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The religious transition

A long-run perspective

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Abstract:

We use the largest common factor in 14 items reported in the World Values Surveys as a robust measure of religiosity. This measure is held to identify the importance of religion in all aspects of people's life. The level of religiosity differs by about 50 percentage points between rich and poor countries. We interpret the change in religiosity in terms of demand and supply. Most components of the demand for religion are reduced by rising levels of per capita income. Rising per capita income also reduces the role of religious institutions as suppliers of core collective goods. Aspects of demand and supply are integrated in a CES production function framework that explains the direction of causality in the observed negative correlation between the level of per capita income and religiosity.

Keywords Religiosity, economic development, transition, collective goods, biogeography

JEL: O11, Z12

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1. Introduction: Concept, literature, and a preview

This is a study of the religious transition that happens when a country goes through the *Grand Transition* (GT) from being a low income country (LIC) to becoming a developed country (DC).[3] The GT-process consists of interacting transitions in most fields of society, as discussed below. The religious transition is one of these transitions.

The paper develops a measure of religiosity, and shows that it falls by about 50 percent during the transition. In the long run, the fall is caused by the rise in income. This transition appears to happen irrespective of the actual religion of the country.

1.1 The R-variable: A representative part of larger complex

Religiosity is defined as a latent variable, $\hat{R}$, which measures the importance of religion in all aspects of people's life. If the full aspect space of religiosity could be measured by $\hat{K}$ variables, $\hat{R}$ would be the largest common factor in all $\hat{K}$ variables.

The *R*-variable used in this paper is estimated by a factor analysis of $K = 14$ items from the *World Values Surveys* (WVS).[4] The items from the WVS are chosen to span as much of the aspect space as possible. One factor is found to have a large loading to all 14 items. This factor is our R-variable.

The items differ in the 5 waves of the VWS, and the R-variable is shown to be robust to the deletion of items. Since *R* is robust to the exclusion of items, we claim that it will also be robust to the addition of items, i.e. $R \approx \hat{R}$.[5] The items are all measured in % between 0 and 100, and so is *R*. Changes in *R* are thus in *pp*, percentage points. Development is proxied by income, *y*, measured as the natural logarithm of GDP per capita, taken from the Maddison data; changes in *y* are in *lp*, logarithmic points.[6]

1.2 Some caveats

The paper discusses a process that happens over 50-300 years, potentially for all countries in the world. Our data sample covers 14 items, for 5 WVS waves, from 1982 to 2005, and 95

3. The paper uses the World Bank terminology of dividing countries into DCs (developed countries) and LDCs (less developed countries), which are further divided into LICs (low income countries) and MICs (middle income countries).
4. See Inglehart et al (1998) and (2004). The data are available at http://www.worldvaluessurvey.org.
5. The 14 items used surely miss many aspects of religiosity; but to get a different *R*-measure there has to be an unobserved set of aspects that would be correlated with each other but and not with *R*.
6. Source Maddison (2003) and the Maddison homepage. A few observations are assessed using the WDI database.

countries. These data seems rather inadequate for the task at hand. However, the religious transition does explain a strong regularity found in the data – we know of no alternative explanation of that regularity.

A complete sample for the 95 countries would hold 475 polls, with 6,650 polled items, but our sample only contains 240 polls and 2,331 polled items. Section 2.3 deals with the sample problems of skewnessess and gaps. They are so large that it makes no sense to use the panel structure in the regressions. Therefore, we either use the sample of 95 country averages, or the 240 polls, with controls for waves and selected countries and groups.

The five waves of sample spans only 24 years. Thus, our analysis hinges crucially upon the *equivalence assumption* that the long-run time-series pattern is the same as the cross-country pattern. Our R-data does not allow us to test if it is true for religiosity, but it is the case for other transitions – such as the agricultural and the democratic transitions – where both types of data exist. Also, the cross-country income levels provide a good measure of long-run development: Consider the ratio between per capita GDP of the richest to the poorest countries. About 300 years ago this ratio was 3-4 times. Today it is grown to about 40 times. This development must reflect differences in long-run growth rates. Therefore, we take the equivalence assumption as the default.[7]

The WVS questionnaire was developed as an English master version; which has been translated into many languages and cultural environments by experts including experienced pollsters in each country.[8] Even then, the translation process introduces some (extra) measurement error – we assume that these errors are random relative to the relations examined. The paper uses the terms of the English master version.

1.3 Religion as a complex good, religiosity as a weight

In economic terms *religion* is a complex good in two dimensions: production and use. It is produced in two ways: within families and by institutions (churches). It is used in two ways: as a consumption good and as a factor of production. This compares with *education*, which has similar complexities.

7. Thus, it is assumed until disproved. Our (scattered) readings in history suggest that it might be true. A partial confirmation is provided by the retrospective data for church attendance given in Iannaccone (2003). It covers 32 countries from 1925 to 1990. Average attendance is 35 pp as for the same countries in the WVS. In the 65 year period attendance fall by 22 pp and incomes increase by almost 1.5 lp, so the fall is 15 pp per lp as in Table 4.
8. Key concepts as "God" and "church" have easy translation into the languages of the Muslim world, but are more difficult in most Far Eastern countries, where people have several overlapping religions. However, we know that great efforts have been made to achieve translations that make sense in each country.

Religion is used as a factor of production in many ways, i.e. by farmers in very different societies, who wish to increase their chances of a good harvest.[9] Religion is consumed where people go to places of worship to get peace at mind as they do in most religions. In this paper we focus on the role of religion as a factor of production and on the formal institutions of religious production (churches). These two dimensions reflect basic aspects of demand and supply.

In contrast to religion, *religiosity* is not considered to be a good or a factor input. We think of religiosity as the weight given to religious beliefs in everyday decision making. The stock of religious beliefs can probably be considered as constant, but the relevance of these beliefs for decision making may change depending on the level of development. In this sense, religiosity bears a similarity to the changing weight of agriculture in the process of development. In rich countries, the share of agriculture in GDP is low, but people still eat. Hence a low level of religiosity does not necessarily mean that people do not believe.

1.4 A brief introduction to the literature[10]

Our hypothesis of a religious transition is related to the secularization hypothesis, which is a component of the theory of *modernization*. Modernization theory goes back to Marx, Freud, Weber, Durkheim, and others. They predicted that economic development would cause religiosity to vanish. Their secularization theory may be interpreted as a qualitative version of the religious transition, i.e., as a theory that R would go to zero in the limit.[11] This has apparently not happened up to now and perhaps this is why Iannaccone (1998) claims that "secularization is a myth".

By contrast, McCleary and Barro (2006) apply a quantitative approach and find that the level of per capita income has a significantly negative effect on various indicators of religiosity. They do not provide an economic rationale for their results. We confirm and expand their results, and provide a frame of reference to put their findings in perspective.

Economists have treated religion as a good that is demanded and supplied, so the observed level of religiosity is held to be determined by the interaction of factors of demand and supply. The demand hypothesis (Azzi and Ehrenberg 1975) considers the time allocation

9. One of the authors has experienced a whole town in the Sahel zone united in a communal prayer for rain.
10. The literature is enormous and written by authors of many trades. Our aim is to integrate the findings into the transition framework, so only a few standard references are included. Furthermore, religion is an important issue for many, and churches are often powerful organizations. Consequently, the field discussed is replete with strong priors and interests that generate controversies of the tornado type, where the center keeps moving.
11. The term *secularization* has several meanings. The religious transition is probably what most participants in the debate term secularization, but to avoid confusion this term is only used in section 1.3.

between religious and non-religious activities at the household level in response to changes in the budget constraint. Durkin and Greely (1991) study the relationship between the demand for religion and the prevalence of risk in modern society. Lipford et al. (1993) investigate the relation between religiosity and social behavior. The supply hypothesis (Finke and Iannacone 1993, Stark and Iannaccone 1994) holds that the level of religiosity is mainly a function of the degree of competition on the market for religion, such that competition increases the efficient supply of religious goods.

1.5 A preview of the rest of the paper

The structure of the paper is simple: Sections 2-4 deal with the empirics of the religious transition. Sections 5 and 6 discuss the mechanisms behind the religious transition. Section 7 considers the consistency of the arguments for a religious transition within a standard general equilibrium analysis.

Section 2 defines our macro measure *R* and shows that it is robust. Section 3 presents the transition framework of the analysis and shows that rising income *causes* falling religiosity in the long run. Section 4 looks at trends over time periods and across country groups. Five appendix tables provide details of our empirical analyses.

Section 5 looks at aspects of demand: Here religion is treated as a good that is demanded mainly as a factor of production. Demand for religion as an input falls with rising income through a process of substitution towards an alternative input, namely science. Section 6 looks at aspects of supply. In traditional society, religion is supplied jointly with the core set of collective goods: education, healthcare and social security. The Grand Transition has had two effects on the production of these goods. It has increased the volumes, and it has moved the control over the production from churches to the state. As measurement is scarce, most of the evidence in sections 5 and 6 is in the form of examples.

Section 7 interprets our measure of religiosity – the weight given to religious beliefs in everyday decision making – as the factor share of religion in a standard production function framework. A CES production function with endogenous growth can be used to summarize most of the arguments. Section 8 concludes.

2. The religiosity variable, *R*

The religious transition does not (normally) cause a change of the prevailing religion, but a fall in the fraction of the decisions affected by religion. The items in the WVS are made as to circumvent the actual religion and instead measure its importance in a dozen fields of life, which is what we term religiosity.

The paper uses 14 religiosity items from the WVS listed in Table 1. All items are scaled so that a higher score means higher religiosity. Note the three counts: The number M = 2331 of *items* polled; the number N = 240 of *polls*; and the number N_c = 95 of *countries*.

The first of the two gray columns to the right deal with the average of each of the 2331 items polled: A_{jit}, where j is the item, i is the country and t is the wave. First the averages of the A_{jit}'s are given for each j, and then the correlation between the A_{jit}'s and income y_{jit} is given for each j. The grand average of all average A_{jit}'s is 56.2 percent.

Table 1. The 14 religiosity items: Short definitions and some counts

Content of item	Countries where each item was polled						Avr. score %	Corr. to Y [a)]
	Wave 1982	Wave 1990	Wave 1995	Wave 2000	Wave 2005	All Sum		
1. God very important in life	20	37	51	69	52	229	62.2	-0.53
2. Family should teach children faith	21	43	53	68	52	237	32.7	-0.52
3. Religion important in life		42	53	69	51	215	38.4	-0.55
4. Better if more people are strongly religious					43	43	33.4	-0.68
5. Believes in god	19	35	50	67		171	82.1	-0.32
6. Churches answer family life problems	16	35		67	46	164	51.9	-0.53
7. Has moments of prayer, meditation					44	44	75.4	-0.44
8. Attend religious service regularly	21	40	51	69	51	232	40.7	-0.43
9. Churches answer social problems		35		67	45	147	42.3	-0.50
10. Churches answer moral problems	16	35		67	45	163	55.8	-0.58
11. Non-believers are unfit for political office				64	43	107	54.4	-0.66
12. Are a religious person	21	42	50	68	52	233	68.6	-0.44
13. Churches answer spiritual needs	16	35		67	45	163	69.4	-0.49
14. Belongs to religious denomination	21	41	52	69		183	79.9	-0.19
Sum or – in the last two columns – averages	171	420	360	811	569	2331 [b)]	56.2	-0.49
Number of countries in wave	21	43	54	70	52	240 [c)]	95 [d)]	
Missing observations, in % of total possible	-41.8	-30.2	-52.4	-17.2	-21.8	-30.6		

Note: Table A1 shows the countries included in the waves. Table A2 gives the full wording and the coding of the items. The order of the 14 items is per the factor loading in Table 2. The polls of each wave are normally done over 2-3 years with the year mentioned as the "peak" year. Note that (a) y is income = ln GDP per capita. (b) M, number of items polled. (c) N, number of polls. (d) N_c, number of countries included in at least one wave.

The second and last gray column gives the correlation between the A_{jit}'s and income y_{jit} for each j. The least significant of the correlations (item 14) just passes the 5 percent level (in the two-way test), so all correlations are statistically significant and negative, and nearly all are substantial in size.

2.1 The factor analysis of Table 2: Factor 1 is termed religiosity

The factor analysis of the religiosity items presented in Table 2 is done independently for each wave. Our criteria for accepting a factor as the religiosity variable is that it loads (i) positively and (ii) highly to all items, and (iii) that it is stable across waves. This is measured by the t-ratio of the cross-wave factor loadings.

Table 2. Factor analysis done for each wave separately

Factor 1 is chosen as our *R*-variable	Results for individual waves					Across waves	
	1982	1990	1995	2000	2005	Avr.	t-ratio
Eigenvalue for Factor1	6.50	6.85	5.67	9.17	8.95	7.43	5.3
Eigenvalue for Factor2	1.43	2.71	0.43	1.04	1.01	1.32	1.7
Eigenvalue for Factor3	0.90	0.59	0.16	0.62	0.61	0.58	2.4
	Factor 1 loadings					Avr.	t-ratio
1. God very important in life	0.98	0.93	0.97	0.95	0.91	0.95	38.1
2. Family should teach children faith	0.95	0.91	0.93	0.94	0.89	0.92	47.0
3. Religion important in life		0.90	0.93	0.93	0.92	0.92	80.6
4. Better if more people are strongly religious					0.92	0.92	
5. Believes in god	0.96	0.80		0.83		0.88	13.9
6. Churches answer family life problems	0.93	0.74		0.89	0.89	0.86	12.1
7. Has moments of prayer, meditation					0.84	0.84	
8. Attend religious service regularly	0.88	0.81	0.89	0.77	0.84	0.84	18.7
9. Churches answer social problems		0.73		0.92	0.81	0.82	10.7
10. Churches answer moral problems	0.92	0.63	0.91	0.86	0.83	0.81	7.4
11. Non-believers are unfit for political office				0.84	0.71	0.78	
12. Are a religious person	0.58	0.82	0.83	0.82	0.79	0.77	8.0
13. Churches answer spiritual needs	0.86	0.67		0.78	0.70	0.75	10.3
14. Belongs to religious denomination	0.28	0.52	0.65	0.69		0.53	3.3
15. Income (ln GDP per capita)	-0.31	-0.43	-0.50	-0.64	-0.69	-0.51	-3.7

Note: The t-ratio given in the right hand column measures the cross-wave stability of the factor loadings. When the cross-wave stability of the loadings to factor 2 is analyzed in the same way, no t-ratio exceeds 0.7.

The first three factors have eigenvalues of 7.4, 1.3 and 0.6. Consequently, the first factor dominates. Also, (i) the factor loadings to factor 1 are large and positive, and (ii) they have

great cross-wave stability. Hence factor 1 fulfills the criteria for a religiosity variable. Moreover, it loads negatively to income, and the negative loading is stable. The second factor is weak and unstable across waves. It mainly reflects independent factors in certain institutional aspects – it will not be discussed. The third and higher factors are of no consequence.

Our results also show that the factor loadings to the religiosity items tend to fall a little for more recent WVS waves, whereas the negative correlation to income tends to rise. Hence in the next sections, we discuss how our main finding – a dominant first factor that is negatively correlated with income – is affected by taking into account the full set of available observations and a possible sample selection bias due to the gradual increase of less developed countries across the WVS waves.

2.2 Alternative measures of stability

The factor analysis is based on a balanced sample (within each wave), so it does not use all the data (in average about 80%). Alternatively, the factor analysis has been run on the pairwise correlations, where each correlation uses as many observations as possible. The pairwise correlation factor analysis thus uses more data, but it is less consistent, so it is debatable which to prefer in principle. However, the alternative results are so close that they are not reported. Also, we have made factor analyses of an aggregate matrix by joining the individual waves. They also give much the same results.

Table A5 (in appendix) shows the average non-diagonal correlations. The results are much as in Table 2, but Table A5 may give the reader an easy intuition. The standard method to weight a set of correlated items is to use principal components as the weights. Consequently, a table of principal components has been calculated parallel to Table 2. The average columns are used as weights for the $N = 240$ Rs given in Table A1. Thus the factor analysis shows that the data contain a strong and robust common factor of religiosity, which it is negatively correlated to income.

2.3 The changing composition of the sample as shown in Table 3 [12]

The 1982 wave covered only 12% of the countries of the world, and these sample countries were almost twice as rich as the average country in the world, mainly due to the sample bias in favor of western countries. After the first wave, the samples came to contain many Post

12. The changing composition of the country sample probably reflects topics of public debate at the time of the wave. It is difficult to fund such a large project as the *WVS*, and funding possibilities depend on the relevance of topics for actual public debates.

Communist (P-Com) countries and some LDCs (Others). As the transition from communism has progressed and largely succeeded, less P-Com countries are included in the most recent wave. However, the sample has now grown due to the inclusion of Muslim countries.

Table 3. The representativity of the sample of *R*-data

	1982	1990	1995	2000	2005	All Polls	All Countries
	Countries included: all and grouped in two ways						
All	21	43	54	70	52	240	95
West	17	20	10	21	14	82	27
P-Com	1	12	22	20	8	63	23
Others	3	11	22	29	30	95	45
Christian	19	37	43	49	30	178	62
Muslim		2	6	15	14	37	23
Others	2	4	5	6	8	25	10
	The share (in %) of the sample in					Average	All [1)]
World Countries	11.7	21.5	26.5	34.3	25.0	27.4	45.7
World Population	17.5	66.8	72.4	81.5	74.7	62.6	89.5
	Excess income (in %) in countries of sample					Average	All [2)]
GDP per capita	96.0	59.2	15.2	20.2	20.5	42.2	12.8

1. All countries covered at least once.

Consequently, each wave of the VWS has a somewhat skewed sample distribution of countries relative to the true distribution of countries the world. However, the picture looks much better once all waves are taken together. The last column of Table 3 reveals that our measure of *R* is based on a sample of 95 countries that have almost 90% of the world population and are only 13% richer than the average country in the world economy.

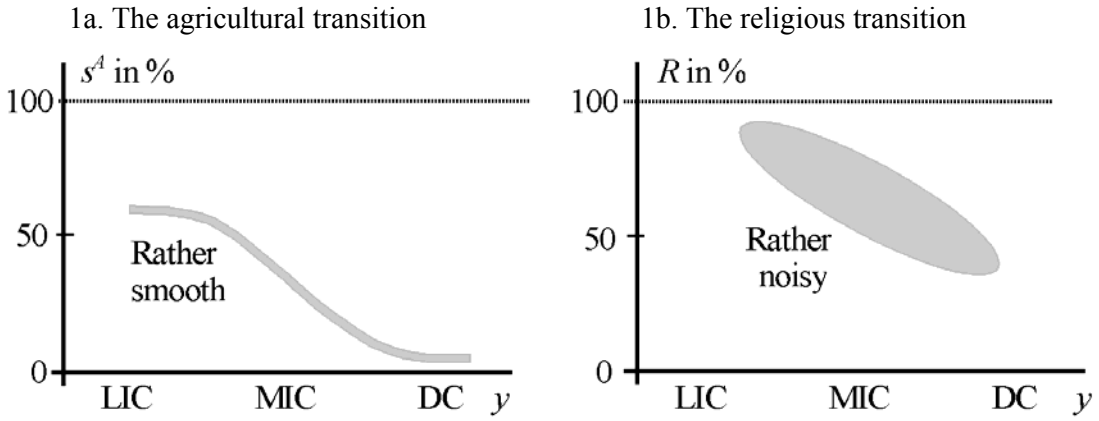
3. The religious transition and long-run causality

The perspective of this paper is the *long run* which is taken to be from half a century and up. The GT (Grand Transition) is the whole of the process of development, which consists of interacting transitions, in most fields of society. The transition perspective implies that development as proxied by income, which is taken as the causal factor. Below we test if this causality holds for the religious transition.[13]

3.1 The transition idea: A shift between two levels

The GT normally takes one to two centuries, but some cases are known where it has taken half a century only. The least controversial of the many transitions involved is the agricultural transition. It is sketched on Figure 1a. Agriculture is the main sector in the economy in LDCs, but in DCs it is a small sector only. The transition of agriculture is due to well-known facts: Demand for food rises less than proportionally with income, and large productivity increases force labor to leave the sector for employment in manufacturing and services.

Figure 1. A sketch of the agricultural and the religious transitions



Note: The horizontal axis is income, i.e. the logarithm to GDP per capita. LIC is low income country, MIC is middle income country, and DC is developed country. The vertical axes are s^A, the share of agriculture in total GDP, and R is the factor of religiosity discussed in the text.

Figure 1b is a preview of our findings about the religious transition. Far less data are available for the religious transition than for the agricultural transition, which is also a much noisier

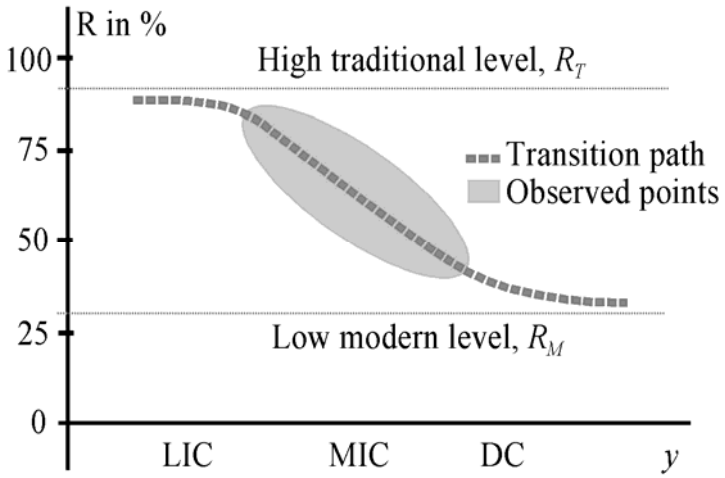
13. The long-run causality test is developed in Gundlach and Paldam (2009a), where it is explained in more detail. Broader aspects of the GT are discussed in Paldam and Gundlach (2008). The long run test is also used in Gundlach and Paldam (2009b and c).

process; but our results show that religiosity falls from a traditional level of about $R_T \approx 90\%$ in the poorest countries to a modern level $R_M < 40\%$ in the richest countries – i.e., religiosity is cut to less than half by the transition observed up to now.

Even when the fall in religiosity appears to be large in the long run, it is small in the short run. A fall of 50 pp would translate into a fall of only 0.2 pp per year over two centuries. That is, 1 pp over the 5-year period of a WVS wave. Hence it is easy to overlook in the perspective of 5-10 years, especially as religiosity data vary considerably across countries.

Most countries that are outliers in one wave are also outliers if included on other waves. This can (often) be explained by historical events with strong path dependency.[14] Religiosity seems to be a variable with great inertia, which also clouds the picture.

Figure 2. Our stylized interpretation of Figure 1b



We suggest that ideal data would reveal the typical form of a transition curve, shown as the dotted transition line on Figure 2. It assumes that the high level of religiosity observed in the poorest countries is as high as it can get (i.e., it is close to 100%). The traditional level must therefore be reasonably well determined at $R_T \approx 90\%$.

The strong inertia in religiosity means that the fall observed may continue for some time – section 4.2 shows that religiosity keeps falling in the West. The modern level may thus converge to $R_M \approx 35\%$ or even lower. This also follows from a related argument. The stylized

14. The two most religious countries in the West are Malta and the United States. Malta was ruled by the religious/military order of the Knights of Malta from 1530 to 1798. The case of the US may be explained by the immigration history of the country. However, Grant (2008) suggests that the story is a great deal more complex, since US religiosity has shown large cyclical swings.

transition of Figure 2 suggests that the highest variation is at the MIC-level and the countries converge to similar levels at the two ends.

There is a weak tendency of a convergence at the modern level to be seen on Figure 3 in section 4, but it is certainly not conclusive, and some adjustment probably remains, especially in countries such as the United States with an unusually high level of religiosity. So the value of R_M is still not well determined.

3.2 The DP-variables used as instruments in the long run causality test

In the part of Europe where both authors live, the dominating religion has changed twice in the recorded history of the last dozen centuries. Religion has been similarly stable in most parts of the world. This suggests that religiosity may also change slowly, which motivates the focus on the long run in the present paper.

Max Weber (1904/05) argued that religiosity in the case of Protestantism was causal for economic development, and others have pursued similar arguments for other religions. To explain the long-run effect of income on religiosity, it is consequently necessary to control for the possible reverse causality from religiosity to income. To this end, we use instruments that try to measure the *development potential* (DP) of countries due to natural conditions prevailing in the areas of present-day countries long before any of the present religions was formed.

The DP-variables are inspired by Diamond (1997) to give the bio-geographical possibilities for development at the time of the Neolithic Revolution. They have been compiled by Olsson and Hibbs (2005) and others. Table A4 gives the definitions and sources of the DP-variables.

The *biological* variables count the number of domesticable animals and arable plants in various areas in those distant times. These variables have been supplemented with others that measure the potential for malaria transmission and the average days with frost per winter. They are both largely time-invariant and may identify exogenous cross-country differences in prosperity. The *geographical* variables cover the more or less fortunate location of countries as regards movements of goods and ideas – it matters for development whether a country belongs to a large landmass or to a distant island, whether a landmass spreads out at an east-west axis or a north-south axis, whether a country is just at the right distance between the equator and one of the poles, and whether it has access to long-distance trade via sea lanes.

On the face of it, it appears inconceivable that they can possibly work, but they surely do, as shown in the papers referred to in footnote 3. Our instrumental variables are also in line with the unified growth theory of Galor (2005), who argues that modern economic

development builds upon the deep changes in society that took place during the long period of very slow growth in the "Malthusian" era that lasted till the onset of the Industrial Revolution.

3.3 The causality test of Table 4, analyzing cross-wave averages $\underline{R}$

The DP-instruments are available as cross-country sets for between 59 and 85 countries. We merge them with the cross-country set for country-averages of $\underline{R}$ over the available waves for 95 countries ($N_c = 95$).

Table 4. The long-run effect of income religiosity

Average data for 1982-2005	Main model	Robustness of model to instrument variation			
Dependent variable: $\underline{R}_i$	(1)	(2)	(3)	(4)	(5)
No. of countries	59	64	59	59	85
		OLS estimates			
Income, y_i	**-12.34**	**-11.79**	**-12.34**	**-12.34**	**-11.01**
(t-ratio)	(-7.5)	(-7.5)	(-7.5)	(-7.5)	(-6.5)
Centered R^2	0.49	0.48	0.49	0.49	0.36
		IV estimates: y is instrumented			
Income, y_i	**-14.99**	**-15.63**	**-14.62**	**-12.82**	**-15.53**
(t-ratio)	(-5.7)	(-6.8)	(-5.6)	(-5.6)	(-6.6)
Instruments	*biofpc, geofpc*	*bioavg, geoav*	*animals, plants*	*Axis, size, Climate*	*Coast, frost, Maleco*
	Hausman test for parameter consistency of OLS and IV estimate				
C-statistic (p-value)	0.18	0.01(!)	0.25	0.76	0.00(!)
	Tests of validity of the IV-procedure				
First stage partial R^2	0.41	0.52	0.41	0.53	0.49
Sargan test (p-value)	0.05(!)	0.92	0.17	0.43	0.04(!)
	Cragg-Donald test for weak instruments				
Presumed causality: $y \Rightarrow \underline{R}$	19.42(?)	32.57	19.72(?)	20.38(?)	26.28
CD critical value	19.93	19.93	19.93	22.30	22.30
Reverse causality: $\underline{R} \Rightarrow y$	13.79	22.45(?)	11.94	7.51	18.75
C-statistic (p-value)	0.01	0.00	0.00	0.00	0.00

Notes: Numbers in parentheses are standard errors. Bolded coefficient estimates are statistically significant at the 5% level. A (!) indicates a problematic result, (?) indicates a borderline result. The observations for income and religiosity are country averages for the available years. The measures of the instruments do not refer to specific years. In column (2), the observations on the instrument variables treat the Western offsprings (Australia, Canada, New Zealand and the USA) as transferred European countries. All specifications include a constant term (not reported). A Cragg-Donald (CD) statistic *above* the critical value (10 percent maximal test size) indicates the rejection of weak instruments. The Sargan test for overidentification tests the joint null hypothesis that the instruments are valid and correctly excluded from the estimated equation.

The test of the direction of causality between religiosity and income is done by comparing two regression estimates: ordinary least squares (OLS) and instrumental variables (IV). An IV-estimate identifies an unbiased effect of income on religiosity, conditional on the statistical quality of the selected instrumental variables. As the IV-estimate of the coefficient to income

is the same as (or higher than) the OLS estimate, causality appears to run entirely from income to religiosity in the long run.[15]

Our estimation results for regressions of religiosity on income ($y \Rightarrow \underline{R}$) are reported in Table 4. The first stage R-squared is high for all instrument combinations, columns (1) to (5). The Sargan test reveals that the instruments are valid and correctly excluded from the estimation equation in three out of five cases. The Cragg-Donald test statistics are fairly satisfactory, as they are above or at the critical value. The instruments are thus reasonably strong.

Several combinations of the instrumental variables have been tried, but as in the previous papers using the same instruments, all combinations proved to produce very similar results. Thus, only results based on a few selected combinations are reported in Table 4. Our favorite combination is in column (1). It uses the principal components of the geographical variables and the biological variables as the two core DP-variables. However, note that the test results are better in column (2).

The small variation in the statistical quality of the alternative instrument combinations instruments has no effect on the estimated size of the effect of income on religiosity. All IV-estimates of the income effect are different from zero at the 1 percent level of significance, and a coefficient estimate of 15 is within the 95 percent confidence interval of all specifications. The Hausman test indicates that the IV-coefficient estimates are not statistically different from the OLS-coefficient estimates in three cases, and the differences between the coefficient estimates are also quantitatively small in the other two cases. Hence we do not find evidence for upwardly biased OLS-coefficients due to reverse causality from religion to income.[16] The conclusion is that most of the regression results show a significant causality from y to R and are otherwise acceptable by statistical criteria. The size of the estimated effects is consistent with the results in section 4 below, which uses all available country observations on $\underline{R}$ ($N = 240$ R).[17]

15. The approximate equality of the estimates indicates that there is no endogeneity bias in the OLS estimate. If the IV coefficient had differed significantly from the OLS coefficient, several interpretations would have been possible. They will not be discussed at present.

16. If there a bias it is the reverse of the expected one, as the IV-estimates are slightly larger the OLS estimates. However, the difference is dubious.

17. The size of the estimated effect may be illustrated by comparing Morocco and New Zealand. The two countries are close to the 25 percentile and the 75 percentile of the income distribution in our sample of column (1). The (log) income difference between the two countries is about 1.76 points. An income coefficient of 15 thus predicts a difference in the measure of religiosity of about 26 points. The actual difference in R for the two countries is 48 points, so our estimated income effect accounts for a little more than half of the observed difference in R between Morocco and New Zealand.

The last two rows of Table 4 (shaded) report another attempt to control for reverse causality from religiosity to income and to check the explanatory power of our instruments.[18] Here religiosity is used to explain income $(\underline{R} \Rightarrow y)$. Only the results of the Cragg-Donald test for weak instruments and of the Hausman test for parameter consistency are reported. The Cragg-Donald test statistic is lower than in the initial regressions in four cases and points to weak instruments in three cases. The OLS-coefficient estimates are substantially smaller (in absolute size) than the IV-coefficient estimates (not shown) and statistically significantly different, as indicated by the Hausman C-statistic. We conclude that our instruments have demonstrated causality from income to religiosity, but not the other way.

18. Logically it appears that the same instruments cannot show causality both ways. Nevertheless, there can be a statistical correlation between the instruments and alternative explanatory variables. The empirical validity of the instruments then depends on the statistical significance of the correlation.

4. Changes in *R* over time and across country groups

In this section we try to explain the R-variable derived from the five waves of the WVS for 95 countries in more detail without recourse to the question of reverse causality. Let us recall the terminology: Religiosity is measured in percent, so differences are in percentage points (***pp***), while income per capita is in points of the natural logarithm (***lp)***, which has a range of 4½ lp from rich to poor countries in the Maddison data. Section 4.3 also uses a set of binary dummies for the country groups defined in Table A3. They are meant to represent cultural cross-country differences. Furthermore, fixed effects for waves were tried. They turned out to be statistically insignificant, and they are not used in the reported results.

4.1 A plot of R as a function of income, for all N = 240 polls

Figure 3 shows how the relation between religiosity and income looks once all available data are taken into account. The relation is clearly visible, but it is also obvious that income is only a partial explanation of religiosity, which leaves room for other possible explanatory factors as well. However, the inclusion of further explanatory factors will not change the size of the estimated income effect given the validity of our instruments discussed in the last section.

Figure 3a. Religiosity explained by income, *N* = 240 polls

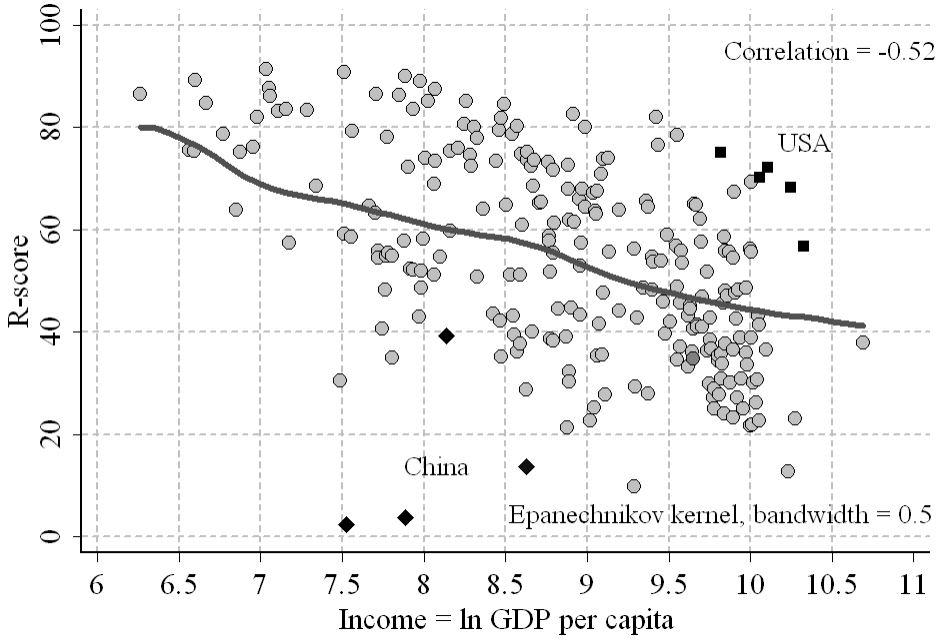
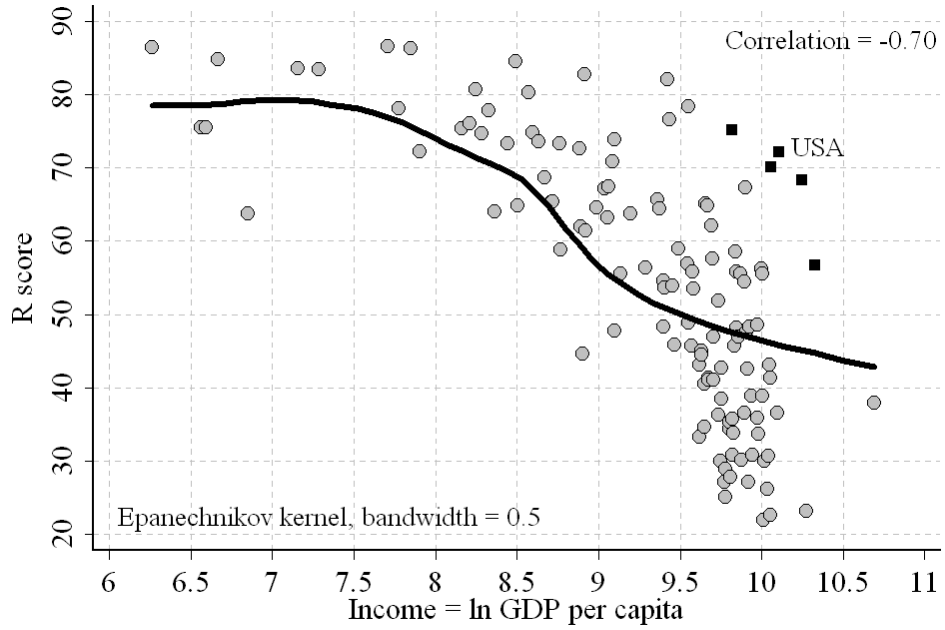


Figure 3b. As figure 3a for Christian countries exclusive of PCom group, N = 124 polls



The WVS covers relatively few low income countries in the bottom income percentile, but these countries have *R*s of almost 90 pp. If a few extreme observations are disregarded, the top income percentile has *R*s below 40 pp. The religious transition is thus about 50 pp, but the transition is probably not complete up to now. The reader will recall from section 3.1 that this fall corresponds to a fall of about 1 pp per 5-year period (i.e., per WVS wave).

The kernel-curve included can be understood as a continuous moving average with a fixed bandwidth. It is a good way to look for non-linearity of the best relation through the observations. The line does appear to become flat at both ends as it should, but the deviation from a straight line is too small for the non-linearity to be well established.

All $N = 240$ observations have a correlation $r = -0.52$. The correlation is stable across the main country groups. For the $N = 82$ observations for the *West* $r = -0.48$; for the $N = 63$ observations for *P-Com* $r = -0.53$; and for the $N = 95$ observations for *others* $r = -0.47$.

Figure 3b shows the data for the largest homogenous group, which is the Christian countries (except the PCom). Here a transition curve does appear, but it is obvious that it is not well defined at the high end, as the transition is still going on.

Two of the most extreme countries – relative to the transition – are depicted in black: China and the United States. The observations for China from the last two waves are less extreme than the previous observations. Perhaps globalization has relaxed the rigid totalitarian social controls in China to a more "normal" level. Also, it looks as if the US is moving toward

a more typical level of religiosity. Nevertheless, both countries remain far off the income-conditioned average of religiosity.

4.2 The development of religiosity over time, for ΔM = 906 polled item changes

As the WVS sample changes in a non-random way from sample to sample, we base the analysis of the trends over time on first differences. This reduces the data considerably, and hence we have to use the larger sample of M = 2331 polled items. They give ΔM = 906 changes, which are defined as $\Delta_{ijt} = R_{ijt} - R_{ijt-1}$, where i is country; j is item; and t is wave.

Table 5 summarizes the results. The average of all 906 changes (for a 5-year period) in religiosity is 0.34 with a t-ratio of 1.1. Hence there is no trend. However, this is due to the rise in the number of Post-Communist (P-Com) countries, which are overrepresented in the sample. If they are excluded N = 625 observations remain and the average change is -1.0 with a t-ratio of -2.8. A change of -1 pp per 5-year period is precisely as predicted from Figure 3.

Table 5. The available changes from one wave the next, ΔM = 906 items changes

	Difference	1982-90	1990-55	1995-00	2000-05	All
			Part A: Aggregate results			
All countries	Average	***-1.47***	**2.88**	**1.13**	***-0.93***	0.34
	t-ratio, N	-1.7, 153	4.3, 184	2.5, 259	-1.7, 310	1.1, 906
Except P-Com	Average	***-1.43***	-0.02	0.38	**-1.97**	**-1.01**
	t-ratio	-1.8, 148	-0.0, 112	0.7, 130	-3.1, 235	-2.8, 625
			Part B: Divided in 3 groups			
West	Average	**-1.60**	-0.78	-0.64	-0.99	**-1.18**
	t-ratio	-2.2, 133	-0.9, 50	-0.8, 37	-1.2, 75	-2.8, 295
P-Com	Average	-2.64	**7.40**	**1.88**	**2.36**	**3.34**
	t-ratio	-0.3, 5	6.4, 72	2.8, 129	2.9, 75	6.3, 281
Others	Average	0.04	0.59	0.79	**-2.44**	-0.85
	t-ratio, N	0.0, 15	0.6, 62	1.1, 93	-2.8, 160	-1.5, 330
			Part C: Parts of Others			
Muslim excl.	Average		***4.69***	-1.71	-1.82	-1.44
P-Pom	t-ratio		1.7, 5	-0.8, 18	-1.3, 68	-1.2, 91
Latin American	Average	3.96	1.19	1.92	**-8.04**	***-1.48***
	t-ratio, N	2.1, 6	0.9, 29	1.7, 43	-8.7, 39	-1.9, 117

Note: Averages in bold are significant at 5% level. Averages in bold and italic are significant at the 10% level. The table uses all available observations. The gray cells are based on one country only. And the first observation in the P-Com row is from before the fall of Communism. The country classification is given in Table A3.

The average changes for the *West* are significantly negative, and the fall is -0.23 pp in average per year. Note that the fall gets gradually smaller suggesting that the transition may converge

to a stable level. For *Others* the fall is similar in size, but more erratic. However, the *P-Com* countries have a significant rise by 0.7 pp per year from 1990 to 2005. It is often alleged that religiosity has increased in the Muslim world in the last quarter century, but this is not confirmed. The next section (4.3) will show that Muslim countries do have a relatively high level of religiosity, but it falls just as in other countries. The Latin American countries also have a large fall in 2000-05. Religiosity falls by about -0.35 per year in both of these country groups, just as predicted from all countries based on Figure 3.

The P-Com countries are the big exception to the general pattern. Our interpretation is that – with the fall of communism – the suppression of religiosity has ceased, and it is returning to a normal level conditioned by the level of income. This interpretation implies that the suppression of religiosity by the communist regimes was temporarily successful, as will be further discussed in Sections 4.4 and 6.1.

4.3 Income vs. culture as explanation of R, for all N = 240 polls

To see whether other variables than income might have a strong effect on religiosity, binary cultural dummies are introduce as defined in Table A3. The results based on the 240 observations of the aggregate *R* are reported in Table 6. The table has three parts: Part A is the point of reference and is termed the base model.[19]

Part B reports results for ten independent regressions of religiosity on a constant and *one* of the country (group) dummies. Income is excluded in column (2) and included in column (3). The results for the base model are the averages of the ten estimates. Here the first t-ratio is is the average from the ten regressions, and the second t-ratio indicates the cross-estimate stability of the ten regressions.

Part C gives the results of two pairs of regressions. Columns (4a) and (5a) include *all* country dummies without and with income. The corresponding columns (4b) and (5b) give the tested down versions, where the least significant country dummies have been excluded, one at a time, till only significant variables remain in the specification.

The top row of estimates in the table shows that the average estimate of the coefficient to income is about –11. When income increases by 4½ lp, *R* falls by about 50 pp. This consistent with the result of section 4.2 and it is in line with the long-run results of Table 4, and thus confirm that our instruments control for possible omitted variables bias.

19. It should be mentioned that all these regressions have also been made with 4 wave-dummies included. They sometimes became significant, but had virtually no effects on the other coefficients estimated, so they are not reported.

Table 6. The effects of income and different cultures on religiosity, $N = 240$ polls

Dependent variable: R	Part A Base	Part B Average of 10 estimates		Part C Regressions with all (significant) groups			
$N = 240$	(1)	(2)	(3)	(4a)	(4b)	(5a)	(5b)
Income	**-10.81**		**-10.72**			**-11.51**	**-11.33**
(t-ratio)	(-9.5)		(-9.1, -7.8)			(-9.0)	(-11.4)
Constant	**150.14**	**53.66**	**148.82**	**67.29**	**67.82**	**158.91**	**157.94**
(t-ratio)	(14.5)	(40.9, 18.5)	(14.1, 11.1)	(25.6)	(36.6)	(15.2)	(17.2)
	None	One group in each estimate		All (significant) groups included			
West		**-11.11**	***5.75***	**-19.18**	**-19.51**	0.88	
(t-ratio)		(-4.3)	(1.9)	(-6.0)	(-7.6)	(0.3)	
P-Com		**-8.55**	**-14.42**	**-20.38**	**-19.71**	**-13.61**	**-14.29**
(t-ratio)		(-3.0)	(-6.2)	(-6.7)	(-7.6)	(-5.0)	(-7.1)
Others		**17.24**	**10.08**		Deleted when West and		
(t-ratio)		(7.4)	(4.2)		P-Com are included		
Oriental		**-17.24**	**-16.76**	**-24.30**	**-24.86**	**-11.50**	**-12.34**
(t-ratio)		(-3.9)	(-4.7)	(-6.0)	(-6.8)	(-3.0)	(-4.0)
Lat. Am.		**16.03**	**15.35**	0.96		**10.93**	**10.28**
(t-ratio		(4.2)	(4.7)	(0.3)		(3.2)	(3.9)
Muslim		**24.40**	**16.10**	**12.89**	**13.14**	**9.84**	**11.24**
(t-ratio)		(7.3)	(4.7)	(3.5)	(4.4)	(3.1)	(4.2)
Arab		**29.30**	**19.76**	1.92		5.02	
(t-ratio)		(7.3)	(3.7)	(0.4)		(1.1)	
Scandinavian		**-19.54**	**-9.19**	**-12.15**	**-12.15**	**-10.65**	**-10.60**
(t-ratio)		(-4.2)	(-2.2)	(-3.3)	(-3.3)	(-3.3)	(-3.4)
China		**-39.90**	**-49.83**	**-28.20**	**-28.17**	**-40.05**	**-39.71**
(t-ratio)		(-4.2)	(-6.3)	(-3.7)	(-3.7)	(-5.9)	(-5.9)
USA		***14.80***	**29.41**	**20.41**	**20.41**	**24.17**	**25.06**
(t-ratio)		(1.7)	(3.9)	(3.2)	(3.2)	(4.4)	(4.5)
AR^2	0.267			0.494	0.498	0.624	0.626

Note: If a second t-ratio is given, it measures the cross-estimate stability. Bolded estimates are significant at the 5% level, while coefficients that are both bolded and in italics are significant at the 10% level only. Note the overlapping of the dummies in the definitions in Table A3. Estimator is pooled OLS.

Part B shows that each individual country dummy is statistically significant, with and without controlling for income. Note that the coefficient to the West changes sign from negative to positive when controlled for income. The West is relatively rich, so *all* of the "secularization" of the West can be explained by the rise in income. The US is only marginally more religious than the average of all countries, but it is much richer, so when religiosity is adjusted for the level of income, it is a very religious country.

The oriental group is less religious than other countries. Especially China is extreme, when unadjusted and even more so when adjusted for income. An unusually low level of religiosity is also found in the Scandinavian countries. They have almost the same level of

income as the United States, but they have about 35 pp less religiosity. The Muslim countries are relatively religious – but only by about 11 pp when controlled for income. The Arab countries are marginally more religious than other Muslim countries (see Paldam 2008).[20]

The P-Com countries are relatively less religious, by about 14 pp when controlled for income. These countries were not covered by the WVS when they were communist before 1990 (except Hungary). However, religiosity has increased by about 11.4 pp in these countries between 1990 and 2005. The average increase is thus about 6 pp by a 5-year period. By adding 14 pp and 6 pp, we assess that religiosity in the communist period was about 20 pp lower than in other countries. This assessment is further evaluated in section 6.1.

Part C of Table 6 reveals which country dummies dominate as explanatory variables, again with and without controlling for income. It is clear that income dominates West. That is, the two times two regressions confirm that the Western countries have a low religiosity only because they are rich. However, the US is highly religious in spite of its wealth. Also the Latin American countries are relatively religious when their income is controlled for.

The Arab countries are not different from other Muslim countries whether or not their relatively high incomes are controlled for. It is also interesting to see that China remains an outlier, even in the presence of a control for being Oriental, and thus has a relatively low religiosity. The results show that religiosity has both a cultural and an economic side. If the Muslim countries became as rich as the West, they would still be about 8 pp more religious, but then they would be less religious than the United States.

20. The analysis does not distinguish between income as such and development. The two concepts are normally much the same, but they differ in the case of oil-countries, which has income without development.

5. The demand side: A substitution of science for religion

Many reasons have been given why people demand religion. The following four, labeled D1-D4, seem to be the main ones: D1 as a higher protection against risk to life and property; D2 as a consolation if these risks materialize; D3 as an explanation of the unknown; and D4 as an existential explanation. While D1 to D3 deal with demand for an input into production, D4 is more of a consumption item.

5.1 Religion as a productive input

One of the functions of religion is to offer protection against risks to life (of self and family) and property (D1). Figure 4 shows that the GT (Grand Transition) doubles the expected life span, due to better healthcare, food, environmental control, etc. Thus the GT greatly reduces risks to life. The GT also allows many people to save enough for an adequate pension, it provides insurance services, public transfers etc., which all reduce the welfare loss due to economic misfortune. So the world becomes much less dangerous with rising levels of development. Accordingly, the need for religious protection is reduced. It follows that the demand for religion falls.

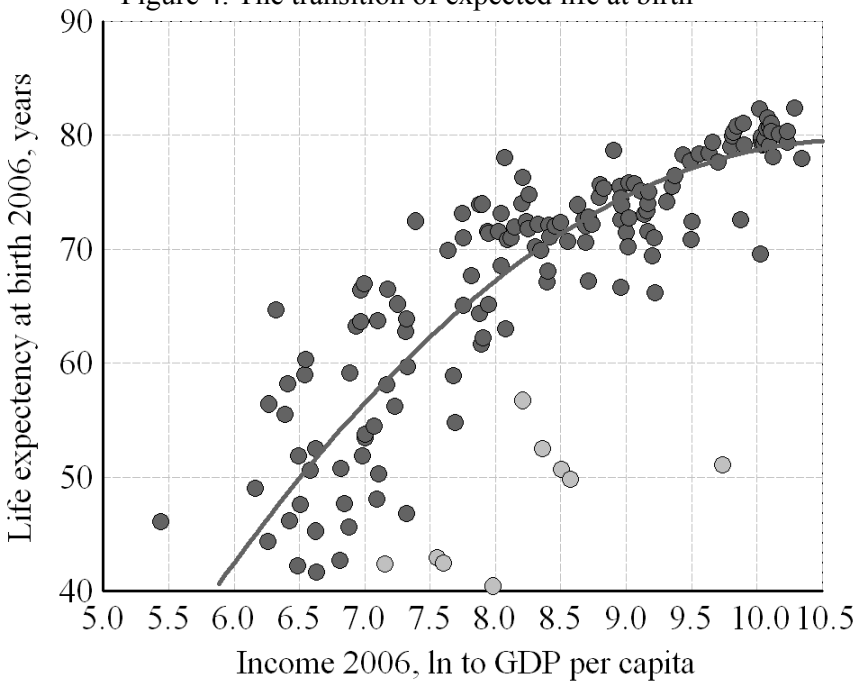
In case protection against risk fails, people need consolation, which is also provided by religion (D2).[21] This is obviously an important factor in poor countries, where the risk to life is high. However, modern society has reduced the frequency of such events and developed alternative ways to alleviate the pain they cause, so the demand for religion as providing consolation also tends to fall with rising levels of development.

Another function of religion is to provide an explanation of the unknown (D3). Science is an alternative, and it certainly has made progress in reducing the unknown. In the post-transition world people have largely ceased to associate diseases to evil spirits and magic spells.[22] It is no wonder that many religious institutions have fought to uphold religious explanations against the onslaught of scientific explanations.

21. The contradiction between D1 and D2 is a part of the theodicy problem. When God is good and almighty, how come that the world is so full of misery? It is a main theological problem, and though many answers exist, it has often been discussed whether the answers are satisfactory.

22. This is visible in Catholic churches in poor and rich countries. In poor countries it is common to find chapels where the walls are covered with silver models of parts of the human body donated by people who have been cured in the said part of their body by the saint of the chapel. Such models are rarer in the rich countries. Also, we all use machines we do not fully understand, but we know that they are understandable. Though it might help to ascribe the *bugs* in our computer to *jujus*, we do not call a witch doctor but a geek to have them cured.

Figure 4. The transition of expected life at birth



Note: The light gray countries are Angola, Lesotho, Mozambique, Swaziland, Gabon, Namibia, South Africa, Botswana, and Equatorial Guinea. Most of these countries have a high prevalence of hiv/aids. The average curve is a quadratic regression line. Sources: Life expectancy is from WDI, income is from Maddison.

All three items D1-D3 are illustrated by the plight of a fisherman. Before the GT he had a dangerous and relatively short life due to the hazards of the sea. Thus religion was highly needed. Now fishermen have a life expectancy that is close to everybody else. All fishermen know that what brought about the change was not better prayers, but better boats, weather forecasts, radio, radar, GPS, etc. This seems to have reduced the previously high level of religiosity in fishing towns (in DCs) almost to national levels.

5.2 Religion as a consumption good

We contemplate three points of view, which may be expressed in many alternative ways and with some overlap. It will not be discussed here if these points of view are consistent in themselves, but all of them suggest that religion is a consumption good in positive demand.

The onion view. It is often said that the development in the last 4-500 years in the West has peeled of all the unimportant reasons to be religious and left the key reason, namely to provide existential explanations (D4). The philosophical school of existentialism discusses if this argument makes sense. We note that some people think that it does.

The extra view. Also, many people feel that the world is too dull when everything is given a rational explanation. Some people claim that they are wiser when they have metaphysical explanations of the world in addition to all the physical ones which they share with irreligious people. A certain terminology speaks of "simple" materialism versus "deep" insight.[23]

The instinct view: Another argument is that people have a religious instinct, which has to be satisfied. People defending religion sometimes argue that atheists behave like believers in certain ways. Instincts suggests a physical base in the brain, and the new field of brain scanning research looks at the reactions in the brain to religious stimuli to see if the reaction differs from other emotional stimuli, see, e.g., Schjødt et al (2008). This research is in its infancy, but so far the results have been mainly negative.

A number of additional arguments can be added. Churches are often strongly integrated into national history and culture. Religious ceremonies are demanded by many as a way to attach their life to the traditions of society in connection with the stages in life such as birth, maturity, marriage, and death. These argument leads to the conjecture that the consumption component of religion may have some irreducible positive level, such that a measure of religiosity would approach a positive constant. Our empirical finding suggests that the irreducible level of religiosity may be less than half of the traditional level, but this conjecture cannot be fully confirmed with the available data.

Two of the 14 items in the WVS deal with the demand for religion as a consumption good. One is item 7, dealing with moments of prayer/meditation, and the other is item 13, asking if churches satisfy a spiritual need. In Table 1 both items have negative correlations to income that are fairly typical for all 14 items. This observation allows us to treat the whole of the demand side (D1-D4) as factor demand in Section 7.

23. This argument does not support generalizations, since it is suggesting some kind of a quantitative relation between wisdom and the size and complexity of the metaphysical structure people believe in. E.g., astrologists are held to be wiser than astronomers.

6. The supply side: A substitution in the provision of collective goods

We consider education, social security and healthcare as the three *core collective goods* that are usually held to be sub-optimally supplied under conditions of perfect competition.[24] Before the GT, religion and the three core goods were jointly produced by formal religious institutions.[25] Put crudely, either the core goods were supplied as a side payment to those who demanded religion, or religion was supplied as a side payment to those who demanded education, social security, and healthcare. The GT is affecting the production of the core collective goods in two ways.

(i) Their share in GDP increases from about 5-10 percent to about 30-40 percent.

(ii) The control over the production of these goods moves from the church to the state.[26]

Thus a transition occurs in size and control. Education participates in forming the values and beliefs of people; social security and healthcare handle major parts of risk to the individual. As discussed in section 5.1, risk is an aspect of life where religion enters. The provision of the three collective goods is thus the *core heights of control* for the churches. Two historical experiments show that the loss of control has a substantial negative effect on our measure of religiosity, the R-variable. This effect can be explained within the economics of the GT.[27]

6.1 A large scale historical experiment: Communist rule

The estimates of section 4 show that income-conditioned level of religiosity was smaller, by about 20 pp, in the 18 P-Com countries in the sample. It appears that the pre-communist governments of these countries behaved much like the typical government in the West toward the church. Consequently we assume that religiosity levels in these countries were similar to levels in the rest of Europe, when adjusted for income.

During the 45-72 years of Communist rule, the state was actively anti-religious. Communism is a totalitarian ideology that is hostile towards competing belief systems. Marx was atheist himself, claiming that "religion is the opium of the people". He thought religion would dull the minds of people and thereby exposing them to capitalist exploitation.

24. The argument in this section is related to the one in Puchades-Navarro and Montero (2009).
25. This was certainly the case in the West, but also in most other civilizations as far as we know.
26. In most countries these sectors have also private firms, but they will be disregarded in the interest of brevity.
27. The nature of the transition is visible to the naked eye by those who look for the most spectacular monument in the similarly sized towns of Vienna and Seattle: In the old European town it is the medieval cathedral. In the new American town, it is the Central Public Library. Both monuments were built from donations.

Consequently, the Communist rulers made a systematic effort to replace religion by the secular communist ideology.[28] This was done by a purge of the production of the three core goods of any church influence; by waves of anti-church propaganda; and by a systematic weakening of the organizational apparatus of the church using a multitude of administrative devices. The most powerful device probably was that the party record (nomenclature) that was decisive for individual career perspectives did register links to a church as negative information.[29]

After the fall of Communism in 1990, pressures against religion have ceased, and the measures of religiosity have increased by no less than 11 pp, as shown. This is consistent with the expected reaction to the discontinuation of the anti religious policies. We conclude that the loss of command over the three core collective goods under Communism negatively affected the level of religiosity. A similar effect can also be seen from an altogether separate and much smaller historical experiment.

6.2 A small scale historical experiment: The Southern Cone

The three Latin American neighbors Argentina, Chile and Uruguay – known as the Southern Cone countries – have much in common. They have approximately the same immigration history, with a dominating Spanish speaking population essentially from Spain and Italy, and as in these homelands the Catholic religion dominates in the Southern Cone as well. The three neighbors also have much the same history of economic development. Of course it is easy to mention many differences, but the level of religiosity would probably have been roughly the same across the Southern Cone, except for one historical fact.

Table 7. The available *R*s from the southern cone

	W1: 1982	W2: 1990	W3: 1995	W4: 2000	W5: 2005	All
Argentina	61.90	58.78	64.48	63.15	47.72	59.21
Chile		73.24	67.45	63.78	53.66	64.53
Uruguay			44.64			44.64
Difference			21.33			18.23[a)]

Note a: The missing value for Chile is likely to be high so this difference is probably too low.

28. Bjørnskov and Paldam (2009) study the cross-country pattern in mass support for socialism, based on a WVS item about the preferences for public vs private ownership to business. They find that mass support for socialism in the P-Com countries are much the same as in Western Europe, when income is controlled for.

29. Several studies have been made of the waves of prosecution and coexistence of churches and states during Communism, notably in the Soviet Union and Poland, see e.g. Anderson (1994) and Ramet (1987). During the Second World War, a period of Church-State cooperation occurred. But in general a totalitarian state could not tolerate an alternative hierarchy.

In Uruguay, politics has been dominated by the Colorado party. Most of the political institutions of the country were formed during the early rule of that party, notably by José Batlle y Ordóñez (1856-1929), who served as president in 1899, 1903-7, and 1911-15. His policies greatly expanded the provision of the three core collective goods and placed them fully within state control. He also enforced a strict separation of state and church.[30] Since then this has been upheld as a main policy rationale of the country. Table 7 shows the effect on religiosity. Only one measure of *R* is available for Uruguay from the WVSs, but it deviates substantially from all other seven measures for the other Southern Cone countries. Consequently, we assess that the difference is approximately 20 pp, like in the case of the P-Com countries.[31]

6.3 The transition of control over the core heights

In both historical experiments the state already played a role before the core heights of the public sector were fully taken over. So the 20 pp fall of religiosity reached in the two examples is likely to be a minimum that can be expected from the changing control of the core heights. As the observed total effect of the GT on religiosity is about 50 pp, this means that the loss of control may account for as much as between a third and one half of the transition.

In our view, the reason for the loss of control by the church of the core heights during the GT is simple and self-reinforcing. In poor societies, tax-collection is difficult and the tax revenue is mainly used to finance the external and internal power-structure that is holding together the state against internal and external enemies. The churches have not had the power to tax, but have collected a great deal in alms. These resources have been used to pay for church-building, as wages for the church employees, and for providing a minimum level of services of the three core collective goods.

When economic development necessitated a large expansion of education, and rising incomes generated a demand for a better protection of health and some social security, the church was no longer able to provide – simply for financial reasons. The production costs of the vastly increased provision of the three core goods became too large. At the same time the state developed an ever greater ability to tax, and consequently gained control over the provision of the core goods. This in turn undermined the ability of churches to collect alms. Thus the result was a dynamic take-over of the core heights by the state and a subsequent decline in religiosity.

30. The separation was so strict that religious symbols such as crosses were forbidden in schools and hospitals.
31. The reader can confirm the information in Table 7 by checking the *religion* information in the CIA Factbook for the 3 countries. It gives the same striking difference. In Uruguay no less than 40% of the population reported that they were “denominational” or “atheist or agnostic” at the last census (2006).

Sections 1.2 and 3.1 compare the fall in religiosity to the fall in the agricultural sector. It does fall, but it cannot become zero, as we all have to eat. Another parallel is that agricultural sector changes from being taxed in traditional society to become subsidized in modern society (see Krueger, 1996). In the same way churches are net providers of public goods in traditional society and net recipients of subsidies in modern society.

7. A summary in terms of a textbook growth model

Our major arguments may be briefly summarized in terms of an endogenous growth model, with religious beliefs *B* and scientific knowledge *Z* as the only two inputs to production. Religious beliefs are produced by churches; scientific knowledge is produced by the state and firms (outside churches). The consumption demand for religion is assumed to be proportional to the production factor demand, as suggested by the evidence discussed in Section 5.

7.1 A Solow model with a CES production function

The two inputs represent alternative ways of decision making, which are substitutable. Each input has diminishing returns. Population is constant and normalized to 1. There is no exogenous technological change. Income growth is endogenous even if all assumptions are straight from Solow (1956). [32]

Output of the single output good of the economy at time *t* is produced according to a CES production function

$$(1) \qquad Y_t = F\left(Z_t, B_t\right) = A\left[\delta Z_t^{-\rho} + \left(1-\delta\right) B_t^{-\rho}\right]^{-1/\rho} ,$$

where Y_t is the real aggregate level of output, Z_t is the aggregate stock of scientific knowledge, B_t is the aggregate stock of religious beliefs, and A, δ, and ρ are parameters of scale, distribution and substitution, respectively. They satisfy the following conditions: $A > 0$, $0 < \delta < 1$, and $\rho \geq -1$. The elasticity of substitution σ is

$$(2) \qquad \sigma = \frac{1}{1+\rho} .$$

Dividing both sides of equation (1) by B generates the intensive form as

$$(3) \qquad y_t = f(z_t) = A\left[\delta z_t^{-\rho} + \left(1-\delta\right)\right]^{-1/\rho}, \text{ with } y_t = Y_t / B_t \text{ and } z_t = Z_t / B_t .$$

Assume that the stock of scientific knowledge can be accumulated and that the stock of religious beliefs is constant. A constant fraction of output $s_z = \dot{Z} / Y$ is saved and invested.

32. The CES production function was first suggested by Solow (1956); but the actual functional form of the production function was derived by Arrow et al. (1961).

The stock of scientific knowledge depreciates with a constant rate $d = D / Z$. The growth rate of the economy, γ_z, is given by the difference between the rate of knowledge accumulation and depreciation as

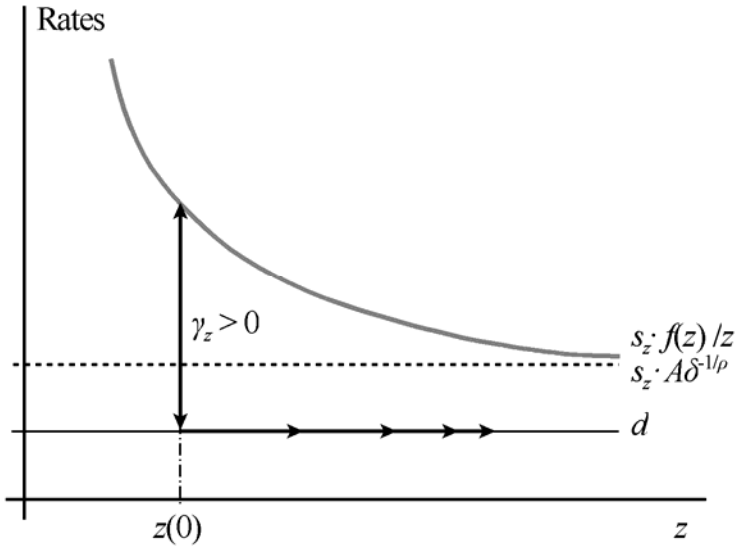
(4) $\gamma_z = s_z \cdot f(z) / z - d$.

As z goes to infinity, the first term of equation (4) approaches a positive constant if the elasticity of substitution is larger than 1. As is well known,[33] the CES technology with $\sigma > 1$ generates endogenous income growth if the parameters satisfy the inequality condition

(5) $s_z A \delta^{-1/\rho} > d$.

This is shown in Figure 5. Whenever the marginal product of scientific knowledge (more generally, the marginal product of the cumulative, productive input) asymptotically achieves some lower bound that is greater than zero and larger than the value of the rate of depreciation, there will be a positive long-run growth rate. Thus a high elasticity of substitution can eliminate the need for some kind of exogenous technological progress as the long-run steady-state engine of growth.

Figure 5. Endogenous growth with knowledge accumulation and constant religion



33. For a textbook exposition, see e.g., Barro and Sala-i-Martin (2004 pp 68-71).

This restrictive framework provides a number of implications that appear to be relevant in the context of our discussion of the religious transition. One immediate implication is that the CES production function allows for output in the presence of only one of the inputs, in contrast to a Cobb-Douglas production function. Without any scientific knowledge *Z*, the elasticity of substitution would be 0 and there would be no long-run growth, but there could be output due to religious beliefs *B*. So the modeling framework appears to be in line, at last in principle, with the Malthusian stagnation before the Industrial Revolution and the era of modern economic growth thereafter.

The framework also allows for a conceptualization of our measure of religiosity. We have emphasized that our measure reflects the relevance or weight of religious beliefs in everyday decision making. At the macro level, this translates into a measure of the weight of religious beliefs in the production process. Hence we conjecture that the *factor share* of religious beliefs is the theoretical counterpart of our empirical measure of religiosity.

7.2 The paths of the factor shares of religious beliefs and scientific knowledge

In contrast to a Cobb-Douglas production function, factor shares are trending in a CES production function in the presence of income growth. In a CES specification, the factor shares do not only depend on the value of the distribution parameter, but also on values of the factor inputs and the elasticity of substitution. For instance, one can show that the factor share of the cumulative input, π_Z, is given by

$$\pi_Z = \frac{\delta Z^{-\rho}}{\delta Z^{-\rho} + (1-\delta) B^{-\rho}} \quad . \tag{6}$$

With scientific knowledge *Z* rising to infinity and constant religious beliefs *B*, the factor share of scientific knowledge will approach 100 percent in the limit if $-1 < \rho < 0$, i.e., if $\sigma > 1$. Since the factor share of religious beliefs equals $1 - \pi_Z$, it will necessarily decline with rising *Z* under the assumptions being made. Since rising *Z* implies rises *y*, the factor share of religious beliefs is also predicted to decline with rising income. Our regression results in Table 4 confirm the statistically significant negative relation between our measure of religiosity and per capita income, with causality mainly from income to religiosity.

The implication of trending factor shares in an endogenous growth model with CES technology and $\sigma > 1$ has been considered as empirically implausible when applied to the traditional factor shares of capital and labor. These factor shares appear to be bounded at

around one third and two thirds. But trending factor shares look more reasonable once scientific knowledge and religious beliefs are considered as input factors. This does not necessarily mean that religion will vanish, as expected by Marx and others. The implication from the model is that people might still believe although the relevance of religious beliefs for everyday decision making in the production process might approach zero in the limit.

Our conceptualization of the religious transition critically hinges on an elasticity of substitution that is larger than 1. Both the demand factors and the supply factors discussed in the previous sections motivate the hypothesis that $\sigma > 1$. For instance, fishermen will easily substitute radar, sonar, and weather forecasts for prayers when going to the open sea. Similarly, the accumulation of scientific knowledge will help to substitute the state supply of education, social security, and healthcare for the same supply provided by the church. Thus there must be a high degree of substitution between science and religion both on the demand side and on the supply side. We leave for further research whether the observed decline in our measure of religiosity is actually driven by endogenous growth due to a high elasticity of substitution between science and religion.

8. Conclusion: A clear transition

The paper started by showing the robustness of the religiosity variable, *R*, in the data. The religious transition is found to be a fall in the *R*-variable from almost 90 percent to about 40 percent. The causality in the long-run runs mainly from income to religiosity. It appears that the transition is still not complete in the rich countries, and it is not yet clear how far the transition will continue. However, the available evidence suggests that it has slowed down – thus the religious transition is a bit larger than the 50 pp that have been observed up to now.

The empirical facts presented in Sections 2 to 4 appear to be strong. It is strange that these matters are disputed in parts of the literature. In sections 5 and 6, a handful of hypotheses provide parts of an explanation of the religious transition. They are backed up by some evidence, but it is weaker and a bit more narrative than we would have preferred. The explanations of the fall in religiosity use three mechanisms.

Religion is demanded as a factor of production and for consumption. We argue that the demand for religion as a factor of production will converge to zero in the limit with rising levels of development, but the demand for religion as a consumption good will probably converge to a level well above zero.

Religion is supplied by institutions that are termed churches for brevity. As regards the production side, the Grand Transition causes churches to lose control over the production of three core collective goods (education, social security, and healthcare), which churches used to supply as a side payment in addition to religious services. The key problem for the churches has been that the production costs of the side payments have grown so much that they cannot be financed from alms, so the churches have lost control.

Aspects of demand and supply are integrated in a CES production function framework in Section 7. This framework shows that various hypotheses on the economics of religion can be integrated in a consistent way within a textbook model of economic growth. Thus we conclude that the religious transition is a substantial phenomenon that has general explanations even if many details of these explanations differ across countries, and, without doubt, also between the religions.

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Appendix A: Extra tables

Table A1. The 240 R-values calculated

		1982	1990	1995	2000	2005			1982	1990	1995	2000	2005
1	Albania			54.39	57.77		49	Latvia		44.01	39.52	44.43	
2	Algeria				83.54		50	Lithuania		35.44	51.21	57.85	
3	Andorra					23.17	51	Luxemburg				37.92	
4	Argentina	61.90	58.78	64.48	63.15	47.72	52	Macedonia			48.66	54.64	
5	Armenia			51.15			53	Malaysia					74.02
6	Australia	55.77		45.73		36.64	54	Mali					82.01
7	Austria		51.86		47.58		55	Malta	84.44	82.64		76.58	
8	Azerbaijan			59.16			56	Mexico		65.39	65.20	72.57	61.43
9	Bangladesh			89.25	78.63		57	Moldova			55.40	64.64	58.22
10	Belarus		21.32	42.23	38.76		58	Morocco				89.99	85.05
11	Belgium	53.50	42.71		38.95		59	Netherlands	45.75	38.47		33.67	26.17
12	Bosnia			54.79	52.18		60	New Zealand			43.11		35.31
13	Brazil		64.86	80.24		68.59	61	Nigeria		86.03	91.29	87.62	
14	Bulgaria		28.82	36.12	37.62	32.25	62	Norway	45.09	35.69	35.86		
15	Burkina					76.05	63	Pakistan			90.74	79.26	
16	Canada	64.85	55.81		55.55		64	Peru			75.34	75.96	63.98
17	Chile		73.24	67.45	63.78	53.66	65	Philippines			86.49	78.01	
18	China		2.41	3.84	39.30	13.62	66	Poland		78.69	75.12	67.99	63.65
19	Colombia			74.84		73.55	67	Portugal		56.32		56.85	
20	Croatia			51.16	61.23		68	Puerto Rico			81.99	78.37	
21	Cyprus					46.98	69	Romania		59.85	68.85	74.04	72.47
22	Czech Re		35.65	25.30	27.78		70	Russia		43.32	35.15	43.21	30.24
23	Denmark	34.71	30.79		30.67		71	Rwanda					63.75
24	Dom Re			72.16			72	Saudi Arabia				80.07	
25	Egypt				88.89	73.46	73	Serbia			40.58	48.20	51.94
26	El Salvador			86.22			74	Singapore				69.20	
27	Estonia		9.73	22.68	29.32		75	Slovakia		52.98	55.49	57.48	
28	Ethiopia					75.46	76	Slovenia		48.63	42.80	41.95	36.12
29	Finland		36.31	41.36	42.63	38.88	77	South Africa		74.65	80.60	77.82	73.31
30	France	40.56	34.38		30.83	21.90	78	Spain	55.54	48.29	53.90	44.48	27.76
31	Georgia			63.20			79	Sweden	33.30	25.04	28.86	27.19	22.65
32	Germany	48.85	41.01	29.96	33.87	30.08	80	Switzerland		48.58	48.32		41.37
33	Ghana					83.42	81	Taiwan			39.68		37.73
34	Greece				54.65		82	Tanzania				86.38	
35	Hong Kong					12.70	83	Thailand					67.84
36	Hungary	38.27	51.74	39.96	39.05		84	Trinidad					67.33
37	Iceland	46.93	48.10		43.12		85	Turkey		60.93	73.59	71.57	65.84
38	India		57.33	68.53	58.62	54.84	86	Uganda				84.72	
39	Indonesia				87.46	85.02	87	UK	45.89	41.06	27.13	36.53	30.06
40	Iran				79.41	72.33	88	Ukraine			42.99	52.42	50.83
41	Iraq				83.17	75.11	89	Ulster	65.68	65.07		54.39	
42	Ireland	70.85	64.44		56.19		90	Uruguay			44.64		
43	Israel				62.03		91	USA	75.14	70.19	72.15	68.34	56.79
44	Italy	58.96	57.65		58.48	55.55	92	Venezuela			73.79	67.08	
45	Japan	34.51	23.99	23.26	25.05	21.70	93	Vietnam				30.48	34.88
46	Jordan				79.93	81.74	94	Zambia					75.40
47	Korea, South	43.46	41.62	27.95	37.11	36.72	95	Zimbabwe				83.56	
48	Kyrgistan				55.76			Averages	52.57	48.69	54.52	58.25	52.83

Note: The observations are weighted using the average principal components from all five waves. Missing observations are filled in proportionally. The average, median and std. of all 240 observations are: 54.03, 54.52 and 19.46 respectively

Table A2. The text of the items in the original English version

Nr	Code	Content
4.	a006	Item in set of what is important in life: Religion important in life. Answer: Very
3.	a040	Item about what it is important to teach children. Answer: Faith
14.	f024	Belongs to religious denomination. Answer: Yes
8.	f028	Attend religious service. Answer: At least once per month
12.	f034	Are a religious person. Answer: Yes
9.	f035	Churches answer moral problems. Answer: Yes
5.	f036	Churches answer family life problems. Answer: Yes
13.	f037	Churches answer spiritual needs. Answer: Yes
11.	f038	Churches answer social problems. Answer: Yes
6.	f050	Believes in god: Answer: Yes
1.	f063	God very important in life. Answers 7 to 10 on 10 point scale
7.	f065	Has moments of prayer, meditation. Answer: Yes
2.	f102	Better if more people are strongly religious Answer: Agree and agree strongly
10.	f104	Politicians who don't believe are unfit for office: Answer: Agree and agree strongly

Note: The text as given in the stata file downloaded from http://www.worldvaluessurvey.org

Table A3. The country-classifications used

1 Albania	PC, M	26 El Salvador	Ot, LA	51 Luxemburg	W	76 Slovenia	PC
2 Algeria	Ot, M, Ar	27 Estonia	PC	52 Macedonia	PC	77 South Africa	Ot
3 Andorra	W	28 Ethiopia	Ot	53 Malaysia	Ot, M	78 Spain	W
4 Argentina	Ot, LA	29 Finland	W, Sc	54 Mali	Ot, M	79 Sweden	W, Sc
5 Armenia	PC	30 France	W	55 Malta	W	80 Switzerland	W
6 Australia	W	31 Georgia	PC	56 Mexico	Ot, LA	81 Taiwan	Ot, Or
7 Austria	W	32 Germany	W	57 Moldova	PC	82 Tanzania	Ot
8 Azerbaijan	PC, M	33 Ghana	Ot	58 Morocco	Ot, M, Ar	83 Thailand	Ot, Or
9 Bangladesh	Ot, M	34 Greece	W	59 Netherlands	W	84 Trinidad	Ot, LA
10 Belarus	PC	35 Hong Kong	Ot, Or	60 New Zealand	W	85 Turkey	Ot, M
11 Belgium	W	36 Hungary	PC	61 Nigeria	Ot	86 Uganda	Ot
12 Bosnia	PC	37 Iceland	W, Sc	62 Norway	W, Sc	87 UK	W
13 Brazil	Ot, LA	38 India	Ot	63 Pakistan	Ot, M	88 Ukraine	PC
14 Bulgaria	PC	39 Indonesia	Ot, M	64 Peru	Ot, LA	89 Ulster	W
15 Burkina	Ot, M	40 Iran	Ot, M	65 Philippines	Ot, Or	90 Uruguay	Ot
16 Canada	W	41 Iraq	Ot, M, Ar	66 Poland	PC	91 USA	W
17 Chile	Ot, LA	42 Ireland	W	67 Portugal	W	92 Venezuela	Ot, LA
18 China	Ot, Or	43 Israel	W	68 Puerto Rico	Ot, LA	93 Vietnam	Ot, Or
19 Colombia	Ot, LA	44 Italy	W	69 Romania	PC	94 Zambia	Ot
20 Croatia	PC	45 Japan	Ot, Or	70 Russia	PC	95 Zimbabwe	Ot
21 Cyprus	W	46 Jordan	Ot, M, Ar	71 Rwanda	Ot		
22 Czech R.	PC	47 Korea, South	Ot, Or	72 Saudi Arabia	Ot, M, Ar		
23 Denmark	W, Sc	48 Kyrgistan	PC, M	73 Serbia	PC		
24 Domenican R.	Ot, LA	49 Latvia	PC	74 Singapore	Ot, Or		
25 Egypt	Ot, M, Ar	50 Lithuania	PC	75 Slovakia	PC		

Note: All countries are divided into 3 groups: W (West), PC (Post Communist) and Ot (others). The countries of West have the subgroup of Sc (Scandinavian); Some PC and many Ot countries are M (Muslim). Some Muslin countries are Ar (Arab). Finally some Ot countries are Or (Oriental).

Table A4. The DP-instruments used in Table 4

animals	Number of domesticable big mammals, weighing more than 45 kilos, which are believed to have been present in prehistory in various regions of the world. Source: Olsson and Hibbs (2005).
bioavg	Average of *plants* and *animals*, where each variable was first normalized by dividing by its maximum value. Source: Hibbs and Olsson (2004).
biofpc	The first principal component of *plants* and *animals*. Source: Olsson and Hibbs (2005).
maleco	Measure of malaria ecology; combines climatic factors and biological properties of the regionally dominant malaria vector into an index of the stability of malaria transmission; the index is measured on a highly disaggregated sub-national level and then averaged for the entire country and weighted by population. Source: Kiszewski and Sachs et al. (2004).
plants	Number of annual perennial wild grasses known to have existed in various regions of the world in prehistory, with a mean kernel weight exceeding 10 milligrams. Source: Olsson and Hibbs (2005).
axis	Relative East-West orientation of a country, measured as east-west distance (longitudinal degrees) divided by north-south distance (latitudinal degrees). Source: Olsson and Hibbs (2005).
climate	A ranking of climates according to how favorable they are to agriculture, based on the Köppen classification. Source: Olsson and Hibbs (2005).
coast	Proportion of land area within 100 km of the sea coast. Source: McArthur and Sachs (2001).
frost	Proportion of a country's land receiving five or more frost days in that country's winter, defined as December through February in the Northern hemisphere and June through August in the Southern hemisphere. Source: Masters and McMillan (2001).
geoavg	Average of *climate*, *lat*, and *axis*, where each variable was first normalized by dividing by its maximum value. Source: Hibbs and Olsson (2004).
geofpc	The first principal component of *climate*, *lat*, *axis* and *size*. Source: Olsson and Hibbs (2005).
lat	Distance from the equator as measured by the absolute value of country-specific latitude in degrees divided by 90 to place it on a [0,1] scale. Source: Hall and Jones (1999).
size	The size of the landmass to which the country belongs, in millions of square kilometers (a country may belong to Eurasia or it may be a small island). Source: Olsson and Hibbs (2005).

Table A5. Average of pairwise correlations, in same order as in Table 2

		Results for individual waves					Across waves	
		1982	1990	1995	2000	2005	Avr.	t-ratio
1.	God very important in life	0.71	0.69	0.83	0.80	0.76	0.76	14.4
2.	Family should teach children faith	0.76	0.71	0.80	0.78	0.74	0.76	24.3
3.	Religion important in life		0.70	0.80	0.76	0.76	0.76	21.1
4.	Better if more people are strongly religious					0.76	0.76	
5.	Believes in god	0.75	0.59	0.79	0.68		0.70	9.2
6.	Churches answer family life problems	0.79	0.59		0.69	0.72	0.70	9.7
7.	Has moments of prayer, meditation					0.70	0.70	
8.	Attend religious service regularly	0.69	0.65	0.77	0.62	0.69	0.68	13.6
9.	Churches answer social problems		0.61		0.76	0.67	0.68	11.0
10.	Churches answer moral problems	0.77	0.46		0.68	0.69	0.65	5.6
11.	Non-believers are unfit for political office				0.69	0.59	0.64	
12.	Are a religious person	0.56	0.64	0.73	0.64	0.64	0.64	11.9
13.	Churches answer spiritual needs	0.74	0.50		0.60	0.56	0.60	6.8
14.	Belongs to religious denomination	0.23	0.42	0.59	0.59		0.46	3.1
15.	Income (ln GDP per capita)	-0.31	-0.30	-0.44	-0.49	-0.59	-0.43	-3.9

Note that income is not included in average that covers all other non diagonal elements in the correlation matrix.