell" is also a concept in Buddhism. To minimize the problem, this work considers ten dimensions or pairs and rests upon the expectation that the size of error is decreasing in the number of dimensions.

[5] Thanks to one of the reviewers who raised this concern.

Table 10 Explaining economic freedom: comparison

	Integrity	Spending	Business	Trade
	CRRS versus Gallup			
	J-Test			
CRRS	0.832	0.903	0.069*	0.490
Gallup	0.277	0.006***	0.245	0.177
	Cox–Pesaran test			
CRRS	0.400	0.447	0.000***	0.168
Gallup	0.007***	0.000***	0.042**	0.005***
	CRRS versus WVS			
	J-Test			
CRRS	0.915	0.218	0.406	0.529
WVS	0.213	0.021**	0.108	0.164
	Cox–Pesaran test			
CRRS	0.459	0.037**	0.120	0.194
WVS	0.000***	0.000***	0.001***	0.003***
	Gallup versus WVS			
	J-Test			
Gallup	0.807	0.038**	0.482	0.721
WVS	0.496	0.424	0.037**	0.569
	Cox–Pesaran test			
Gallup	0.408	0.001***	0.254	0.342
WVS	0.156	0.231	0.001***	0.248

To better validate the idea of using the massive search data for constructing a measure of any values, we may first seek to understand what search terms or topics are associated with the value of interest. However, it would be a massive empirical work that involves conducting surveys of a sufficient large and representative sample. Acknowledging its limitation, this work serves as a starting point of the discussion on the usage of search data, while skipping the scientific exploration of the search behaviors of religious people.

The results may not be very robust since they are generated from a sample of 58 countries of one single year. Still, the methodology shows us a promising path for further developing the construction of a religiosity index by extending to more countries and a longer time frame. Moreover, the same idea can be applied to other cultural values by modifying the topics being queried.

Size of Errors

As discussed above, the proposed index may not precisely reflect subjects preferences because religious agents may not search for religious terms and non-religious agents could also search for religious terms. This section is to show that the size of this error is negligible if there are sufficient agents searching on the search engine. Consider an economy of two types of agents: religious and non-religious. Define

q the proportion of religious agents in the population and the rest of the population $(1-q)$ are non-religious. Only two topics are available for search; either a religious topic or a secular topic. For religious agents, the probability of searching a religious topic is p and that of a secular topic is $(1-p)$. By the definition of being religious, p is greater than 0.5. On the contrary, the probability of searching a religious topic is $(1-p)$ for non-religious agents. Therefore, if someone is randomly picked from the economy, the probability that his or her search is a religious topic is $x = qp + (1-q)(1-p)$. Suppose the economy is a religious one, e.g. $q > 0.5$. What is the probability that we find more agents searching the religious topic given a sample size (number of agents) of N?[6] The probability can be interpreted as the accuracy of obtaining a correct ranking of overall preference revealed by Google Trends. Suppose N is an odd number. The probability that N_r, the number of agents searching the religious topic, is larger than N_n, the number of agents searching the secular topic, is the following:

$$P\left(N_r > \frac{N+1}{2}\right) = \sum_{i=1,3,5\ldots}^{N} \binom{N}{\frac{N+i}{2}} x^{\frac{N+i}{2}} (1-x)^{\frac{N-i}{2}} \tag{2}$$

I am going to show that this probability is increasing in N, holding x constant. By probability theory, we know that for the same variable X and the same threshold value K:

$$P(X > K)_{N=N_1} > P(X > K)_{N=N_2}$$

if $N_1 > N_2$. Therefore, we have

$$P\left(N_r > \frac{N-1}{2}\right)_N > P\left(N_r > \frac{N-1}{2}\right)_{N-2}$$

Expanding this inequality, we obtain the following:

$$P\left(N_r > \frac{N+1}{2}\right)_N + \binom{N}{\frac{N-1}{2}} x^{\frac{N-1}{2}} (1-x)^{\frac{N+1}{2}} > P\left(N_r > \frac{N-1}{2}\right)_{N-2}$$

The first term of the left-hand side and the term on the right-hand side are cumulative distribution functions, which do not converge to zero when N goes to infinity. The next step is to show that the second term on the left-hand side goes to 0 when N goes to infinity. Suppose the term is instead non-decreasing in N, that is:

[6] The same proof applies to the case when q is smaller than 0.5. It is the other side of the same coin. The parameters p and q can always be redefined in the opposite way. We do not need this assumption to validate the index.

$$\binom{N}{\frac{N-1}{2}} x^{\frac{N-1}{2}}(1-x)^{\frac{N+1}{2}} - \binom{N+2}{\frac{N+1}{2}} x^{\frac{N+1}{2}}(1-x)^{\frac{N+3}{2}} \geq 0$$

$$\frac{N!}{\left(\frac{N+1}{2}\right)!\left(\frac{N-1}{2}\right)!} x^{\frac{N-1}{2}}(1-x)^{\frac{N+1}{2}} \left[\frac{4(N+2)}{(N+3)} x(1-x) - 1\right] \geq 0$$

$$\frac{N+2}{N+3} x(1-x) \geq \frac{1}{4}$$

Since $x(1-x)$ is at most 0.25 and $(N+2)/(N+3)$ must be smaller than 1, this inequality can never be held. By contradiction, the term must be decreasing. Besides, since the probability of hitting a particular value is always positive, this term goes to 0, but not negative, when N goes to infinity. Therefore, if N is sufficiently large, we arrive at the following conclusion:

$$P\left(N_r > \frac{N+1}{2}\right)_N > P\left(N_r > \frac{N-1}{2}\right)_{N-2} \tag{3}$$

This inequality means that the probability of obtaining a correct ranking, i.e. Google Trends ranks the religious term above the non-religious term in a religious country, is larger when the number of agents increases. This is exactly what big data can do for todays researchers: reducing measurement and prediction errors by gathering a large amount of information. On the other hand, since by assumptions p and q are larger than 0.5, x is increasing in p and in q. The probability of obtaining a correct ranking is increasing in the actual religiosity indicator p and the probability of making a consistent search q.[7]

Conclusion

This paper proposes a new method of measuring religiosity at the country-level by exploiting the public information provided by Google Trends. The construction of the proposed measure, named Christian Religiosity Revealed by Searches (CRRS), involves ten comparisons of topics between the religious and the non-religious worlds. The proposed index is arguably a better predictor than the Gallup Index and the World Values Survey in explaining several political and economic indicators.

References

Al-Marhubi, F. 2004. The determinants of governance: A cross-country analysis. *Contemporary Economic Policy* 22(3): 394–406.

Alon, I., and G. Chase. 2005. Religious freedom and economic prosperity. *The Cato Journal* 25: 399.

[7] The proof when N is an even number is a bit trickier but almost identical.

Barrett, D.B., G.T. Kurian, and T.M. Johnson. 2000. *World christian encyclopedia*, vol. 3. Oxford: Oxford University Press.
Barro, R.J., and R. McCleary. 2003. *Religion and economic growth*. Technical report, National Bureau of Economic Research.
Bjørnskov, C. 2010. How comparable are the gallup world poll life satisfaction data? *Journal of Happiness Studies* 11(1): 41–60.
Choi, H., and H. Varian. 2012. Predicting the present with google trends. *Economic Record* 88: 2–9.
Cox, D. R. 1961. Tests of separate families of hypotheses. In *Proceedings of the fourth Berkeley symposium on mathematical statistics and probability*, vol. 1, p. 23.
Cox, D.R. 1962. Further results on tests of separate families of hypotheses. *Journal of the Royal Statistical Society: Series B (Methodological)* 24(2): 406–424.
Da, Z., J. Engelberg, and P. Gao. 2014. The sum of all fears investor sentiment and asset prices. *The Review of Financial Studies* 28(1): 1–32.
Davidson, R., and J.G. MacKinnon. 1981. Several tests for model specification in the presence of alternative hypotheses. *Econometrica* 49(3): 781–793.
Dialga, I., and T. Vallée. 2018. The index of economic freedom: Methodological matters. *Studies in Economics and Finance*. https://doi.org/10.1108/SEF-07-2015-0181.
Diener, E., L. Tay, and D.G. Myers. 2011. The religion paradox: If religion makes people happy, why are so many dropping out? *Journal of Personality and Social Psychology* 101(6): 1278.
Dincer, O.C. 2008. Ethnic and religious diversity and corruption. *Economics Letters* 99(1): 98–102.
Elgin, C., T. Goksel, M.Y. Gurdal, and C. Orman. 2013. Religion, income inequality, and the size of the government. *Economic Modelling* 30: 225–234.
Heinemann, F., and Schneider, F. 2011. Religion and the shadow economy. In *ZEW-Centre for European Economic Research Discussion Paper* (11-038).
Hill, P.C., and R.W. Hood. 1999. *Measures of religiosity*. Birmingham, AL: Religious Education Press.
Inglehart, R., C. Haerpfer, A. Moreno, C. Welzel, K. Kizilova, J. Diez-Medrano, M. Lagos, P. Norris, E. Ponarin, B. Puranen, et al. 2014. *World values survey: Round six-country-pooled datafile 2010–2014*. Madrid: JD Systems Institute.
Jong, E. D. 2008. Religious values and economic growth: A review and assessment of recent studies. In *NiCE Working Paper 08-111*.
Kahneman, D., and A. Deaton. 2010. High income improves evaluation of life but not emotional well-being. *Proceedings of the National Academy of Sciences* 107(38): 16489–16493.
Kaufmann, D., A. Kraay, and M. Mastruzzi. 2011. The worldwide governance indicators: Methodology and analytical issues. *Hague Journal on the Rule of Law* 3(2): 220–246.
Lipset, S. M. 1995. The social requisites of democracy revisited. In *Einigung und Zerfall: Deutschland und Europa nach dem Ende des Ost-West-Konflikts*, 287–314. Springer.
McCleary, R.M., and R.J. Barro. 2006. Religion and economy. *Journal of Economic perspectives* 20(2): 49–72.
Noland, M. 2005. Religion and economic performance. *World Development* 33(8): 1215–1232.
Norris, P., and R. Inglehart. 2011. *Sacred and secular: Religion and politics worldwide*. Cambridge: Cambridge University Press.
North, C.M., W.H. Orman, and C.R. Gwin. 2013. Religion, corruption, and the rule of law. *Journal of Money, Credit and Banking* 45(5): 757–779.
Pesaran, M.H. 1987. Global and partial non-nested hypotheses and asymptotic local power. *Econometric Theory* 3(1): 69–97.
Preis, T., H.S. Moat, H.E. Stanley, and S.R. Bishop. 2012. Quantifying the advantage of looking forward. *Scientific Reports* 2: 350.
Stephens-Davidowitz, S. 2014. The cost of racial animus on a black candidate: Evidence using google search data. *Journal of Public Economics* 118: 26–40.
Vosen, S., and T. Schmidt. 2011. Forecasting private consumption: Survey-based indicators vs. Google trends. *Journal of Forecasting* 30(6): 565–578.