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# The religious transition

## A long-run perspective

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Abstract:

The largest common factor in 14 items reported in the World Value Survey is used as a robust measure of religiosity,  $R$ . Development causes  $R$  to fall by 50% from the traditional level,  $R_T$ , to the modern level,  $R_M$ . Most components of the demand for religion are reduced by development. The four main civilian collective goods are: Education, health, social security and religion. Development causes the control of the production of the three first services to change from churches to the state. This causes the supply of religion to fall. Aspects of supply and demand are integrated in a CES production function framework that explains the direction of causality in the observed negative correlation between income and religiosity.

Keywords     Levels of development, religiosity, biogeography

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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.<sup>3</sup> The GT-process consists of interacting transitions in most fields of society as discussed in section 3. One of these transitions is the religious transition. We show that it reduces religiosity to half, and it appears to happen irrespective of the actual religion in 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 is estimated by a factor analysis of  $K = 14$  items from the *World Value Survey* (WVS).<sup>4</sup> The items from the WVS are chosen to span as much of the aspect space as possible. One factor has a large loading to all 14 items. It is our  $R$ -variable. It is shown to be robust to the deletion of items as the items differ in the 5 waves of the WVS, with little effect on the  $R$ -variable. We claim that since  $R$  is robust to the exclusion of items, it will also be robust to the addition of items, i.e.  $R \approx \hat{R}$ .<sup>5</sup>

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 are in  $lp$ , logarithmic points.<sup>6</sup>

The basic finding is that  $R$  – and each of the 14 items – are negatively correlated to income. These correlations are all statistically significant.

## 1.2 Religion as a factor input and consumption good

In economic terms *Religion* is a complex good in two dimensions: It is produced by families and institutions, which will be termed churches. It is produced as a consumption good and to serve as a factor of production. This is related to the good of education, which has the same

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3. The paper uses the World Bank terminology of dividing countries in DCs, developed countries, and LDCs, less developed countries, which are divided in 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 misses many aspects of religiosity; but to get a different  $R$ -measure there has to be a set of aspects that are correlated to each other and not to  $R$ .

6. Source Maddison (2003) and the Maddison homepage. A few observations are assessed using the WDI.

dual production structure and serve the same two roles. Like in the economics of education we concentrate on the factor of production role and on the formal institutions of production.

Religion is used by individuals as factor of production 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. The second role 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.<sup>7</sup>

In contrast, *religiosity* is not considered to be a good. 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 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. A low level of religiosity does not necessarily mean that people do not believe.

### 1.3 A brief introduction to the literature<sup>8</sup>

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.

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. 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.<sup>9</sup> 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 reli-

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7. Many religions have ceremonies where the devout offer e.g. food to the Gods. Here people trade these goods for something that may be in this life or the next. These trades will have to be considered production and consumption respectively in the economic terminology.

8. The literature is enormous, but our aim is to integrate the findings into the transition framework, so only a few standard references are included. Furthermore, the literature is written by authors of many trades – to communicate the formal analysis is concentrated in one section.

9. 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.

giosity. 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 Iannaccone 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*

The structure of the paper is simple: The empirics, demonstrating the size and robustness of the  $R$ -variable and the transition, is in sections 2 to 4, and then the mechanism explaining the transition are presented in sections 5 and 6. Section 7 analyzes the consistency of the explanations by a general equilibrium analysis.

Empirics (macro): Section 2 defines the macro measure  $R$  and shows that it is robust. Section 3 presents the transition framework of the analysis and a long-run causality test, showing that rising income *causes* falling religiosity. Section 4 looks at trends over time and across country groups. To demonstrate that the transition applies for many countries are needed, so we can only consider the main religions and country groups.

Explanation (micro): Section 5 looks at aspects of demand: Here religion is treated as a *good* that is demanded mainly as a factor that enters production. Demand falls through a process of substitution away from religious goods. Section 6 looks at aspects of supply. In traditional society, religion is supplied jointly with the core set of collective services: 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. As measurement is scarce, most of the evidence in sections 5 and 6 is in the form of examples.

The dynamic general equilibrium analysis in section 7 uses an endogenous growth model. As it has to explain changing factor shares it uses a CES production function. It shows that most of the analysis can be summarized in a consistent way. Section 8 concludes, and the Appendix provides five additional tables – they are referred to as Tables A1 to A5.

## 2. The religiosity variable, $R$

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.

### 2.1 The 14 WVS items of Table 1

The 14 religiosity items from the WVS used in this paper are listed in Table 1. All items are scaled so that higher religiosity means higher scores. Note the three counts: The number of polls  $N = 240$ , done in  $N_c = 95$  countries, and the number of items polled  $M = 2331$ .

The two gray columns give the average score in percent – for all 14 items it is 56.2% – and the correlation between the average values of the item for each poll and income. The least significant of these correlations (item 14) just pass the 5% level (in the two-way test), so all correlations are significantly negative, and nearly all are substantial in size.

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

Content of item	Countries where each item was polled						Avr. value %	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	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 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	171	420	360	747	579	2331 <sup>b)</sup>	56.2	-0.49
Number of countries in wave	21	43	54	70	52	240 <sup>c)</sup>	95 <sup>d)</sup>	
Missing observations, in % of total possible	-41.8	-30.2	-52.4	-17.2	-21.8	-30.6		

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 2. The polls of each wave are normally done over 2-3 years with the year mentioned as the “peak” year. (a)  $y$  is income = ln GDP per capita. (b)  $M$ , number of items polled. (c)  $N$ , number of polls. (d) Number of countries included in at least one wave.

## 2.2 The factor analysis of Table 2: Factor 1 is 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.

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.

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.

Table 2. Factor analysis done for each wave separately

Factor 1 is chosen as our <i>R</i> -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.

### 3.3 *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 was 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. The results are so close that they are not reported. Also, we have made factor analyses of the aggregate matrix reached by joining the waves. It also gives much the same results. Table A5 (in the appendix) shows the average non-diagonal correlations. This may give the reader an easy intuition. At the two-digit presentation the 14 variables can be ordered the same as before.<sup>10</sup> So the analysis in Tables 2 and A5 give almost the same result.

The standard way to weight a set of correlated items is to use principal components as weights. Consequently, a table of principal components has been calculated parallel to Table 2. The average columns are used as weights for the  $N = 240$   $R$ s given in Table A1.

Thus the factor analysis shows that the data contain a strong and very robust common factor of religiosity, which it is negatively correlated to income.

## 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 interacting changes termed development. The transition perspective implies that the causal factor is development as proxied by income.<sup>11</sup> The paper analyzes the cross-country pattern in religiosity. It is taken to be the same as the long-run time-series pattern. It is not known 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.

### 3.1 *The transition idea: A shift between two levels: $R_T$ and $R_M$*

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

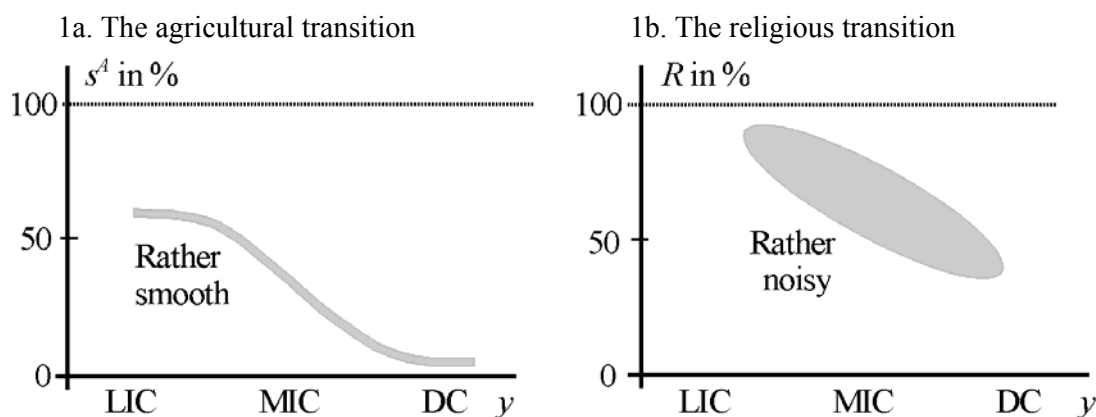
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10. With more digits the order changes a little, but the correlation between the average factor loadings and correlations is 0.991.

11. 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.

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, and also it is a much noisier 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.

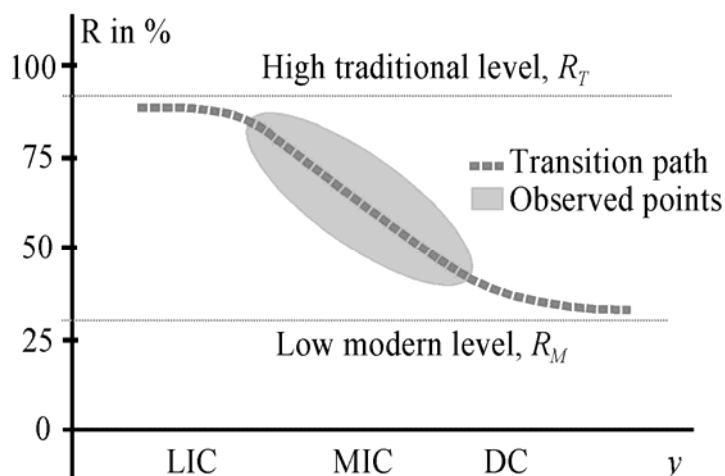
Even when the fall in religiosity appears to be large in the long run, it is small in the short run. A fall of 50 pp would translate into a fall of only 0.2 percent per year over two centuries. That is, 1 pp over the 5-year period of a WVS wave. Hence it is easy to overlook in the perspective of 5-10 years, especially as religiosity data vary considerably across countries. In most cases the outliers can be explained by historical events with strong path dependency.<sup>12</sup> Consequently, religiosity seems to be 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

12. The two most religious countries in the West are Malta and the USA. The unusual religiosity Malta was ruled by the religious/military order of the Knights of Malta from 1530 to 1798, while the case of the USA may be explained by the immigration history of the country, however, Grant (2008) suggests that the story is a great deal more complex, as religiosity has shown large cyclical movements in the USA.

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  $R_T \approx 90\%$ .

Figure 2. Our stylized interpretation of Figure 1b



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 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 USA with an unusually high level of religiosity. So the value of  $R_M$  is still not well determined.

### 3.2 *An introduction to the DP-variables and 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. 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.

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 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. 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.

Table A4 gives the definitions and sources of the DP-variables. 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” period that lasted till the onset of the Industrial Revolution.

### 3.3 *The causality test of Table 3, analyzing cross-wave averages $\underline{R}$*

The instruments are available as cross-country sets and consequently we compare with the cross-country set of  $N_c = 95$   $\underline{R}$ 's, which are averages over the available waves. The DP-instruments are available for between 59 and 85 of the 95 countries.

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 ( $y \Rightarrow \underline{R}$ ) are reported in Table 3. 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 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.

Table 3. 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, $y_i$	<b>-12.34</b>	<b>-11.79</b>	<b>-12.34</b>	<b>-12.34</b>	<b>-11.01</b>
( 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, $y_i$	<b>-14.99</b>	<b>-15.63</b>	<b>-14.62</b>	<b>-12.82</b>	<b>-15.53</b>
( t-ratio)	(-5.7)	(-6.8)	(-5.6)	(-5.6)	(-6.6)
Instruments	<i>biofpc,</i> <i>geofpc</i>	<i>bioavg,</i> <i>geoav</i>	<i>animals,</i> <i>plants</i>	<i>axis, size,</i> <i>Climate</i>	<i>coast, frost,</i> <i>Maleco</i>
	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. 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.

Several combinations of the instrumental variables have been tried, but as in the previous papers using the data, all combinations proved to produce very similar results. Thus, only results based on a few selected combinations are reported in Table 3. Our favorite combination is column (1) of the table. It uses the principal components of the geographical variables and the biological variables as the two core DP-variables.

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 5 percent level of statistical 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 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.

The conclusion is that most of the regression results are acceptable and show a significant causality from  $y$  to  $R$ . The size of the effects found are consistent with the results in section 4 even when they use the  $N_c = 59$  to 85 average  $\underline{R}$ s and not all  $N = 240$   $R$ s.<sup>13</sup> Note that the coefficients to the instrumented coefficients on income are larger than the non-instrumented, and that the difference is significant in 2 of the 5 regressions. This suggests a negative simultaneity bias. Consequently, an exogenous rise in religiosity may cause income to fall marginally. However, it might also be due to the measurement error in the  $R$ s.

The last two rows of Table 3 (shaded) report another attempt to control for reverse causality from religiosity to income and to check the explanatory power of our instruments. 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), as indicated by the Hausman C-statistic. 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.

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13 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.

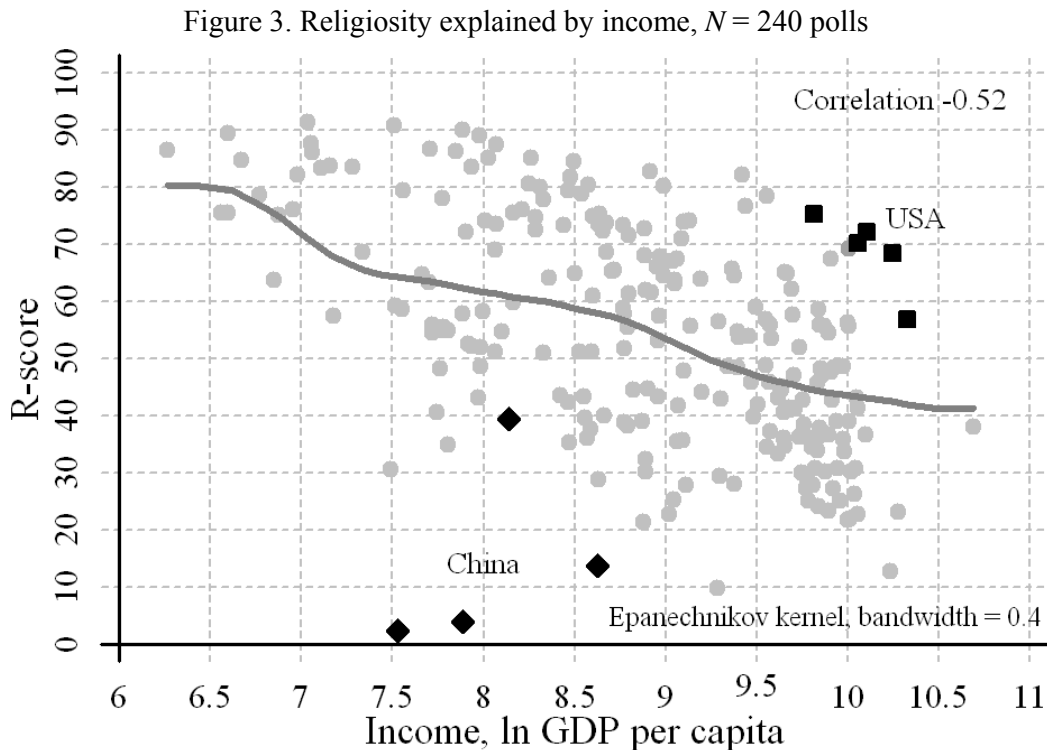
The results in Table 3 use the averages of the religiosity score for each country. In Table 5, we use the year-specific  $R$ s for each country from the 240 polls to get a higher  $N$ . It is reassuring that the results change marginally only, as shown in the next section.

#### 4. Changes in $R$ over time and across country groups

We now try to explain the  $R$ -variable 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  $4\frac{1}{2}$   $lp$  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. The relation is clear to see, but it is also obvious that income is only a partial explanation of religiosity.



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.

The figure shows that all  $N = 240$  observations have a correlation  $r = -0.52$ . The  $N = 82$  observations for Western countries with  $r = -0.48$ , the  $N = 64$  observations for Post Communist countries with  $r = -0.53$  and observations  $N = 94$  for other countries with  $r = -0.47$ . So the correlations are stable across country groups.

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.

#### 4.2 *The development of religiosity over time, for $M' = 906$ polled item changes*

As the 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  $M' = 906$  changes, which are defined as  $\Delta_{ijt} = R_{ijt} - R_{ijt-1}$ , where  $i$  is country;  $j$  is item; and  $t$  is wave.

Table 4 summarizes all these changes. 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. However, 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. A change of -1 pp per 5-year is precisely as expected from the analysis of Figure 3.

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 shown 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.

Table 4. The available changes from one wave the next,  $M'$ = 906 items changes

	Difference	1982-90	1990-55	1995-00	2000-05	All
Part A: Aggregate results						
All countries	Average	<b>-1.47</b>	<b>2.88</b>	<b>1.13</b>	<b>-0.93</b>	0.34
	t-ratio, N	-1.7, 153	4.3, 184	2.5, 259	-1.7, 310	1.1, 906
Except Post-com	Average	<b>-1.43</b>	-0.02	0.38	<b>-1.97</b>	<b>-1.01</b>
	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	<b>-1.60</b>	-0.78	-0.64	-0.99	<b>-1.18</b>
	t-ratio	-2.2, 133	-0.9, 50	-0.8, 37	-1.2, 75	-2.8, 295
Post-com	Average	-2.64	<b>7.40</b>	<b>1.88</b>	<b>2.36</b>	<b>3.34</b>
	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	<b>-2.44</b>	-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		<b>4.69</b>	-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	<b>-8.04</b>	<b>-1.48</b>
	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.

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 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 introduced as defined in Table A3. The results based on the 240 observations of the aggregate  $R$  are reported in Table 5.

Table 5. The effects of income and different cultures on religiosity,  $N = 240$  polls

Dependent variable: $R$ $N = 240$	Part A	Part B		Part C			
	Base (1)	Average of 10 estimates (2) (3)		Regressions with all (significant) groups (4a) (4b) (5a) (5b)			
Income	<b>-10.81</b>	<b>-10.72</b>				<b>-11.51</b>	<b>-11.33</b>
(t-ratio)	(-9.5)	(-9.1, -7.8)				(-9.0)	(-11.4)
Constant	<b>150.14</b>	<b>53.66</b>	<b>148.82</b>	<b>67.29</b>	<b>67.82</b>	<b>158.91</b>	<b>157.94</b>
(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		<b>-11.11</b>	<b>5.75</b>	<b>-19.18</b>	<b>-19.51</b>	0.88	
(t-ratio)		(-4.3)	(1.9)	(-6.0)	(-7.6)	(0.3)	
Post-com		<b>-8.55</b>	<b>-14.42</b>	<b>-20.38</b>	<b>-19.71</b>	<b>-13.61</b>	<b>-14.29</b>
(t-ratio)		(-3.0)	(-6.2)	(-6.7)	(-7.6)	(-5.0)	(-7.1)
Others		<b>17.24</b>	<b>10.08</b>			Deleted when West and Post-Com are included	
(t-ratio)		(7.4)	(4.2)				
Oriental		<b>-17.24</b>	<b>-16.76</b>	<b>-24.30</b>	<b>-24.86</b>	<b>-11.50</b>	<b>-12.34</b>
(t-ratio)		(-3.9)	(-4.7)	(-6.0)	(-6.8)	(-3.0)	(-4.0)
Lat. Am.		<b>16.03</b>	<b>15.35</b>	0.96		<b>10.93</b>	<b>10.28</b>
(t-ratio)		(4.2)	(4.7)	(0.3)		(3.2)	(3.9)
Muslim		<b>24.40</b>	<b>16.10</b>	<b>12.89</b>	<b>13.14</b>	<b>9.84</b>	<b>11.24</b>
(t-ratio)		(7.3)	(4.7)	(3.5)	(4.4)	(3.1)	(4.2)
Arab		<b>29.30</b>	<b>19.76</b>	1.92		5.02	
(t-ratio)		(7.3)	(3.7)	(0.4)		(1.1)	
Scandinavian		<b>-19.54</b>	<b>-9.19</b>	<b>-12.15</b>	<b>-12.15</b>	<b>-10.65</b>	<b>-10.60</b>
(t-ratio)		(-4.2)	(-2.2)	(-3.3)	(-3.3)	(-3.3)	(-3.4)
China		<b>-39.90</b>	<b>-49.83</b>	<b>-28.20</b>	<b>-28.17</b>	<b>-40.05</b>	<b>-39.71</b>
(t-ratio)		(-4.2)	(-6.3)	(-3.7)	(-3.7)	(-5.9)	(-5.9)
USA		<b>14.80</b>	<b>29.41</b>	<b>20.41</b>	<b>20.41</b>	<b>24.17</b>	<b>25.06</b>
(t-ratio)		(1.7)	(3.9)	(3.2)	(3.2)	(4.4)	(4.5)
AR <sup>2</sup>	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.

Table 5 has three parts: 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.

The top row of the table shows that the average estimate of the coefficient to income is about  $-11$ , which compares with the slightly larger OLS coefficients estimated in Table 3 based on averaged religiosity data. When income increases by  $4\frac{1}{2}$  lp,  $R$  falls by about 50 pp. This is in line with the OLS results in Table 3 and consistent with the result from section 4.2.

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. 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 marginally more religious than other Muslim countries (see Paldam 2008).<sup>14</sup>

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, 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 5 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

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14. 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.

because they are rich. However, 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.

## **5. The demand side: A fall in the components**

Many reasons have been given why people demand religion. The following four, labeled D1-D4, seem to be the main ones:<sup>15</sup> 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 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 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).<sup>16</sup> 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

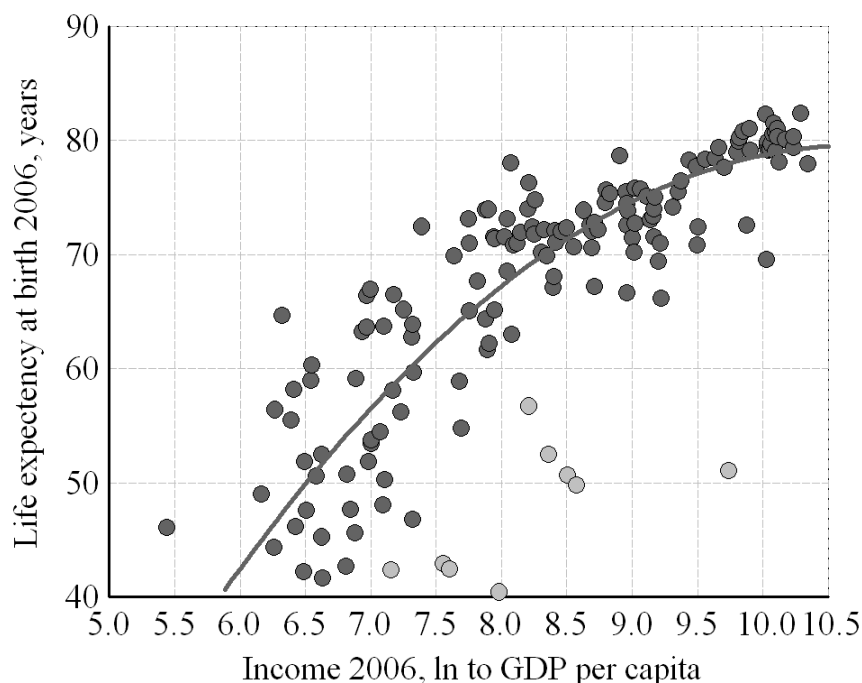
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15. Several other explanations for the demand for religion can be given, such as the demand for ceremonies to accompany the transitions in life, the demand for links to the national identity, etc.

16. 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.

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.

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.

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.<sup>17</sup> 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

17. 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.

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 almost to national levels.

## 5.2 *Religion as a consumption good*

We have here found three main points of view, which suggest that religion is a consumption good. They may be expressed in many ways of which some may even overlap some. It will not be discussed if these arguments make sense:

*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: To provide existential explanations (D4). The philosophical school of existentialism discuss if this make 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 in addition to all the physical explanations, which they share with irreligious people, they also have metaphysical ones. A certain terminology speaks of “simple” materialism versus “deep” insight.<sup>18</sup>

*The religious 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). They report mainly negative findings, but this research is in its infancy.

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 a conjecture: Maybe the consumption component has some irreducible level. Our empirical finding is that the irreducible level may be less than half of the traditional level. However, this conjecture is not confirmed in the data.

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,

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18. This argument does not support generalizations, as it suggesting some kind of a quantitative relation between wisdom and the size and complexity of the metaphysical structure people believe in. That is, it argues that astrologists are wiser than astronomers.

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.

## 6. The supply side: Losing control of the three core goods

In this section we consider only the formal institutions – termed churches – that produce religion. We define education, social security and healthcare as the three *core goods*.<sup>19</sup> Before the GT religion and the core goods were jointly produced by institutions dominated by the church.<sup>20</sup> Put crudely, the core goods were supplied as a side payment to those, who demanded religion or vice versa. The GT has two effects upon the production of the core goods:

- (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.<sup>21</sup>

Thus a transition in size and control occurs. 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 4.1, risk is an aspect of life where religion enters. The three institutions are thus the *core heights of control* for the churches. Two historical experiments are discussed to demonstrate that the said loss of control matters substantially for our measure of religiosity, the R-variable. Then it is discussed why the church loses control during the GT.<sup>22</sup>

### 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.<sup>23</sup> In our reading, religiosity in these countries were similar to the ones in the rest of Europe, when controlled for income. The previous governments of the 18 countries behaved much like the typical government in the West toward the church.

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19 . The argument in this section is related to the one in Puchades-Navarro and Montero (2009).

20. This was certainly the case in the West, but also in most other civilizations as far as we know.

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

22. 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.

23. 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.

During the 45-72 years of Communist rule, the state was actively anti-religious in these countries. Communism is that as 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 to capitalist exploitation.

Consequently, the Communist rulers made a systematic effort to replace religion by the secular communist ideology.<sup>24</sup> This was done by (i) a purge of the production of the three core goods 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. 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.<sup>25</sup>

After the fall of Communism in 1990, pressures against religion have ceased, and the *Rs* 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. Hence, we conclude that the command of the core institutions matters for religiosity. This can also be seen from an altogether separate and much smaller historical experiment.

Table 6. The available *Rs* 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 <sup>a)</sup>

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

## 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. It is easy, of

24. 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.

25. 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.

course, to mention many differences between the three countries, but religiosity would probably have been roughly the same, except for one historical fact.

In Uruguay, politics has been strongly influenced by the Colorado party. Most of the institutions of the country were formed during the early rule of 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.<sup>26</sup> This has since then been upheld as a main policy rationale of the country. Table 6 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.<sup>27</sup>

### 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 the loss of control may account for 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

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

27. The reader can confirm the information in Table 6 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).

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.

## 7. Dynamic general equilibrium

Our major arguments may be briefly summarized in terms of an endogenous growth model, with religious beliefs  $R$  and scientific knowledge  $S$  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.

### 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, so the technological change is endogenous even if all assumptions are straight from Solow (1956).<sup>28</sup>

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

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

$Y_t$  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  $A$ ,  $\delta$ , and  $\rho$  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  $\sigma$  is

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

Dividing both sides of equation (1) by  $B_t$ , generates the intensive form as

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

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28. 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).

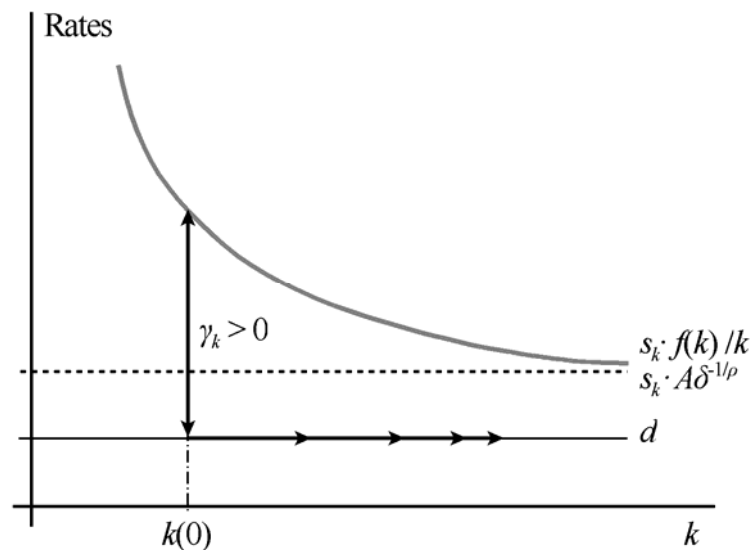
Assume that the stock of scientific knowledge can be accumulated and that the stock of religious beliefs is constant, which is why the state gains control of the core heights as discussed in Section 6. A constant fraction of output  $s_k = \dot{K} / Y$  is saved and invested. The stock of scientific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

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

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,<sup>29</sup> the CES technology with  $\sigma > 1$  generates endogenous growth if the parameters satisfy the inequality condition

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

Figure 5. Endogenous growth with knowledge accumulation and constant religion



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

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

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.

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 our measure reflects 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).

## 8.2 *The paths of the shares of religion and science*

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,  $\pi_K$ , is given by

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

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 3 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. 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 health services, education services, and social services 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 defining the religiosity variable,  $R$ , and showing its robustness in the data, and next it analyzed the size of the religious transition. It found a fall in the  $R$ -variable from almost 90% to about 40%. It appears that the transition is still not complete in the rich countries. It is not yet clear 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. It has been demonstrated that the causality is from income to religiosity.

The empirical facts presented in Sections 2 to 4 appear very strong. There is indeed a religious transition. 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 the interpretation. 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, though it appears to be falling as well up to now.

Religion is supplied by institutions, which 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, healthcare and social security, 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 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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## Appendix A: Extra tables

Table A1. The 240 R-values calculated

	1982	1990	1995	2000	2005		1982	1990	1995	2000	2005	
1			54.39	57.77		49		44.01	39.52	44.43		
2				83.54		50		35.44	51.21	57.85		
3					23.17	51				37.92		
4	61.90	58.78	64.48	63.15	47.72	52			48.66	54.64		
5			51.15			53					74.02	
6	55.77		45.73		36.64	54					82.01	
7		51.86		47.58		55	84.44	82.64		76.58		
8			59.16			56		65.39	65.20	72.57	61.43	
9			89.25	78.63		57			55.40	64.64	58.22	
10		21.32	42.23	38.76		58				89.99	85.05	
11	53.50	42.71		38.95		59	45.75	38.47		33.67	26.17	
12			54.79	52.18		60			43.11		35.31	
13		64.86	80.24		68.59	61		86.03	91.29	87.62		
14		28.82	36.12	37.62	32.25	62	45.09	35.69	35.86			
15					76.05	63				90.74	79.26	
16	64.85	55.81		55.55		64			75.34	75.96	63.98	
17		73.24	67.45	63.78	53.66	65			86.49	78.01		
18		2.41	3.84	39.30	13.62	66		78.69	75.12	67.99	63.65	
19			74.84		73.55	67		56.32		56.85		
20			51.16	61.23		68			81.99	78.37		
21					46.98	69		59.85	68.85	74.04	72.47	
22		35.65	25.30	27.78		70		43.32	35.15	43.21	30.24	
23	34.71	30.79		30.67		71					63.75	
24			72.16			72				80.07		
25				88.89	73.46	73			40.58	48.20	51.94	
26			86.22			74				69.20		
27		9.73	22.68	29.32		75		52.98	55.49	57.48		
28					75.46	76		48.63	42.80	41.95	36.12	
29		36.31	41.36	42.63	38.88	77		74.65	80.60	77.82	73.31	
30	40.56	34.38		30.83	21.90	78	55.54	48.29	53.90	44.48	27.76	
31			63.20			79	33.30	25.04	28.86	27.19	22.65	
32	48.85	41.01	29.96	33.87	30.08	80		48.58	48.32		41.37	
33					83.42	81				39.68	37.73	
34				54.65		82					86.38	
35					12.70	83					67.84	
36	38.27	51.74	39.96	39.05		84					67.33	
37	46.93	48.10		43.12		85		60.93	73.59	71.57	65.84	
38		57.33	68.53	58.62	54.84	86					84.72	
39				87.46	85.02	87	45.89	41.06	27.13	36.53	30.06	
40				79.41	72.33	88				42.99	52.42	50.83
41				83.17	75.11	89	65.68	65.07			54.39	
42	70.85	64.44		56.19		90			44.64			
43				62.03		91	75.14	70.19	72.15	68.34	56.79	
44	58.96	57.65		58.48	55.55	92			73.79	67.08		
45	34.51	23.99	23.26	25.05	21.70	93				30.48	34.88	
46				79.93	81.74	94						75.40
47	43.46	41.62	27.95	37.11	36.72	95					83.56	
48				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 Muslim countries are Ar (Arab). Finally some Ot countries are Or (Oriental).

Table A4. The DP-instruments used in Table 3

<i>animals</i>	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).
<i>bioavg</i>	Average of <i>plants</i> and <i>animals</i> , where each variable was first normalized by dividing by its maximum value. Source: Hibbs and Olsson (2004).
<i>biofpc</i>	The first principal component of <i>plants</i> and <i>animals</i> . Source: Olsson and Hibbs (2005).
<i>maleco</i>	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).
<i>plants</i>	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).
<i>axis</i>	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).
<i>climate</i>	A ranking of climates according to how favorable they are to agriculture, based on the Köppen classification. Source: Olsson and Hibbs (2005).
<i>coast</i>	Proportion of land area within 100 km of the sea coast. Source: McArthur and Sachs (2001).
<i>frost</i>	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).
<i>geoavg</i>	Average of <i>climate</i> , <i>lat</i> , and <i>axis</i> , where each variable was first normalized by dividing by its maximum value. Source: Hibbs and Olsson (2004).
<i>geofpc</i>	The first principal component of <i>climate</i> , <i>lat</i> , <i>axis</i> and <i>size</i> . Source: Olsson and Hibbs (2005).
<i>lat</i>	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).
<i>size</i>	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.