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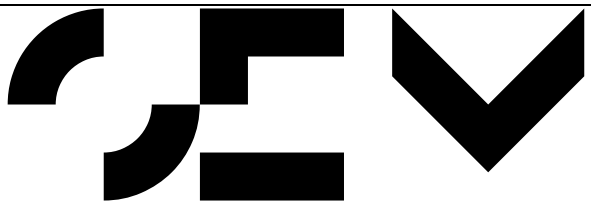

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The religious transition
A long-run perspective

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The religious transition

A long-run perspective

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Abstract:

We use factor analysis to derive a robust measure of religiosity from items reported in five waves of the World Value Survey. Our measure of religiosity is negatively correlated with per capita income. Development apparently causes religiosity to fall to about half its pre-modern level. Most components of the demand for religion are reduced by development. The supply of religion declines once churches lose control over the institutions providing collective goods like education, health, and social security. These goods used to be supplied by churches jointly with religious services but tend to be supplied by the state with rising levels of development. Aspects of supply and demand are integrated in a CES production function framework that can explain the direction of causality in the observed negative correlation between income and religiosity.

Keywords Levels of development, religiosity, biogeography

JEL: O11, Z12

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1. Introduction: Concept, literature, and a preview

This is a study of the transition of religiosity that happens when a country goes through the *Grand Transition* (GT) from being a LIC to become a DC[3] – a process we proxy by the rise in income.[4] The general process consists of interacting transitions in most fields of society as discussed in section 2. The religious transition is one of these transitions which apparently happens irrespective of the actual religion in the country. The main hypothesis of this paper is that the level of religiosity falls as countries become richer.

1.1. The R-variable: Measuring a representative part of larger complex

We define religiosity 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 N variables, $\hat{R}$ would be the largest common factor in all N variables. Our basic question is whether the importance of religion in people's lives is independent of the level of development.

The R-variable used in this paper is estimated by a factor analysis of 14 items from the *World Value Survey* (WVS).[5] The scale measures R in % as a share between 0 and 100, where zero is the lowest score on all items while 100 is the highest. Reported changes in R are thus in percentage points (*pp*). All the 14 items are scaled so that a rising score means that religiosity goes up. Income y is measured as the natural logarithm of GDP per capita, taken from the Maddison data (*lp* for logarithmic points).

The items from the WVS are chosen to span as much of the aspect space as possible, but some aspects are surely missing. We find that one factor has a large positive loading to all 14 items considered which is robust to the deletion of items, and to the polling error. This is tested as the items differ in the 5 waves of the VWS, with no obvious effect on our measure of religiosity, R. It has a significant negative correlation to income. In fact, each item of R also has a statistically significant negative correlation to income. A key assumption of our analysis is that R will be robust to the addition of items since it is robust to the exclusion of items, i.e. $R \approx \hat{R}$.

3. Broader aspects of the GT are discussed in Paldam and Gundlach (2008), while Gundlach and Paldam (2009a, b and c) analyze long-run causality in the transitions of democracy, corruption and agriculture.
4. LIC, MIC and DC mean Low Income, Middle Income and Developed Country respectively.
5. See Inglehart et al (1998) and (2004). The data are available at http://www.worldvaluessurvey.org.

1.2 Religion vs. religiosity: On goods and weights

Religion can be considered as a good that is produced by institutions which will be termed churches. It appears that it is produced to serve a dual role which is often hard to sort out:

One role is as *factor of production* used by the individual to increase production. One of the authors has experienced a whole town (in the Sahel zone) united in a communal prayer for rain. In many societies hunters perform ceremonies to increase their chances of prey. Also, stories have been told of business men in LICs and MICs, who have their new Mercedes Benzes blessed by the priests and even bishops, presumably as additional insurance, etc.

The second role of religion is as *consumption good* which increases people's welfare in itself. When people say that religion satisfies a spiritual need, it is a term of consumption. Most religions have places of worship where people go to get peace at mind. Many religions have ceremonies where the devout offer e.g. food to the Goods. Here people trade these goods for something that may be in this life or the next. We will have to term these trades production and consumption respectively in the economic terminology. The dual role of religiosity makes it a tricky good to analyze, but a similar dual role is known also for the good of education which serves both as a factor of production and a consumption good.

Our term *religiosity* is not considered to be a good. We think of religiosity as the weight that is given to religious beliefs in everyday decision making. The stock of religious beliefs can probably be considered as constant, but the relevance of religious beliefs 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 pretty low, but people still eat. So a low level of religiosity does not necessarily mean that people do not believe.

1.3 A brief introduction to the literature[6]

Religion is an important issue for many, and churches are often powerful organizations. Consequently, we are dealing with a field that is replete with strong priors and interests that generate controversies of the tornado type, where the center keeps moving.

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

6. The literature is enormous, but our aim is to integrate the findings into the transition framework, so we only include a few standard references. Futhermore, it is written by authors of many trades, so to communicate we have concentrated the formal analysis in one section.

would cause religiosity to vanish. One may interpret their secularization theory as a qualitative version of the religious transition, i.e., as a theory that *R* would go to zero in the limit.[7] 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 between religious and non-religious activities at the household level in response changes in the budget constraint. Other authors (e.g. Durkin and Greely, 1991) study the relationship between the demand for religion and the prevalence of risk in modern society. 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 that prevails on the market for religion, such that competition increases the efficient supply of religious goods.

1.4 A preview of the rest of the paper

Section 2 presents the framework of the empirical analysis and provides a long-run causality test, showing that rising income *causes* falling religiosity. Section 3 deals with the data, and presents the factor analysis. It is awkward that the analysis in section 2 uses the data presented in section 3, but section 3 uses the framework defined in section 2, so a linear presentation is not possible. Section 4 presents a basic discussion of the evidence, looking at trends over time, country groups and the effect of income.

Section 5 looks at aspects of demand: Religion is a *good* that is demanded as a factor that enters production in various ways: We argue that these demand components all decrease due to rising levels of development that provide a vast increase in the scope of alternative suppliers as regards most purposes. Thus, demand falls through a process of substitution away from religious goods.

Section 6 looks at aspects of supply. Religion is partly produced by churches. In traditional society, religion is supplied jointly with the core set of collective services:

7. 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 1.2.

Education, healthcare and social security. The Grand Transition has had two effects on the production of these collective goods: It increases the production, and it moves the control of the production from churches to the state. Consequently, the role of churches decreases with rising levels of development.

Thus we have three factors that explain the religious transition: (i) Falling demand, (ii) substitution and (iii) the loss of church control of the core heights of institutions. As measurement is scarce, most of the evidence in sections 4 and 5 is in the form of examples. Though we try to quantify, the evidence is not as systematic as we would have wanted.

Section 7 presents a formal summary of our hypothesis in the context of a simple endogenous growth model, with reference to the CES production function first mentioned in Solow (1956). This summary is considerably more abstract than the analysis till then, but it uses one of the most well-known workhorses of economic theory, and we believe that it does pull things together in a consistent way. Section 8 concludes.

2. The religious transition and long-run causality

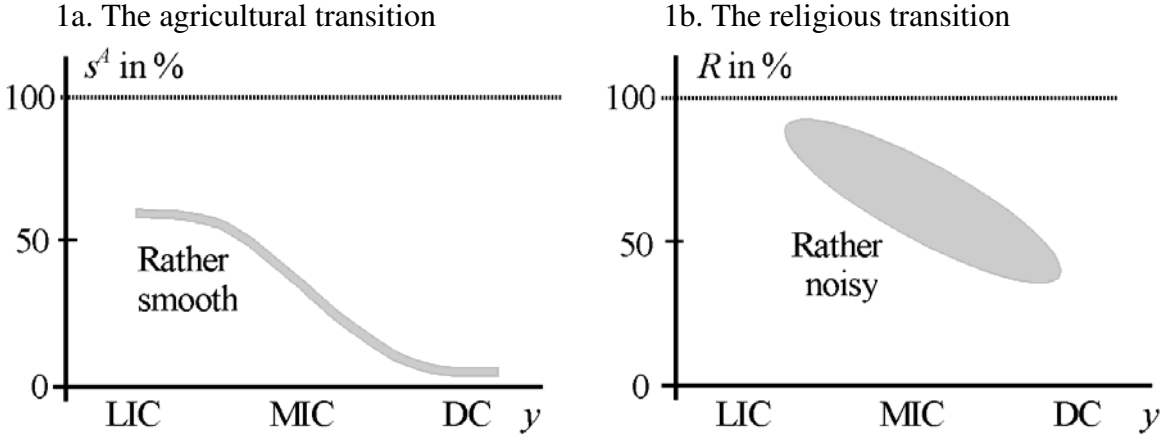
The perspective of this paper is the long run which is taken to be from half a century and up. The GT (Grand Transition) is the whole of the process of interacting changes termed development. The transition perspective implies that the causal factor is development as proxied by income. The paper analyzes the cross-country pattern in religiosity. It is taken to be the same as the long-run time-series pattern. We do not know if this is true for religiosity, but as it is the case for other transitions where both types of data exist, it is taken as the default.

2.1 The basic transition idea: A shift between two levels

The GT normally takes 1-2 centuries, but some cases are known where it took half a century only. The least controversial transition is the one of the share of agriculture. 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 1b is a preview of our findings about the religious transition. We have far less data for the religious transition, and also it is a much noisier process; but we find that religiosity falls from about 90% in the poorest countries to about 40% or less in the richest countries – i.e., religiosity is cut to less than half by the transition observed up to now.

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

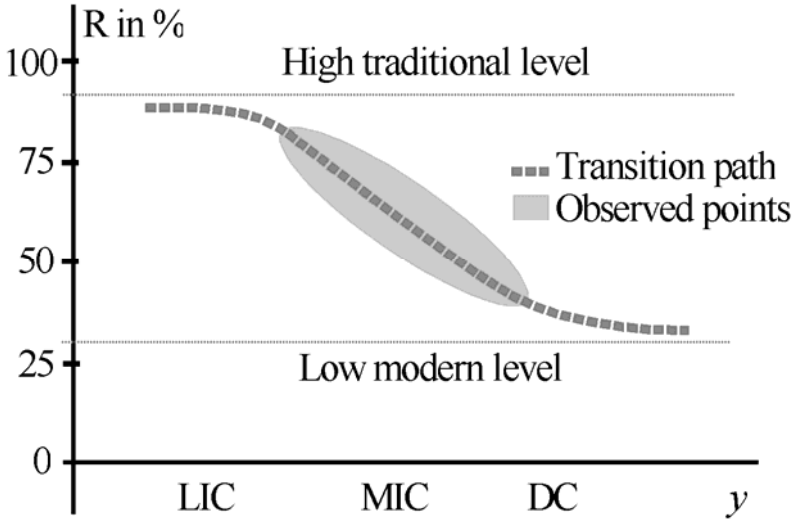


Note: The horizontal axis is income, i.e. the logarithm to GDP per capita. LIC is low income country, MIC is middle income country, and DC is developed country. The vertical axes are s^A, the share of agriculture in total GDP, and R is the factor of religiosity discussed in the text.

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 percent 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. In most cases the outliers can be explained by historical events with strong path dependency.[8] Consequently, we conjecture that religiosity is a variable with great inertia.

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 is therefore taken to be about 90%.

Figure 2. Our stylized interpretation of Figure 1b



The strong inertia in religiosity means that the fall observed may continue for some time – section 3.5 shows that religiosity keeps falling in the West. The modern level may thus converge to 35% or even lower. This also follows from a related argument. The stylized 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 for that pattern to emerge on Figure 3 in section 4, but it is certainly not conclusive, so we take it that some adjustment remains, especially in countries such as the USA with an unusually high level of religiosity.

8. The two most religious countries in the West are the USA and Malta. The unusual religiosity of the USA may be explained by the immigration history of the country, while Malta was ruled by the religious/military order of the Knights of Malta from 1530 to 1798.

2.2 A short introduction to the extreme DP-variables and the IV-test for causality

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. Somewhat counter-intuitively, the long run is best captured by a cross section of countries. The reason is that all countries started at comparable levels of income about 200 years ago, so the present differences in per capita income reflect differences in long-run growth rates.

Once we want to explain the long-run effect of income on religiosity, we need an instrumental variable to control for the possible reverse causality from religiosity to income, which could be derived for the case of Protestantism with reference to Max Weber (1904/05). To control for the possible endogeneity of religiosity, we use instruments that try to measure the *development potential* (DP) of countries due to natural conditions prevailing in the areas of modern countries long before any of the present religions was formed.

The DP-variables are inspired by Diamond (1997) and give the bio-geographical possibilities for development in Neolithic time. They have been compiled by Olsson and Hibbs (2005) and others, and have been used, e.g., by Gundlach and Paldam (2009a) to explain the democratic transition. The *biological* variables count the number of domesticable animals and arable plants in various areas in those distant times. We also consider variables that measure the potential for malaria transmission and the average days with frost per winter, which both are largely time-invariant variables that 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. All instruments together are available for between 59 and 85 of the 95 countries for which we have religiosity data.

Table A5 gives the definitions and sources of these data. On the face of it, it appears inconceivable that they can possibly work, but they surely do, as we have 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" period that lasted till the onset of the Industrial Revolution.

We have tried several combinations of our instrumental variables, but as in the previous papers using the data, all combinations proved to produce very similar results. So we only report results based on a few selected combinations. Our favorite combination (see column (1) of Table 1) uses the principal components of the geographical variables and the biological variables as the two core DP-variables.

2.3 The regression results

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. If the IV-estimate of the coefficient to income is the same as the OLS estimate, causality appears to run entirely from income to religiosity in the long run since there would be no endogeneity bias of the OLS estimate. If the IV coefficient is significantly smaller than the OLS coefficient, causality could run both ways. And if the IV coefficient is larger than the OLS coefficient, the level of income would prove to be a poor proxy variable for the true level of development that is held to affect the level of religiosity according to our basic hypothesis.

Our estimation results for regressions of religiosity on income ($y \Rightarrow R$) are reported in Table 1, with income defined as the natural logarithm of GDP per capita from the Maddison data-set (Maddison homepage). The first stage R-squared is high for all instrument combinations (columns (1)-(5)). The Sargan test reveals that the instruments are valid and correctly excluded from the estimation equation in three out of four cases. The Cragg-Donald test statistics are fairly satisfactory, as they are above or at the critical value. The instruments are thus reasonably strong.

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-coefficient estimates are different from zero at the 5 percent level of statistical significance, and a coefficient estimate of 0.15 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 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.

We conclude that most of the regression results are acceptable and show a significant causality from *y* to *R*. To illustrate the size of the estimated effect, we refer to the difference in log GDP per capita between Morocco and New Zealand which are countries that 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 0.15 thus predicts a difference in the measure of religiosity of about 0.26 points. The actual difference in the religiosity score for the two countries is 0.48 points, so our estimated income effect accounts for a little more than half of the observed difference in the religiosity score between Morocco and New Zealand.

Table 1. The long-run effect of income religiosity

Average data for 1982-2005	Main model	Robustness of model to instrument variation			
Dependent variable: R_i	(1)	(2)	(3)	(4)	(5)
No. of obs. (countries)	59	64	59	59	85
		OLS estimates			
Income, y_i	**-0.12** (0.02)	**-0.12** (0.02)	**-0.12** (0.02)	**-0.12** (0.02)	**-0.11** (0.02)
Centered R^2	0.49	0.48	0.49	0.49	0.36
		IV estimates: *y* is instrumented			
Income, y_i.	**-0.15** (0.03)	**-0.16** (0.02)	**-0.14** (0.03)	**-0.13** (0.02)	**-0.16** (0.02)
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)	0.19	0.02	0.26	0.79	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: $y \Rightarrow R$	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: $R \Rightarrow y$	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. The observations for income and religiosity are country averages for the available years. The measures of the instruments do not refer to specific years. 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 last two rows of Table 1 (shaded) report another attempt to control for reverse causality from religiosity to income and to check the explanatory power of our instruments. Here we regress income on religiosity ($R \Rightarrow y$) but only report the results of the Cragg-Donald test for

weak instruments and of the Hausman test for parameter consistency. 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), hence the Hausman C-statistc indicates that they are statistically significantly different from each other. These results do not prove that there is no causality from religiosity to income, but they show that our instruments are less suited to identify any potential exogenous variation in religiosity than in income.

3. The factor of religiosity

The religious transition does not (normally) cause a change of 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. This is what we term religiosity.

3.1 The 14 WVS items chosen

The 14 religiosity items from the WVS used in this paper are listed in Table 2. The two right hand columns give the average score in percent and the correlation between all values of the item and income. Thus the average of all 14 items is 56.2 pp. The least significant of the individual correlations (item 14) just pass the 5% level (in the two-way test), so all correlations are significantly negative, and in addition they are substantial in size.

Table 2. The 14 measures of religiosity: Number of observations and average score

Content of item	Number of countries where it was used						Avr.	Corr.
	Wave 1982	Wave 1990	Wave 1995	Wave 2000	Wave 2005	All Sum	Score %	to y [a)]
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	52	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 at least once per month	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. Politicians who don't believe are unfit for 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	171	420	360	747	579	2331	56.2	-0.49
Number of countries in wave	21	43	54	70	52	240[b)]	95[c)]	
Missing observations, in % of total possible	-41.8	-30.2	-52.4	-17.2	-21.8	-30.6		
Missing due to missing items in wave, in % of same	6.1	8.8	2.4	2.3	6.2	4.7		

Note: Table A1 shows how the countries included in the waves. Table A2 gives the wording and the coding of the items. The order of the 14 items is per the factor loading in Table 3. The polls of each wave are normally done over 2-3 years with the year mentioned as the "peak" year. (a) y is income. (b) Number of polls. (c) Number of countries included in at least one wave.

All items are scaled so that, if there is a common factor of religiosity, it should load positively with all 14 items. Our criteria for accepting a factor as a religiosity score is thus (i) that it loads positively and highly to all items, and (ii) that it is stable across waves. This is measured by the t-ratio of the cross-wave factor loadings.

3.2 The factor analysis: Factor 1 is religiosity

Table 3 presents a factor analysis of the religiosity items of each wave. The results are abundantly clear. The first three factors have eigenvalues of 7.4, 1.3 and 0.6. So the first factor dominates. In addition we note that: (i) the factor loadings to factor 1 are large and positive, and (ii) have great cross-wave stability. Hence factor 1 fulfills the criteria for a religiosity score. Moreover, it loads negatively to income, and the negative loading is stable.

The second factor is weak and unstable across waves. It appears that it mainly reflects independent factors in certain institutional aspects – it will not be discussed. The third and higher factors are of no consequence.

Table 3. Factor analysis done for each wave separately

	Results for individual waves					Across waves	
	1982	1990	1995	2000	2005	Avr.	t-ratio
Eigenvalue for Factor1, chosen as our *R*-variable	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 at least once per month	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. Politicians who don't believe are unfit for 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 waves include mostly the DCs of the West; but gradually more LDCs are brought in, and the last waves also include poor African countries. This causes the factor loadings to the religiosity items to fall a little, and the negative loading to income to rise.

Thus we see that the data contain a strong common factor of religiosity, and that it is negatively correlated to income. We have already shown in section 2 that the negative correlation can be interpreted as a causal link from rising development to falling religiosity.

3.3 The average correlations, based on pairwise correlations

The previous factor analysis is based on a balanced sample (within each wave), so it does not use all the data (in average about 80%). Alternatively, we have run the factor analysis on the pairwise correlations, where each correlation uses as many observations as possible. The results are so close that they are not reported.[9]

Table 4. Average of pairwise correlations, in same order as in Table 3

		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 at least once per month	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.	Politicians who don't believe are unfit for 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	-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.

As all factor loadings are positive and fairly similar, we simply present the average non-diagonal correlations (using the pairwise approach). Table 4 may give the reader an easy

9. While the pairwise correlation factor analysis uses more data, it is less consistent, so it is debatable which to prefer. Also we have made factor analysis of the aggregate matrix reached by joining the waves. It also gives much the same results. The pattern shown in Tables 3 and 4 is very robust.

intuition. The cross-wave stability is analyzed as in Table 3. The factor analysis gives more stable results, but they are also rather stable for the correlation analysis. At the two-digit presentation we can order the 14 variables the same as before.[10] So the analysis in Tables 3 and 4 give almost the same result.

The standard way to weight a set of correlated items is to use the principal components as the weights. Consequently, we have calculated a table (available upon request) parallel to Table 3 for the principal components and used the average-column as the weights to calculate the R-scores given in Table A1. These R-scores are used in Table 1, and in all aggregate calculations below.

10. With more digits the order changes a little, but the correlation between the average factor loadings and correlations is 0.991.

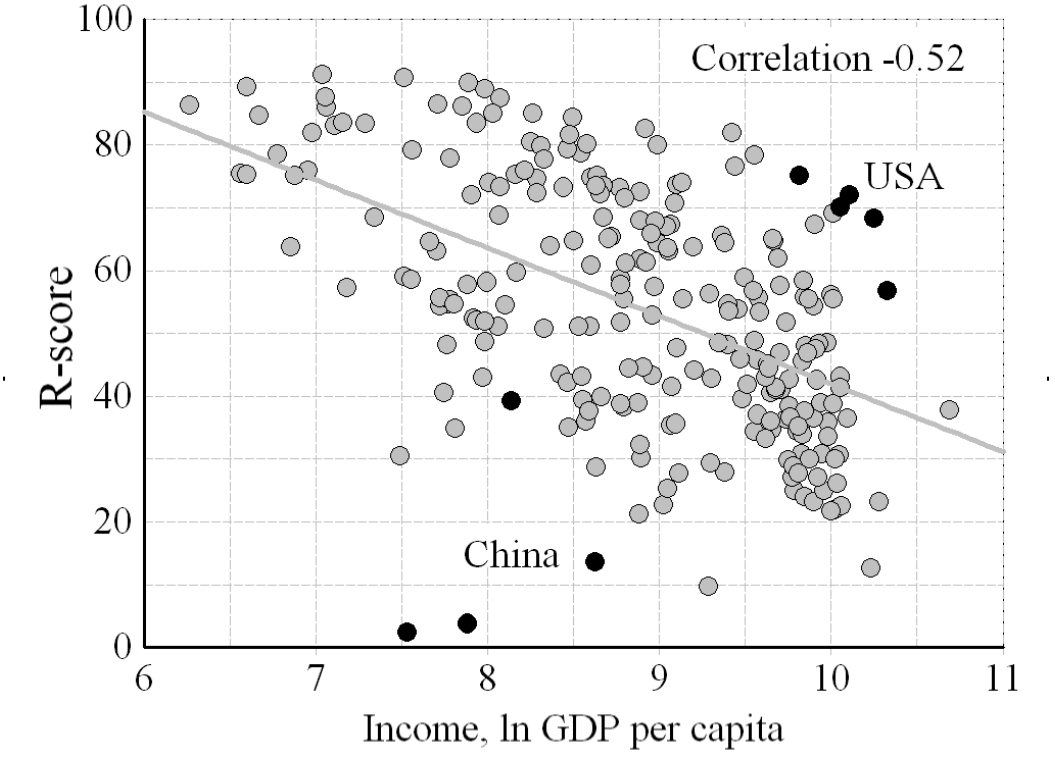
4. Analyzing the R-score: Changes over time and across country groups

We now try to explain the 240 R-scores derived from the five waves of the WVS for 95 countries. 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 in the Maddison data. In sub-section 4.3 we also use a set of binary dummies for the country groups defined in Table A3 which 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 All available R-scores as function of income

It is obvious from Figure 3 that there is a strong relation between religiosity and income, but it is also clear that income is only a partial explanation of religiosity once the religiosity data are no longer aggregated for each country as in Table 2.

Figure 3. Religiosity explained by income



The line shown is a simple linear regression. The WVS covers relatively few low income countries in the bottom income percentile, but these countries have religiosity scores of

almost 90 pp. If we disregard a few extreme observations, the top income percentile has religiosity scores below 40 pp. The religious transition is thus about 50 pp, but we expect that the transition is not complete up to now.

Two of the most extreme deviations are depicted in black. They are from important countries: China and the USA. The observations from 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 USA is moving toward a more typical level of religiosity. Nevertheless, both countries remain far off the income-conditioned average religiosity score.

4.2 The development of religiosity over time

Table 5 summarizes all available changes in individual religiosity scores, defined as: $\Delta_{ijt} = R_{ijt} - R_{ijt-1}$, where i is country; j is item; and t is wave. Here we report the averages of the changes in each of the 14 items from the WVS, and not just the change in the aggregate religiosity score. This greatly increases the number of observations, but of course it also further increases the variation. We also differentiate by country groupings.

Table 5. The available changes from one wave the next

	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 Post-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
Post-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. Post- comm	Average		***4.69***	-1.71	-1.82	-1.44
	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 Post-Com row is from before the fall of Communism. The country classification is given in Table A3.

For all $N = 906$ observations the average change in religiosity is 0.34 over five years, with a t-ratio of 1.1. Hence there is no trend; but this is due to the large rise in the Post-Communist 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.

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 *Post-Communist* 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. Muslim countries do have a relatively high level of religiosity, as we will see below, but it falls just as in other countries. The Latin American countries also have a large fall in 2000-05. Thus 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 post-communist 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 4.4 and 6.1.

4.3 Income vs. culture as determinants of religiosity

To see whether other variables than income might have a strong effect on religiosity, we introduce binary cultural dummies as defined in Table A3. The results based on the 240 observations of the aggregate *R* are reported in Table 6.

Table 6 has three sections. Part A is the point of reference and is termed the base model. Part B reports average results for ten independent regressions of religiosity on a constant and *one* of the country dummies, with income excluded in column (2) and with income included in column (3). The first t-ratio below the estimates is the average from the ten regressions, and the second t-ratio indicates the cross-country stability of the ten estimates.

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.

Also, the average estimate of the coefficient to income is about –11. This is in line with the OLS estimates of Table 2, which are based on country averages of *R* that are not

measured in percent (i.e., the country averages have been divided by 100). Thus, when income increases by 4½ lp, the religiosity score falls by about 50 pp.

Table 6. The effects of income and different cultures on religiosity

Dependent	Part A	Part B		Part C			
variable: *R*	Base	Average of 10 estimates		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)	
Post-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)		Post-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 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 country dummy is statistically significant if included individually, with and without controlling for income. However, two of the coefficients are only marginally significant: The West is marginally more religious than other countries when controlled for income; but the West is relatively rich, so it deviates downwards if it is *not* controlled for

income. This means that *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 it is a very religious country when the score is adjusted for the level of income.

The oriental group is consistently less religious than other countries. Especially China is extreme, when unadjusted and even more so when adjusted for income. Also the Scandinavian countries have unusually low levels of religiosity. The Scandinavian countries have the same level of income as the USA, 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 only marginally more religious than other Muslim countries.[11]

The Post-communist 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, we know that religiosity has increased by about 11.4 pp in these countries between 1990 and 2005. The average increase is thus about 6 pp. 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 score because they are rich. The USA is highly religious in spite of its wealth. Also the Latin American countries are relatively religious when their income is controlled for.

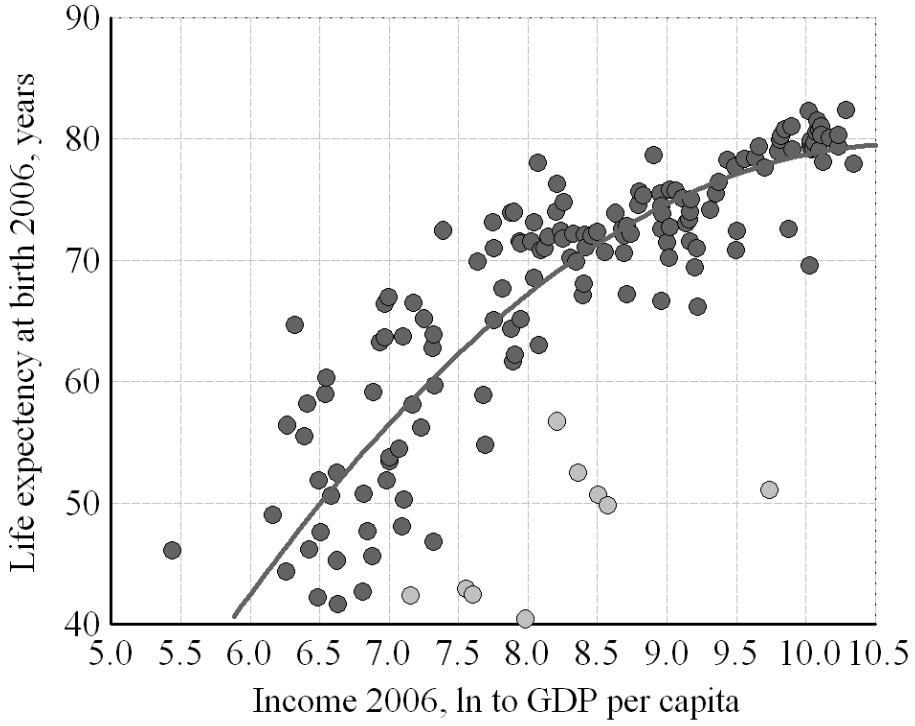
The Arab countries are not different from other Muslim countries whether or not their relatively high incomes are controlled for. It is also interesting to see that China remains an outlier, even in the presence of a control for being Oriental, and thus has a relatively low religiosity. The results show 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 USA.

11. 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 factor

Many reasons have been given why people demand religion. The following four, labeled D1-D4, seem to be the main ones:[12] 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.

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 high prevalence of hiv/aids. The inserted curve is a simple quadratic regression line inserted for purely illustrative reasons. Sources: Life expectancy is from WDI, income is from Maddison.

5.1 Religion as a productive input

One of the functions of religion is to offer protection against risk 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

12. Several other explanations for the demand for religion can be given, such as the demand for ceremonies to accompany the transitions in life, the demand for links to the national identity, etc.

risk 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.

But in case protection against risk fails, people need consolation, which is also provided by religion (D2).[13] 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 way, 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.[14] Though it sometimes helps to ascribe the *bugs* in the computer to *jujus* – we do not call a witch doctor, but a geek, to have them cured. It is no wonder that many religious institutions have fought to uphold religious explanations against the onslaught of scientific explanations.

The three items are illustrated by the plight of a fisherman. Before the GT he had a dangerous and relatively short life due to the dangers 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 almost to national levels the previously high level of religiosity in fishing towns.

5.2 Religion as a residual consumption good

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: To provide existential explanations (D4). In a similar vein many people feel that something is missing when everything is given a rational explanation. Some people even claim that they are wiser, when in addition to all the physical explanations (which they share with irreligious people) they also have

13. 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 if they are satisfactory.

14. 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.

metaphysical ones. We shall not discuss if these arguments make sense, but just report that they appear to treat religion as an item of consumption.

A related formulation claims that people have a religious instinct which has to be satisfied. People defending religion sometimes argue that atheists behave like believers in certain ways. There may be areas of religious or other belief activity in the brain, see, e.g., Schjødt et al (2008), though this line research based on brain scanners is still in its infancy.

This argument leads to two conjectures: The GT is a peel-off process reducing religiosity to some irreducible level; and the irreducible level of religiosity may be determined by the constant consumption demand. Our empirical finding is that the irreducible level may be less than half of the traditional level. However, the second conjecture is not confirmed as far as the data allow us to tell.

Two of the 14 items in the WVS deal with 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. From Table 2 we note that 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.

6. Supply and institutions: Losing the core heights of control

The three core civilian collective institutions are the ones producing *education, social security and health.* Before the GT these goods were jointly supplied by institutions dominated by the church, at least in the West. Put very crudely, these services were supplied as a side payment to those who consumed religion. The GT has two effects upon these core institutions:

(i) The relative size increases from about 5-10% of GDP to between 30 and 40%.

(ii) The control over these institutions moves from the church to the state.[15]

Thus we have a transition in size and control. Education participates in forming the values and beliefs of people; social security and health handle major parts of risk to the individual. As discussed in section 4.1, risk is an aspect of life where religion enters easily. The three institutions are thus the *core heights of control* for the churches. We discuss two historical experiments to demonstrate that the said loss of control matters substantially for our measure of religiosity, the R-score. Then we discuss why the church loses control during the GT.[16]

6.1 A large scale historical experiment: Communist rule

The estimates of section 4 show that religiosity was smaller in the communist countries, by about 20 pp.[17] In our reading, the previous governments of the 18 states that later became communist were positive or neutral to the respective churches, and that religiosity scores in these countries were similar to the ones in the rest of Europe, when controlled for income. But during the 45-72 years of Communist rule, the state was actively anti-religious in these countries.

The basis for the Communist negativity to churches was that as a totalitarian ideology it would not allow competition in matters of belief systems. Marx was atheist himself, claiming that "religion is the opium of the people". He thought religion would dull the minds of people to capitalist exploitation. Consequently, the Communist rulers made a systematic

15. In most countries there are both collective and private parts of these sectors, but this will be ignored in the present context..

16. The nature of the transition is illustrated by a visit to the old European town of Vienna, where the most spectacular monument is the medieval cathedral, and to the new (similar sized) American town of Seattle, where the most spectacular monument is the Central Public Library. Both monuments were built from donations.

17. The countries are: Albania, Armenia, Azerbaijan, Belarus, Bosnia, Bulgaria, Croatia, Czech R., Estonia, Georgia, Hungary, Kyrgyzstan, Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Slovenia and Ukraine. Note that the list includes Greek and Roman Catholic, Muslim and Protestant countries, as well as Armenia and Georgia, which have their own brands of Christianity.

effort to replace religion by the secular communist ideology.[18] This was done by (i) a purge of the three core institutions of any church influence; by (ii) waves of anti-church propaganda; and, (iii) by a systematic weakening of the apparatus of the church using a multitude of administrative devices, where the most powerful one was that the party record (nomenclature) that was decisive for people's career did register links to a church as negative information.[19]

After the fall of Communism in 1990, pressures against religion have ceased, and the R-score has increased by no less than 11 pp, as shown. This is consistent with the expected reaction to the discontinuation of the anti religious policies. Hence, we see that the command of the core institutions matters for religiosity scores. This 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 in these homelands, the Catholic religion dominates in the Southern Cone as well. The three neighbours also have much the same history of economic development. It is easy, of course, to mention many differences between the three countries, but we presume that religiosity scores would be roughly the same, 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.

18. Bjørnskov and Paldam (2009) study the cross-country pattern in mass support for socialism, and find that it is not higher in the ex-communist countries (except Russia) than in Western Europe, based on a WVS item about the preferences for public vs private ownership to business.

19. 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). Especially 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 strongly influenced by the Colorado party. Most of the institutions of the country were formed during the early rule if that party, notably by José Batlle y Ordóñez (1856-1929, who was president 1899, 1903-7, and 1911-15). His policies greatly expanded the three core institutions and placed them fully within state control. He also enforced a strict separation of state and church.[20] This has since then been upheld as a main policy rationale of the country. Table 7 shows the effect. Only one measure of *R* is available from Uruguay, but it deviates substantially from all other seven measures from the other Southern Cone countries. Consequently, we assess that the difference is app. 20 pp, like in the case of the previously communist countries.[21]

6.3 The transition of control over the core heights

In both historical experiments the state already played a considerable 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 the minimum that can be expected from the changing control of the core heights. As the observed total effect of the GT is 50 pp, this means that we may be dealing with as much as 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 did not have the power to tax, but did collect a great deal in alms. These resources were used to pay for church-building, as wages for the church employees, and for providing a minimum level of services of the three core institutions.

When economic development necessitated a large expansion of education, and rising incomes demanded 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 production of these services became too large. At the same time the state developed a greater and greater ability to tax, and consequently it took over. This undermined the ability of churches to collect alms. The result was thus a dynamic take-over of the core heights by the state and a subsequent decline in religiosity scores.

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20. The separation was so strict that religious symbols such as crosses were forbidden in schools and hospitals.
21. 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).

7. Understanding the Religious Transition

We provide a brief summary of our major arguments in terms of a most parsimonious Solowian endogenous growth model. Religious beliefs *R* and scientific knowledge *S* are considered as the only two inputs to production. Religious beliefs are produced by churches, scientific knowledge is produced by the state (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. 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.

Output of the single output good of the economy at time *t* is produced according to a CES production function[22]

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

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

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

Dividing both sides of equation (1) by B, we get the intensive form as

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

We assume that the stock of scientific knowledge can be accumulated and that the stock of religious beliefs is constant, which is why the state gains control of the core heights as discussed in Section 6. A constant fraction of output $s_k = \dot{K} / Y$ is saved and invested. The stock of scientific knowledge depreciates with a constant rate $d = D / K$. The growth rate of

22. 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 economy, γ_k, is given by the difference between the rate of knowledge accumulation and depreciation as

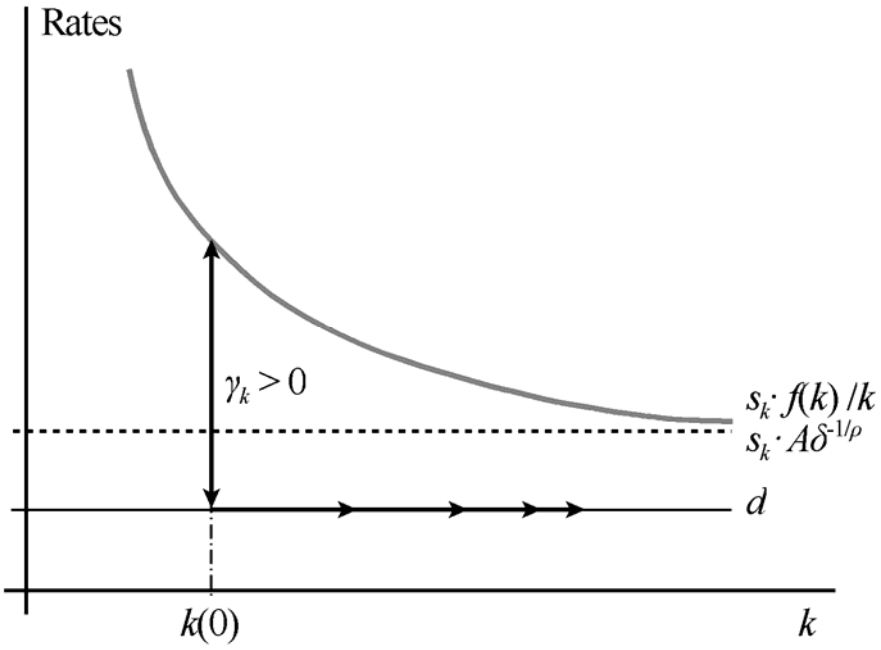
(4) $\gamma_k = s_k \cdot f(k)/k - d$

As k 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,[23] the CES technology with $\sigma > 1$ generates endogenous growth if the parameters satisfy the inequality condition

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

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



23. 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 *K*, 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 we think of our measure as reflecting the relevance or weight of religious beliefs in everyday decision making. If so, it can be represented by the distributional parameter in the CES production function, which is denoted by $(1-\delta)$ in equation (1).

In a Cobb-Douglas production function, the distributional parameter would equal a constant factor share. In the more general CES specification, the factor shares are not constant but depend, in addition to the value of the distribution parameter, on values of the factor inputs and the elasticity of substitution. One can show that the factor share of the cumulative input, π_K, is given by

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

With scientific knowledge *K* 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 $1 - \pi_K$, it will necessarily decline with rising *K* under the assumptions made. Our regression results in Table 1 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 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 reasonable once scientific knowledge and religious beliefs are considered as input factors. This does not mean that religion will vanish, as expected by Marx and others. The implication from the model is that people will still

believe although the relevance of religious beliefs for everyday decision making might approach zero in the limit. The share of agriculture in GDP also appears to approach zero in the limit, but people will still eat.

Our conceptualization of the religious transition critically hinges on an elasticity of substitution that is larger than 1. We think that both the demand factors and the supply factors discussed in the previous sections can 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 health services, education services, and social services for the same supply provided by the church. So we hypothesize that there is 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. Conclusions

The paper started by calculating the size of the religious transition. It found a fall in religiosity scores from almost 90% to about 40%. It appears that the transition is still not complete in the rich countries. We cannot be sure how far the transition will continue, but the 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. We have also demonstrated that the causality is from income to religiosity.

We think that the empirical facts presented in Sections 2 to 4 are very strong. There is indeed a religious transition. It is strange that these matters are disputed in parts of the literature (Stark and Iannacone 1994, Iannacone 1998). However, the interpretation of the facts remains to be discussed. We have provided parts of the interpretation. In sections 5 and 6, we present a handful of hypotheses that are backed up by some evidence. This evidence is weaker and a bit more narrative than we would have preferred.

The explanations of the fall of the religiosity scores use three mechanisms: Religion is demanded as a factor of production and for consumption. Religion is supplied by institutions, which are termed churches for brevity. 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 some higher level, though it appears to be falling as well up to now. As regards the production side, the Grand Transition causes the churches to lose control over the production of three core collective goods. Education, healthcare and social security used to be supplied as a side payment in addition to religious services by the church. The key problem for the churches has been that the production costs of side payments have grown so much that they cannot be financed from alms, so the churches lose 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 standard 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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WDI, World Development Indicators from the World Bank, URL: http://devdata.worldbank.org/dataonline/

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25. Reprinted 1920 in *Gesammelte Aufsätze zur Religionssoziologie*, 17-206. Often reprinted in that version.

Appendix A: Data

Table A1. The 240 R-scores 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).

Appendix B: Definitions and sources of the DP-variables used in Table 1

Dependent variable and main explanatory variable used in Table 1	
R	Measure of religiosity, in percent.. Source: WVS homepage, own calculations
y	Natural logarithm of GDP per capita, measured in 1990 international Geary-Khamis dollars. Source: Maddison homepage: http://www.ggdc.net/maddison/, data set downloaded 22 March 2009.
Instruments used in Table 1.	
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), (downloaded 27-10-03): www.earth.columbia.edu/about/director/malaria/index.html#datasets
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).

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