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Religion and income: Heterogeneity between countries

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ABSTRACT

This paper tests whether the behaviour of households in different countries is homogeneous with respect to the influence of religion on income. The violation of the homogeneity assumption would have two consequences. First, results based on country studies might not be applicable to other countries. Second, one should be careful when pooling cross-country data in this type of research. Data at household level from the European and World Values Survey are pooled for 25 western countries. We estimate simultaneously an income and a religion equation to correct for the endogeneity of religiousness. We find that estimation outcomes are different for low- and high-income countries: whereas church membership is found to have a positive effect on income for high-income countries, this effect is negative for low-income countries. This result is robust to denominational distribution, participation effects and alternative measures of religiousness.

1. Introduction

Religion is believed to affect income levels and growth. Theories have described different channels through which religion influences income.[1] Empirical studies testing the effect find mixed results. The empirical literature, however, disregards the idea that the effect of religion on income might be heterogeneous between countries.[2] This is surprising as the theoretical literature provides arguments in favour of a heterogeneity hypothesis. This paper finds empirical support for this hypothesis as estimations show that the effects of religion differ between low- and high-income countries. After we have described the theoretical channels, we briefly discuss the empirical literature.

The theoretical literature suggests three different channels for a negative effect of religion on income. First, Azzi and Ehrenberg (1975) apply the neo-classical framework to explain the allocation of time between working and religious activities. Religious activities occur at the expense of productive activities, resulting in lower income. In line with this, Barro and McCleary (2003) argue that belief is the crucial factor influencing income. An increase in church attendance without strengthening beliefs would depress income growth. However, the time allocation between working hours and leisure differs across countries. People in low-income countries work on average 1810 h a year, while the average number of hours is only

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[1] See the survey of Iannaccone (1998).

[2] The literature on the general role of religion suggests that its impact is heterogeneous over countries. Huber (2005) argues, for instance, that countries differ in their relation between belief and participation, and Sacerdote and Glaeser (2001) report cross-country differences in the effect of education on religion.

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1646 in high-income countries (OECD, 2008).[3] The time consumption effect of religion will therefore probably have a larger negative effect in low-income countries than in countries where leisure time is more abundant. In contrast, opportunity costs are lower in low-income countries as a lower wage rate decreases the relative cost of religious activities.

Second, a negative effect of religion on income might result from household choices with respect to labour participation of both spouses. Inglehart and Baker (2000) show that people living in more conservative countries more often opt for the traditional roles of man and wife. This behaviour is strengthened by religion. Religious households living in traditional countries might therefore have a lower household income than religious households in more secular-rational countries. Data from the World Values Survey show that 65 percent of religious people living in low-income countries answer positively to the question of whether it is important for women to have children. For high-income countries, the figure is only 39 percent. The percentages are 10 and 6 points lower for non-religious people in low- and high-income countries respectively.

Third, religion might reduce the utility derived from income. If a religion stresses the value of 'good works', like the Roman-Catholic religion for example, the value of income reduces. However, utility functions are probably not homogeneous for people living in different countries. If a country is characterised more by materialistic values, for instance, the utility of income will be weighted differently than in a post-materialistic country. Inglehart and Baker (2000) find indeed that high-income countries are post-materialistic, while low-income countries are more materialistic.

The theoretical literature suggests two different channels for a positive effect of religion on income. First, the Weberhypothesis is the prime example stressing a favourable effect of Protestant ethic (Weber, 1930). The attitudes of Protestants are believed to result in higher income growth. The literature shows, however, that the potential for income growth differs between countries as it interacts with the initial level of human and social capital (Desdoigts, 1999). Thus, even with the same attitudes, differences in growth patterns will result if countries differ in other characteristics. In other words, individuals with the same abilities and attitudes do not have equal opportunities when they live in completely different countries.

Second, more recent theories see religion as an important component of social capital (Sacerdote and Glaeser, 2001; Gruber, 2005). Churches are seen as part of a social network that contributes to better income opportunities. Also here, it could be expected that opportunities are different between countries as religion is complementary with other types of social capital.

As we have distinguished several positive and negative channels through which religion might influence income, the income effects of religion are theoretically undetermined. Furthermore, the interpretation of the theoretical literature suggests that the income effects of religion might differ between low- and high-income countries. The direction of this difference is uncertain on theoretical grounds. Still, several characteristics suggest that negative effects are larger in low-income countries and that positive effects might be smaller where less social capital is present. Therefore, in this paper, we test the hypothesis that the effect of religion on income is more favourable in high-income countries.

Almost all empirical papers assume homogeneity between countries. We distinguish two types of studies in the empirical literature; see the summary in Table 1. The first type estimates the relation for a single country, either with a cross-section at a micro-level (studies 1–7) or with time series at the macrolevel (study 8). All micro-studies are applied to the USA and Canada, except Bettendorf and Dijkgraaf (forthcoming), who focus on the Netherlands. The question of whether the results found for one country can be considered representative for other countries is analysed in Mangeloja (2005). After estimating the same specification separately for eight OECD countries, he concludes that the effect of religion on income growth is not uniform across countries. While he finds an insignificant effect of participation on income for five countries, two countries show a negative and one a positive effect.[4]

The second type of empirical studies is based on a panel of US states (studies 9–11) or of countries (study 12). Barro and McCleary (2003) use a pooled data set for 41 countries and three time periods.[5] They conclude that religious beliefs (in Hell, Heaven and an afterlife) relative to church attendance are the main channel through which religion stimulates economic growth. As these studies pool cross-country/state data, they implicitly assume that the behaviour of individuals in different countries/states is homogeneous with respect to the impact of religion.

This paper tests whether the relationship between religion and income can indeed be assumed to hold equally for sets of countries. In other words, we examine whether findings from single-country studies might be applied to other countries and whether pooling data in multi-country studies is appropriate. We check the consequences of heterogeneity by using household-level data for 25 western countries from the World Values Survey.[6] As well as heterogeneity, we also deal with the endogeneity problem in estimation.[7] According to the survey of Iannaccone (1998), income affects religious variables

[3] In Section 2, we explain how we define low- and high-income countries.

[4] He also reports panel estimation results, in which belief in Hell has a significant effect and church attendance has an insignificant effect on economic growth.

[5] McCleary and Barro (2006) have extended this data set to 53 countries, yielding similar results. Sala-i-Martin et al. (2004), employing a cross-section of 88 countries, find that the fractions of different religions in the population are among the significant variables in explaining economic growth.

[6] A related paper is Guiso et al. (2003), which studies the impact of religion on economic attitudes by also using micro-data from the World Values Survey. We notice two main differences. First, Guiso et al. focus on the impact of religious beliefs on attitudes that are considered conducive to higher income. As a consequence, the income decile is one of our dependent variables, while they use it as an exogenous control variable. Second, Guiso et al. do not consider differential effects across countries, although they use data for 66 countries.

[7] This paper does exactly what Barro and McCleary (2003, p. 10) propose: 'To distinguish country-wide effects from individual effects, we would have to use micro data, as well as deal with the issues of causality'.

Table 1
Literature: effect of religion on income.

Nr.	Country	Level of data	Measure of religion	Effect on income
1.	USA	Micro: men	Membership	Positive (Jewish)
2.	Canada	Micro: men	Membership	Insignificant (within memberships)
3.	Canada	Micro: men	Membership	Positive (Jewish) Insignificant (Protestants vs. Catholics)
4.	USA	Micro: men	Membership	Positive (Jewish)
5.	USA	Micro: men	Membership	Positive (Jewish and Catholic) Insignificant (within Protestants)
			Participation	Negative (Protestants) Insignificant (other memberships)
6.	USA	Micro: women	Membership	Insignificant (for pay per hour)
			Participation	Positive (on hours worked)
7.	Netherlands	Micro	Membership	Insignificant (with endogeneity)
			Participation	Insignificant (with endogeneity)
8.	Eight OECD	Country	Participation	Positive (1 country) Negative (2 countries) Insignificant (5 countries)
			Beliefs	Positive (2 countries) Negative (1 country) Insignificant (5 countries)
9.	USA	States	Membership	Positive (Jewish) Insignificant (liberal Protestant) Negative (Catholic and Orthodox Protestant)
10.	USA	States	Membership	Insignificant
11.	USA	States	Membership	Negative
12.	Panel (max. 41)	Country	Membership	Negative
			Participation	Negative
			Beliefs	Positive

(1) Chiswick (1983), (2) Tomes (1984), (3) Tomes (1985), (4) Chiswick (1993), (5) Steen (1996), (6) Cornwell et al. (2003), (7) Bettendorf and Dijkgraaf (forthcoming), (8) Mangeloja (2005), (9) Heath et al. (1995), (10) Crain and Lee (1999), (11) Lipford and Tollison (2003) and (12) Barro and McCleary (2003).

(such as attendance, membership, frequency of prayer and beliefs).[8] Although this suggests that there might be a bi-causal relationship between religion and income, most studies ignore the endogeneity of religion. Exceptions are Barro and McCleary (2003), Lipford and Tollison (2003) and Bettendorf and Dijkgraaf (forthcoming). In this study, we deal with the endogeneity problem by estimating a system of equations, which also enables us to identify the main determinants of religion. However, our main result is that we find that heterogeneity between low- and high-income countries is very important for the effect of religion on income. While we find a positive effect of religion on income for high-income countries, this effect is negative for low-income countries. Several sensitivity analyses show this main finding to be robust.

The next two sections discuss the data and the estimation methodology. Section 4 reports the estimation results and is followed by sensitivity analyses in Section 5. Section 6 draws some conclusions.

2. Data

Data are from the European and World Values Survey.[9] This survey is held in a large number of countries in four waves. We use the 1999 data. Data are available for a wide variety of religious measures and respondent characteristics. As our focus is on western religions, we exclude countries where eastern religions are dominant. This means that the data include most of the European countries, as well as Canada, New Zealand and the United States (see Table 2 for a list of countries included).

An important source of exclusion is whether sufficient information is available on income. In the survey, a card with 10 income deciles was shown to respondents. The respondents were asked which class their household is in, counting all wages, salaries, pensions and other incomes.[10] As the income deciles shown are country-specific, the decile information for the different countries does not match. In many cases, the decile points were not based on the usual 10 equally sized groups. For five countries the decile points rise by a fixed and equal amount in all deciles, while for six countries the higher deciles have a larger interval than the lower deciles.[11] This results in unequal frequencies for the whole panel. Fig. 1 shows that

[8] Dealing with the effect of income on religion also accounts for selection effects if, for instance, households with low incomes are church members primarily to gain from church aid.
[9] Data and codebooks are downloadable from http://www.worldvaluessurvey.org.
[10] As household size is not available, we cannot calculate the income per household member.
[11] The countries in the first group are Austria, Germany, Iceland, Malta and Sweden. The second group consists of Canada, Estonia, Latvia, Lithuania, the Netherlands and the USA.

Table 2
Descriptive statistics.

	Average income	Average membership	GDP per capita	Number of observations
Low-income countries				
Bulgaria	2.28	0.71	6	738
Russia	1.42	0.53	7	2030
Latvia	2.98	0.61	7	821
Lithuania	3.11	0.82	8	742
Croatia	4.80	0.87	8	690
Estonia	3.54	0.26	9	733
Slovak Republic	4.07	0.79	11	1028
Czech Republic	4.43	0.37	13	1471
Slovenia	1.14	0.71	16	541
Malta	5.46	0.99	16	586
Average	3.32	0.67	10	938
High-income countries				
Spain	5.20	0.84	19	1306
New Zealand	7.55	0.82	20	882
Sweden	7.92	0.75	24	883
Italy	6.66	0.83	24	1140
France	5.83	0.58	24	1104
Germany	6.11	0.62	25	1425
Netherlands	6.92	0.44	27	847
Canada	7.81	0.74	27	1535
Austria	6.50	0.87	27	1053
Iceland	7.35	0.96	27	750
Ireland	6.28	0.93	28	703
Northern Ireland	5.70	0.84	28	647
Switzerland	6.91	0.91	28	890
Denmark	8.34	0.90	28	743
USA	8.53	0.76	34	974
Average	6.91	0.79	26	992
Average all countries (unweighted)	5.47	0.74	20	970

GDP per capita in 1000 US dollars using PPPs.

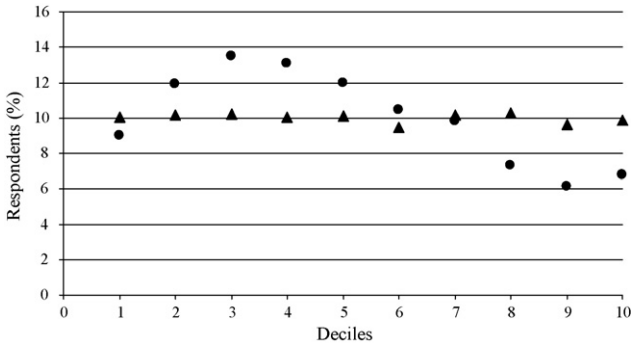

Fig. 1. Original deciles (dots) and final deciles (triangles).

deciles 2–5 are over-represented in our sample at the cost of especially deciles 8, 9 and 10. The distribution is even more unequal for some countries. In Germany, for example, 80 percent of the respondents are found in deciles 2–5, while the last three deciles include only 3.8 percent of respondents. Another example is Latvia, where 32.5 percent of respondents are in decile 2 while only 1.5 percent are in the last three deciles.

For cross-country estimation, it is appropriate to make the deciles comparable over countries. We need to transform the income information into a common currency and price level. Given the available information, we use the following procedure.[12] First, we calculate the decile points in US dollars using purchasing power parities from the Penn World Table (Heston et al., 2000). Note that this results in exclusion of a number of countries for which decile points are not given.[13] Second, we calculate the average level of income for each decile as the average of the lower and upper bounds of the decile.[14] Third, all individuals are sorted on their average income level. Finally, new deciles are created, aiming at the usual 10 equally

[12] We test whether our results depend on this procedure using the original decile information in a sensitivity analysis in Section 5.
[13] The countries are Australia, Belarus, Belgium, Finland, Great Britain, Hungary, Luxembourg, Norway, Poland, Portugal, Romania and Ukraine.
[14] The income level of the first decile is set at 50 percent of the first decile point. The income level of the last decile is set equal to the last decile point.

sized groups. This results in a cross-section with more or less the same number of observations per decile. These numbers are not exactly equal as households with equal incomes have to be in the same decile.[15] The decile with the lowest number of observations has a share of 9.5 percent, while the decile with the highest number of observations has a share of 10.3 percent (see the triangles in Fig. 1). This procedure implies that our basic specifications test the influence of income differences between households across all countries.

As the focus of the paper is on adults, we exclude observations for households where only children (probably in most cases students) are present. Furthermore, we exclude all observations with missing information for the basic variables. This results in 24,262 observations for 25 countries.

In our data set, several measures are available to indicate how religious individuals are. In Section 4 we focus on church membership as it is one of the most objective measures. However, we present sensitivity analysis for six other measures (see Section 5.1). Thus, the main religion variable is a dummy with value 1 if the respondent says that he or she is a church member and zero otherwise.

Table 2 gives the average values for income and for membership and the number of observations for each country. As we analyse whether heterogeneity exists between countries, we also include GDP per capita (in thousands of PPP dollars).[16] In our basic models, we test whether a difference exists between low- and high-income countries with respect to the religion–income relationship. We do this by including a dummy for high-income countries. High-income countries are defined as the countries with a GDP per capita that is greater than or equal to that of Spain. It would, of course, be attractive to split these groups of countries further to test for heterogeneity at a lower level. Unfortunately, the methodology necessary to tackle both endogeneity and heterogeneity requires a relatively high number of observations, rendering estimation on smaller subsamples less appropriate. It should be kept in mind that the chosen terminology with respect to low and high income might be misleading. The two groups might also be labelled as former communist versus capitalist countries, or as traditional versus post-materialist countries (compare Inglehart and Baker, 2000). Therefore, we do not suggest that the income difference between countries is the only or most important relevant characteristic.

We also include socio-economic characteristics, as reported in the European and World Value Survey (a list of variables and descriptive statistics are available in Appendices A and B respectively).

- The variable *Age* is the age of the respondent, and both linear and quadratic terms are included.
- The dummy *Man* equals 1 if the respondent is male.
- The dummy $Breadwinner_{NoPart}$ equals 1 if the respondent is the breadwinner and has no partner; $NoBreadwinner_{Part}$ equals 1 if the respondent has a partner who is the breadwinner. The benchmark covers the case in which the respondent is the breadwinner with a partner.
- The dummy *NoKids* equals 1 when the household does not include children.
- The variable *Education* equals 0 if the respondent has hardly any education, 1 for finishing low level, 2 for medium level and 3 for high level (see Appendix A for details of these levels).
- Country fixed effects are included to correct for country-specific features.

The coefficients of all the control variables were significant in the single-equation estimations. However, estimation of the full system seems to demand too much from the data, as indicated by large standard errors. We therefore choose to restrict the number of variables. We defined a new variable Age_{com} by restricting the shape of the quadratic function to the single-equation results.[17]

3. Methodology

We are primarily interested in the effect of religion on income. However, the literature shows that estimating an income equation will probably result in biased coefficients due to endogeneity. As our results also indicate endogeneity problems and as system estimation is more efficient than single-equation estimation, we only present results for the system approach.[18] As income and religion are measured as discrete variables, a probit estimator is applied. We take membership of a church

[15] Note that this means that a natural alternative, creating equal deciles for each country, is not possible as we cannot discriminate between households with the same income level. For all countries combined, this is not a serious obstacle as we have much more data available.

[16] The correlation between average income and GDP per capita is 0.85. This suggests that our observations might be interpreted as representative for the whole population.

[17] We define the age variable as $Age_{com} = \alpha Age + \beta Age^2$, where α and β are based on the free estimation of the single income equation. Since we include γAge_{com} in the system estimation, we in fact impose the restriction that $\beta/\alpha = -0.012$. The same restriction is used for the religion equation to guarantee comparability between the equations. Although this is restrictive, the age effects in the income and religion single equations are highly correlated (0.7).

[18] The single specifications are clearly rejected against the system approach on the basis of a log-likelihood-ratio test. Furthermore, we find support for endogeneity in the system estimations as the correlation between the residuals of the two equations (ρ), is significant at 1 percent. As income influences religion, a single-equation approach will result in biased coefficients. However, our main finding, a positive effect of religion on income for high-income countries and a negative effect for low-income countries, is also found for the single-equation approach. Results for the single equations are available on request.

as our main measure of religion.[19] Membership is denoted by the dummy y_{1i} with the value 1 if household i is a member of a church. As income is available only in deciles, y_{2i} denotes the before-tax income class of household i.

The system of *structural* equations is expressed in terms of the latent variables. This specification assumes that households have complete flexibility in their decisions but that the researcher can only observe the choices as discrete variables (see Blundell and Smith, 1994).[20] The structural model written in terms of the latent variables (y_1^* and y_2^*) and vectors of socio-economic control variables (x_1 and x_2) is

$$\begin{aligned} y_{1i}^* &= \alpha_1 y_{2i}^* + \beta_1' x_{1i} + u_{1i}, \qquad y_{1i} = 1 \quad \text{if } y_{1i}^* > 0, = 0 \text{ otherwise} \\ y_{2i}^* &= \alpha_2 y_{1i}^* + \beta_2' x_{2i} + u_{2i}, \qquad y_{2i} = j \quad \text{if } \mu_{j-1} < y_{2i}^* \le \mu_j \;\; j = 1, \ldots, J \end{aligned} \tag{1}$$

The income equation contains $J+1$ cutoffs μ_j. Assuming that y_2^* has an infinite support yields that $\mu_0 = -\infty$ and $\mu_J = \infty$. Since x_2 includes a constant, $\mu_1 = 0$ has to be imposed. The remaining $J-2$ cutoffs are estimated.

Model (1) cannot be directly estimated since it contains non-observables on the right-hand side. Therefore, the *reduced* form equations are derived as

$$\begin{aligned} y_{1i}^* &= \bar{\beta}_1' x_i + v_{1i}, \qquad \bar{\beta}_1' x_i = \frac{\beta_1' x_{1i} + \alpha_1 \beta_2' x_{2i}}{D}, \qquad v_{1i} = \frac{u_{1i} + \alpha_1 u_{2i}}{D} \\ y_{2i}^* &= \bar{\beta}_2' x_i + v_{2i}, \qquad \bar{\beta}_2' x_i = \frac{\alpha_2 \beta_1' x_{1i} + \beta_2' x_{2i}}{D}, \qquad v_{2i} = \frac{\alpha_2 u_{1i} + u_{2i}}{D} \end{aligned} \tag{2}$$

with $D \equiv (1 - \alpha_1 \alpha_2)$ and where $x_i = x_{1i} \cup x_{2i}$. A variable that occurs in both structural equations thus has a coefficient equal to $(\beta_1 + \alpha_1 \beta_2)/D$ and $(\alpha_2 \beta_1 + \beta_2)/D$ in the reduced form equations, respectively. Identification of the structural coefficients requires that x_1 contains at least one variable that is not included in x_2 and vice versa.[21] The reduced form disturbances v_k are assumed to have a joint normal distribution with means 0, variances 1, and covariance ρ.[22] To compare the results of the system estimation, we also apply a probit regression to each equation separately. The single equations are specified similarly as in (1), where the latent variable y_k^* on the right-hand side is replaced by the observed y_k.[23] The estimation procedure is explained in Appendix C.

4. Estimation results

Results are presented in Table 3. The identifying variable in the religion equation is the dummy for households for which the partner of the respondent is the breadwinner ($NoBreadwinner_{Part}$); for the income equation, it is the dummy for households without children (*NoKid*). We first discuss the estimated cross-effects between membership and income; in Section 4.2 we briefly discuss the (marginal) effects of the control variables.

4.1. Cross-effects between religion and income

Model A represents the specification with the assumption that the relation between religion and income is homogeneous between countries. According to this model, we find hardly any evidence of a relationship between religion and income, as the coefficient for membership is insignificant in the income equation while the coefficient for income in the membership equation is only significant at 10 percent. The insignificant membership coefficient is in accordance with some studies using micro-data for one country (Tomes, 1984; Crain and Lee, 1999; Cornwell et al., 2003). It contradicts results from Barro and McCleary (2003) which are also based on an international database.[24] They find that beliefs positively affect income, while church attendance affects income negatively.

Model B introduces heterogeneity as all effects are now allowed to differ between low- and high-income countries.[25] We do this by introducing an interaction effect with the high-income dummy (see Section 2 for definition). Model A, which does not discriminate between low- and high-income countries, is clearly rejected against model B using a likelihood-ratio

[19] Although data are available about the specific denomination of individuals, we have chosen to concentrate on membership in general. The main motivation would be that endogeneity is difficult to handle since incorporating several denomination dummies would necessitate a system of more than two equations. For our specification with probits, this is technically unsolvable. However, we analyse the robustness of our conclusions for denomination in Section 5.3.

[20] Maddala (1983, p. 124) interprets a latent variable as a measure of intensions. Blundell and Smith (1994) consider a class of structural models which are simultaneous in the observed dependent variables. As a consequence, the reduced form can not be derived explicitly and extra coherency restrictions have to be imposed.

[21] As identifying restrictions we use variables that are only significant in one equation (see next section).

[22] This implies that the structural disturbances $u_k = v_k - \alpha_k v_{k'}$ $(k \neq k')$ are normally distributed with means 0, variances $(1 + \alpha_k^2 - 2\alpha_k \rho)$ and covariance $(1 + \alpha_1 \alpha_2)\rho - \alpha_1 - \alpha_2$.

[23] Note that the rejection of the hypothesis $\rho = 0$ means that system estimation is preferred above single-equation regressions.

[24] They use average figures for countries and thus have one observation per country per year (observations are available for three years). As dependent variable, they use economic growth, which makes it possible to include countries we have to exclude.

[25] An alternative model with only heterogeneous effects for the income and religion variables is clearly rejected against model B with a likelihood-ratio test of 130 (10 restrictions). Note that there is evidence for the hypothesis that other explanatory characteristics also have a heterogeneous relationship with religion. Sacerdote and Glaeser (2001), for instance, find cross-country differences in the relation between education and religion.

Table 3
Results for homogeneity (A), heterogeneity (B) and subsamples of low-income (C) and high-income (D) countries.

	A	B	C	D
Effect on income				
Member	0.07 (0.10)	−1.15 (0.33)***	−1.20 (0.32)***	
High-income*		1.68 (0.37)***		0.52 (0.16)***
Age_{com}	1.03 (0.07)***	0.16 (0.31)	0.20 (0.30)	
High-income*		1.03 (0.32)***		1.15 (0.09)***
Man	0.26 (0.04)***	−0.31 (0.15)**	−0.32 (0.15)**	
High-income*		0.73 (0.15)***		0.41 (0.04)***
$Breadwinner_{NoPart}$	−0.77 (0.03)***	−0.79 (0.07)***	−0.83 (0.07)***	
High-income*		0.10 (0.09)		−0.67 (0.06)***
$NoBreadwinner_{Part}$	0.21 (0.02)***	0.07 (0.06)	0.07 (0.06)	
High-income*		0.19 (0.07)***		0.25 (0.03)***
Education	0.34 (0.01)***	0.20 (0.04)***	0.22 (0.04)***	
High-income*		0.19 (0.04)***		0.38 (0.02)***
Effect on religion				
Income	−0.24 (0.13)*	−0.50 (0.28)*	−0.48 (0.25)*	
High-income*		0.51 (0.32)		0.01 (0.15)
Age_{com}	−0.44 (0.14)***	−0.30 (0.34)	−0.29 (0.33)	
High-income*		−0.23 (0.37)		−0.53 (0.14)***
Man	−0.25 (0.03)***	−0.33 (0.04)***	−0.33 (0.04)***	
High-income*		0.12 (0.06)**		−0.21 (0.04)***
$Breadwinner_{NoPart}$	−0.36 (0.12)***	−0.43 (0.22)*	−0.43 (0.21)**	
High-income*		0.19 (0.26)		−0.24 (0.14)*
NoKids	−0.19 (0.03)***	−0.09 (0.09)	−0.09 (0.08)	
High-income*		−0.09 (0.09)		−0.18 (0.03)***
Education	−0.01 (0.05)	0.06 (0.09)	0.06 (0.08)	
High-income*		−0.14 (0.10)		−0.08 (0.05)
ρ	−0.02 (0.01)*	−0.02 (0.01)*	−0.08 (0.02)***	0.02 (0.01)
LLH	−53,288	−53,170	−18,464	−34,534
Observations	24,262	24,262	9380	14,882

Standard errors in parentheses. Coefficients with ***/**/* are significant at the 1 percent/5 percent/10 percent level.
All specifications estimated with country fixed effects.

test (LLR = 236 with 12 restrictions). This is not surprising, as all but one interaction coefficients are significant for the income model, while one of them is significant in the religion model. More important, however, is that our main result is affected by allowing for heterogeneity. Now we find a negative effect of religion on income for low-income countries and a positive effect for high-income countries. This means that the result of Barro and McCleary (2003) is only reproduced for high-income countries. This confirms our hypothesis that including heterogeneity might be necessary to estimate the true effects between income and religion. The effect of income on religion weakens when heterogeneity is introduced. Although a negative effect is found for low-income countries and a positive effect for high-income countries, the effects are barely significant.

Full heterogeneity is assumed in models C (the subsample of low-income countries) and D (the subsample of high-income countries). These models are estimated allowing also for heterogeneity in the structure of the error terms. Model B is clearly rejected against C and D (LLR = 344 with 1 restriction). For both equations, the differences between low- and high-income countries in coefficients are generally very modest, however, compared with model B. The main result, a negative effect of religion on income for low-income countries and a positive effect for high-income countries, is found again.

Concluding, we find that the effect of religion on income is not stable over groups of countries. The average income level of countries seems to influence the relationship between these variables. When this type of heterogeneity is neglected, estimation results depend on the coincidental mix of data from low- and high-income countries. If this mix is dominated by low-income countries, the probability is much larger that negative effects will be found, while in the opposite case positive results might prevail. This means that we indeed find evidence for our theoretical hypothesis that the effects of religion on income are more favourable for high-income countries (see Section 1).

4.2. Effects of socio-economic characteristics

The estimation results for the control variables are briefly discussed by way of the marginal effects of the reduced forms (based on columns C and D in Table 3). The marginal effects averaged over the households are reported. Using the marginal probabilities computed for each income decile, the average decile change is shown in Fig. 2.[26]

[26] The calculation of the marginal effects is explained in more detail in Appendix D.

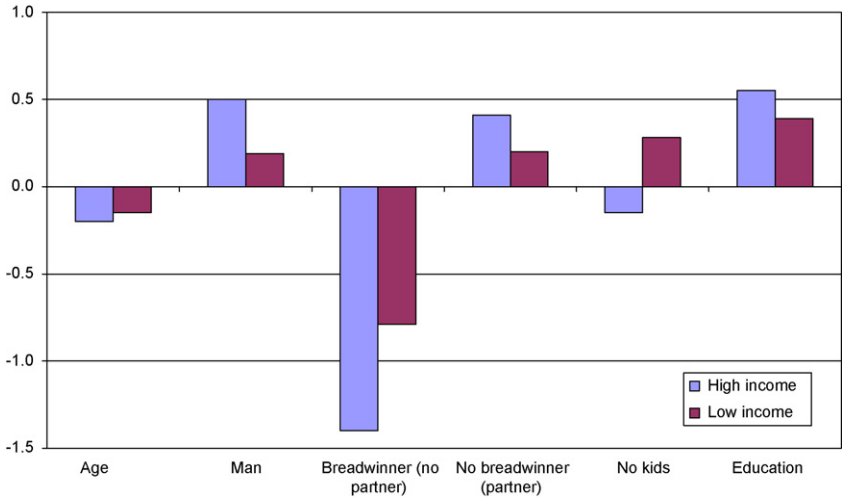

Fig. 2. Marginal effects of socio-economic characteristics on income.

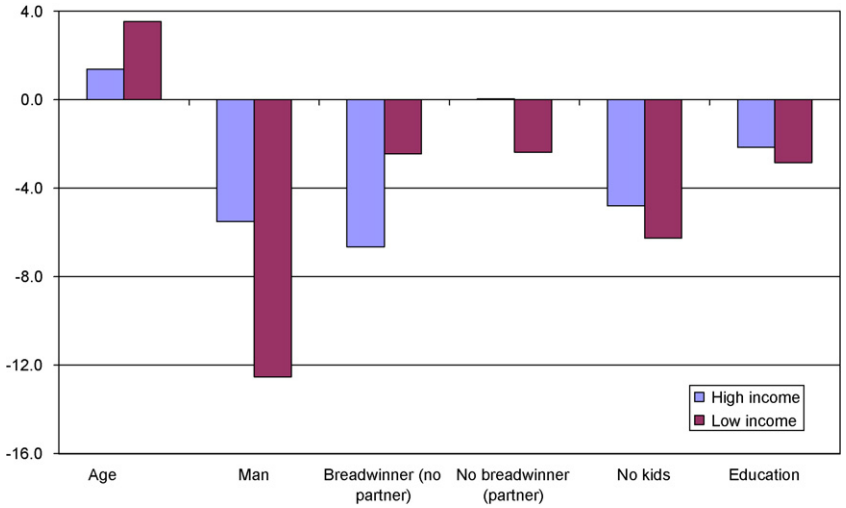

Fig. 3. Marginal effects of socio-economic characteristics on religion.

Since age is modelled as a hump-shaped quadratic function, a positive coefficient means that income first rises and then falls with age.[27] As the marginal effects are evaluated on average at a high age, age has a negative effect on income in both subsamples.[28] Households for which the respondent is male earn a higher income than those for which the respondent is female. For low-income countries, the structural coefficient is negative but the total effect is positive because of the upwards effect of lower church membership. Breadwinners without a partner have a lower income than breadwinners with a partner. The reverse effect holds when the respondent has a partner who is breadwinner. Since its structural coefficient is restricted to zero, the effect of *NoKids* runs indirectly through the impact on church membership. Increasing the education index by one unit improves income by around half a decile in both country groups.

The marginal effects of the exogenous variables on membership can be found in Fig. 3. Age effects now follow a U-pattern, implying that the marginal effects are positive for higher ages.[29] Male respondents are less often a member of a church than female respondents. The three dummies representing family composition all have a depressing effect

[27] With cross-section data, age effects can obviously not be distinguished from cohort effects. The proper interpretation of the age coefficients includes the effect of the year of birth, as well as age, of the respondent.

[28] Marginal effects of age are multiplied by its standard deviation to get a comparable scaling.

[29] Sawkins et al. (1997) find a similar pattern for the relation between age and church attendance in Great Britain. In contrast, Barro and McCleary (2003) find that beliefs in Heaven, as well as in Hell, fall with the share of the population older than 65 (whereas their effects on church attendance are not significant).

Table 4
Results for alternative religious variables.

Effect on	Variable	Belief in God	Religious person	Confidence in church	Religion important	Belief in Heaven	God important
Low-income countries							
Income	Religion	−0.29	**−1.65*****	**−2.21**	**−1.35**	−7.31	**−1.75**
Religion	Income	−2.56	−0.49	0.17	−0.23	−0.49	−0.34
ρ		**−0.07**	**−0.07**	**−0.06**	**−0.09**	−0.07	**−0.07**
Observations		8298	8700	8898	9154	7344	9044
% religious		0.74	0.69	0.56	0.50	0.43	0.41
High-income countries							
Income	Religion	**0.34**	**0.39**	**0.93**	**0.39**	**0.72**	**0.38**
Religion	Income	−0.10	−0.03	−0.04	0.01	0.25	−0.15
ρ		−0.02	−0.00	**−0.02**	**−0.06**	**−0.07**	**−0.08**
Observations		13,950	14,330	14,580	14,761	13,443	14,682
% religious		0.79	0.66	0.52	0.51	0.53	0.41

Bold coefficients are significant at 5 percent. All specifications estimated with country fixed effects.
Results for other explaining variables are available on request.

on religiousness. Finally, membership seems to fall with the education level (although the structural coefficients are not significant).[30]

5. Sensitivity analysis

This section shows that our main findings are robust to various types of sensitivity analysis and analyses other types of heterogeneity.

5.1. Measurement of religion

In this section, we test whether our results depend on the choice of the religious variable, which is for instance the case for Barro and McCleary (2003). We expect that membership does not always measure religiousness properly. Membership, for instance, is very high in countries with a state religion (as in Scandinavian countries), while other religious measures point to a low level of religion.[31]

We estimate our preferred subsample models (C and D) for six alternative measures. These measures are based on the answers to the following questions: (i) do you believe in God? (ii) are you a religious person? (iii) do you have confidence in the church? (iv) do you believe in Heaven? (v) is God important in your life? and (vi) is religion important in your life? According to the number of households that answered positively, belief in God and membership are the broadest religion measures (77 percent of respondents believe in God, 74 percent are members of a church), while the importance of God is the strictest measure (41 percent finds God important).

Results for the cross-effects are presented in Table 4. Note that we use a smaller database for these analyses than for our base case as the measures are not available for all households. Almost all conclusions are robust when the results for different religion measures are compared with our previous results for membership. This is remarkable as the measures vary significantly with respect to the fraction of religious households. All specifications result in a positive effect of religion on income for high-income countries and a negative effect for the low-income countries. In the latter case, the effect is insignificant for the two smallest samples. For the opposite relation, again only weak evidence is found for an effect of income on religion. For the alternative measures system estimation is also preferred as ρ is often significant at 1 percent.

5.2. Membership or participation

Another way to measure religion is by active participation. Barro and McCleary (2003) stress that membership and participation have opposite impacts on economic growth. Guiso et al. (2003) show that the aspect of religion that seems to matter is different for various attitudes. Trust towards others, for instance, is affected mainly by participation, while intolerance is correlated with affiliation. In this section, we study whether effects on income are also different for individuals who participate actively in church services compared with members who do not go to church or who go less often. For each respondent, we know whether church services are attended (i) at least once a week, (ii) at least once a month, (iii) on special days such as Easter and Christmas, (iv) less than once a year or (v) never. While all these respondents are included in our

[30] This conflicts with Barro and McCleary (2003), who find that higher education levels lead to higher levels of church membership as well as to more religious participation. Sacerdote and Glaeser (2001) argue that households with a higher education more often choose to leave the church, but intensify their religious behaviour when they decide to stay. Sawkins et al. (1997) also find a positive effect of education on church attendance.

[31] Compare, for instance, the high level of membership in Denmark (Table 2) with the very low levels of respondents stating that God or religion is important in their lives (Table B.2).

Table 5
Results for membership at different levels of participation.

Effect on	Variable	> 1/week	> 1/month	Special	< 1/year
Low-income countries					
Income	Religion	**−1.01**	**−1.03**	**−0.89**	**−1.01**
Religion	Income	**−0.80**	**−0.74**	**−0.66**	**−0.62**
ρ		**−0.10**	**−0.10**	**−0.08**	**−0.07**
Observations		5227	6034	7698	8557
% religious		32 percent	41 percent	54 percent	58 percent
High-income countries					
Income	Religion	**0.22**	**0.22**	**0.33**	**0.43**
Religion	Income	−0.08	0.01	−0.06	−0.05
ρ		−0.01	0.01	0.02	0.02
Observations		6771	8368	10,448	12,559
% religious		50 percent	60 percent	68 percent	77 percent

Bold coefficients are significant at 5 percent. All specifications estimated with country fixed effects.
Results for other explanatory variables are available on request.

previous results, the first column of Table 5 restricts the group of members to households that attend services at least once a week, again with non-members as a benchmark.[32] In subsequent columns, the sample is extended progressively to include members who participate less frequently.

Our main result is found again, irrespective of the intensity of participation. In all cases, we find a positive effect of membership on income for high-income countries and a negative effect for low-income countries. For low-income countries, the effect of membership on income is stable across households with different intensities of participation. This suggests that the main effect is driven by membership rather than participation. For high-income countries, a declining pattern with increasing intensity emerges. This means that all religious households have a higher income level, but that more active households benefit less. Although the coefficients are not significantly different from each other, it should be kept in mind that the estimated effect in the last column is cumulated over all included intensity categories. The effect for respondents going to church less than once a year is therefore probably higher than the estimated 0.43.

For the effect of income on membership, we see the opposite result. While all coefficients are insignificant for high-income countries, the effects for low-income countries show an increasing pattern when intensity rises. The most frequent churchgoers respond more elastically to an income change than members who hardly ever attend services.

The exercise is repeated for the six alternative religion variables with similar results (see the income coefficients in Table E.2). In all cases, positive effects are found for high-income and negative effects for low-income countries. All income coefficients are significant for all participation classes for three measures: 'religious person', 'religion important' and 'God important'. However, many insignificant coefficients are found for the other measures.

5.3. Denomination

In the analysis presented so far, we have neglected the role of denominations. This might result in biased conclusions if our results are in fact driven by denominational choice rather than by the role of religion. A significant difference between countries for the income effect of religion could originate from differences in the distribution of denominations. This is illustrated by the example of Roman-Catholics having a lower income than Protestants, high-income countries being dominated by Protestants and low-income countries by Roman-Catholics. In this section, we analyse whether our findings indeed depend on denomination. Note that we cannot test this by including denomination dummies as this would require a system of more than two equations, which is technically unsolvable for our specification with probits. Therefore, we restrict our data set to individuals who are either non-members or members of a specific church, which leaves us with only two equations to estimate. Interestingly, this test explores not only the question of whether households with the same denomination behave differently when living in different countries but also the question of whether the effect of religion differs across denominations Guiso et al. (2003) confirm the last type of heterogeneity).

Table 6 presents the results. The first column repeats the base case of Table 3. The next three columns are based on subsamples containing non-members plus Roman-Catholics, Protestants or non-Roman-Catholics, respectively (the last group is defined as Protestants, members of the Orthodox Church plus members of other denominations). Our main result, a significantly different effect of religion on income between high-income and low-income countries, is found for all denominations. This means that the effect of religion on income is also heterogeneous between countries, within a single denomination. Even for the relatively homogeneous Roman-Catholic church, the relationships differ between low- and high-income countries. However, the effects are not significantly different from zero in all cases. Interestingly, Roman-Catholics seem to drive the negative effect for low-income countries as we find insignificant effects for Protestants and non-Roman-Catholics. This result

[32] An alternative would be to define members with lower participation as non-members. We prefer our procedure as this guarantees that we have the same group as a benchmark throughout the paper.

Table 6
Results for heterogeneity with respect to denomination.

Effect on	Variable	Members versus non-members	Roman-Catholics versus non-members	Protestants versus non-members	Non-Roman-Catholics versus non-members
Low-income countries					
Income	Religion	**−1.20**	**−0.91**	−1.60	−2.73
Religion	Income	−0.48	−0.22	−1.02	**−0.89**
ρ		**−0.08**	**−0.06**	−0.06	**−0.10**
Observations		9380	6954	3927	5966
% religious		67 percent	49 percent	12 percent	40 percent
High-income countries					
Income	Religion	**0.52**	0.55	**0.59**	**0.51**
Religion	Income	0.01	0.04	−0.07	−0.07
ρ		0.02	0.02	**0.05**	0.01
Observations		14,882	9611	7624	8608
% religious		79 percent	65 percent	56 percent	61 percent

Bold coefficients are significant at 5 percent. All specifications estimated with country fixed effects.
Results for other explanatory variables are available on request.

Table 7
Results for gradual heterogeneity and for national income distribution.

	Gradual heterogeneity	Original deciles low-income	Original deciles high-income
Effect on income			
Member	**−2.60**	**−1.05**	**0.50**
*GDP	**0.12**		
Effect on religion			
Income	**0.81**	−0.51	0.01
*GDP	**−0.02**		
ρ	−0.02	**−0.11**	0.01
LLH	−53,144	−24,201	−37,327
Observations	24,262	9380	14,882

Bold coefficients are significant at 5 percent. All specifications estimated with country fixed effects.
Results for other explanatory variables are available on request.

might suffer from the relatively low number of observations for the last two groups. For high-income countries, Protestants and members of other non-Roman-Catholic churches seem to drive the positive effect. This conclusion is robust the effect of religion on income is insignificant for the Roman-Catholics sample despite a large sample size.[33] It should be kept in mind that we focus only on differences between Roman-Catholics, Protestants and non-Roman-Catholics, while differences might also be significant within these denominations. Exploring this heterogeneity, however, asks too much from the data.

5.4. Gradual heterogeneity

It is not clear whether the consequences of heterogeneity between countries are gradual or not. Column B of Table 3 reports results following a dummy approach to differentiate between low- and high-income countries. The gradual heterogeneity model in the first column of Table 7 tests interaction effects in terms of levels of GDP per capita. This model indeed finds that the relationship between membership and income level of individuals depends on the GDP level of countries. Membership stimulates the income level of individuals more when the average income in a country is higher. The effect is negative up to a GDP level of 22 000 dollars per capita, just above the level of our poorest high-income country (see Table 2).

5.5. National income distribution

The original data on income suffer from the problem that the deciles are differently defined over the countries. We therefore choose to express all incomes in PPP-$s and rank all households according to a single 'worldwide' income distribution. As a consequence, all households in the poorest country, Bulgaria, are located in the lowest four deciles, whereas most households in the richest country, the USA, are found in the top five deciles. We are thus assuming that households with the same income *level* (and other characteristics) behave the same, irrespective of which country they live in (except for the country fixed effects).

Another reasonable assumption is that it is the position in the national distribution that matters, not the position in the international distribution. Households living in different countries are considered to be identical if they report the same

[33] Table E.1 presents the income effects of religion for the other six religion measures. In the main, the discussed results are robust.

'national' income decile. Notice that a Bulgarian household from the top decile might earn a lower real income than a USA household from a medium decile. The main drawback of using this information is that it does not take into account that the income information is collected following different methods. As a robustness check, we re-estimated models C and D from Table 3 with the original decile information. The results in the last two columns of Table 7 show that all findings on the income–religion relation are reproduced using the original information. The differences between all coefficients remain remarkably small.

6. Conclusions

The theoretical literature proposes several positive and negative channels by which religion might influence income. As a result, the income effects of religion are theoretically undetermined. More important for our paper, however, is that interpretation of the theoretical literature suggests that the income effects of religion might differ between countries. We find support for the hypothesis that the effect of religion on income is more favourable in high-income countries. While a negative effect of religion on income is found for low-income countries, this effect is positive for high-income countries. This result is robust to alternative measures of religiousness, denominational distribution and participation levels. It should be kept in mind that the chosen terminology with respect to low and high income might be misleading. The classification might also reflect the difference between former communist and capitalist countries, or the difference between traditional and post-materialist countries. We do not suggest, therefore, that differences in income levels between countries are the only or most important relevant characteristic explaining the difference found in the relation between religion and income.

Our result implies in the first place that one should be careful when pooling cross-country data in this type of research. The specific mix of countries included might determine the outcome. If, for instance, the data set is dominated by high-income countries, it is more likely that a positive income effect will be found. This is even more the case when the sample is unbalanced with respect to denominational distribution, since the relation also differs between Roman-Catholics and non-Roman-Catholics. If, for instance, the data set is also dominated by Protestant countries, the probability of finding a positive effect increases even more. This suggests that research should check for composition effects, for example by varying the countries included. For future research, we plan to combine large micro-data sets from different countries. This would allow testing for individual country heterogeneity, whereas this paper was only able to test heterogeneity between groups of countries.[34]

The heterogeneity finding implies in the second place that results from single-country studies might not be applicable to other countries. This suggests that it is worthwhile considering countries not yet investigated. Since the current literature is dominated by studies for the USA, adding evidence from other countries would improve the understanding of the relation between religion and income in general.

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Appendix A. List of variables

Income (decile)	Decile of household income (deciles based on equal number of households per class)
The following variables are dummies that equal 1 when:	
Member	Respondent is member of a church
Belief in God	Respondent answers yes to question 'do you believe in God?'
Religious person	Respondent answers yes to question 'are you a religious person?'
Confid. church	Respondent answers yes to question 'do you have confidence in the church?'
Relig. import.	Respondent answers yes to question 'is religion important in your life?'
Belief in Heaven	Respondent answers yes to question 'do you belief in Heaven?'
God import.	Respondent answers yes to question 'is God important in your life?'
Man	Respondent is male
$\text{Breadwinner}_{NoPart}$	Respondent is the breadwinner, has no partner
$\text{NoBreadwinner}_{Part}$	Respondent is not the breadwinner, has partner
NoKids	Respondent has no children
Education_{low}	Respondent has education at junior general secondary level
Education_{mid}	Respondent has education at senior or pre-university general secondary level or at vocational secondary level
Education_{high}	Respondent has education at higher professional or university level
Education	equals $\text{Education}_{low} + 2 * \text{Education}_{mid} + 3 * \text{Education}_{high}$
High-income	Respondent lives in country with relatively high per capita GDP
Age	Age of respondent (integer)

[34] In Bettendorf and Dijkgraaf (forthcoming), we employed a large micro-data set for the Netherlands. We did not find significant cross-effects between religion and income.

Appendix B. Descriptive statistics

See Tables B.1 and B.2.

Table B.1
Descriptive statistics: average values of exogenous variables

	Age	Man	$Breadw_{NoPart}$	$NoBreadw_{Part}$	NoKids	Education
Bulgaria	53.00	0.42	0.21	0.41	0.00	1.86
Russia	49.00	0.41	0.39	0.30	0.11	1.63
Latvia	49.64	0.45	0.40	0.25	0.14	1.59
Lithuania	46.42	0.49	0.28	0.31	0.12	1.96
Croatia	44.20	0.39	0.19	0.42	0.15	1.74
Estonia	48.79	0.45	0.38	0.27	0.17	1.43
Slovak	47.13	0.47	0.23	0.37	0.11	1.31
Czech	50.87	0.46	0.29	0.35	0.10	1.54
Slovenia	47.90	0.48	0.25	0.41	0.12	1.36
Malta	49.58	0.53	0.16	0.37	0.15	1.38
Spain	50.88	0.49	0.23	0.38	0.19	0.89
New Zeal.	46.31	0.47	0.22	0.46	0.18	1.72
Sweden	45.56	0.49	0.38	0.32	0.29	1.72
Italy	50.59	0.51	0.21	0.37	0.20	1.29
France	48.17	0.55	0.38	0.26	0.19	1.20
Germany	51.43	0.43	0.41	0.29	0.22	1.08
Netherl.	47.47	0.53	0.40	0.29	0.29	1.76
Canada	47.51	0.41	0.34	0.37	0.23	1.67
Austria	49.39	0.44	0.23	0.42	0.14	0.90
Iceland	46.83	0.50	0.31	0.29	0.27	1.20
Ireland	44.96	0.51	0.42	0.16	0.17	1.36
N-Ireland	47.55	0.52	0.38	0.28	0.21	1.48
Switzerl.	48.90	0.49	0.24	0.35	0.18	1.30
Denmark	49.95	0.49	0.35	0.30	0.21	1.07
USA	44.70	0.42	0.36	0.38	0.24	2.07
Average	48.27	0.47	0.31	0.33	0.17	1.46
Low-inc.	48.65	0.45	0.29	0.34	0.11	1.58
High-inc.	48.01	0.48	0.32	0.33	0.21	1.38

Table B.2
Descriptive statistics: average values of religious variables.

	Belief in God	Member person	Religious church	Confid.	Relig. import.	Belief in Heaven	God import.
Bulgaria	0.66	0.71	0.53	0.35	0.49	0.28	0.28
Russia	0.71	0.53	0.67	0.62	0.47	0.36	0.32
Latvia	0.80	0.61	0.78	0.68	0.35	0.33	0.34
Lithuania	0.87	0.82	0.86	0.69	0.59	0.65	0.51
Croatia	0.92	0.87	0.84	0.64	0.78	0.59	0.55
Estonia	0.53	0.26	0.42	0.45	0.23	0.18	0.17
Slovak Republic	0.85	0.79	0.84	0.70	0.60	0.57	0.53
Czech Republic	0.40	0.37	0.45	0.21	0.22	0.20	0.17
Slovenia	0.66	0.71	0.71	0.38	0.37	0.28	0.29
Malta	0.99	0.99	0.75	0.85	0.92	0.88	0.90
Average	0.74	0.67	0.69	0.56	0.50	0.43	0.41
High-income countries							
Spain	0.87	0.84	0.65	0.48	0.51	0.53	0.37
New Zeal.	0.77	0.82	0.50	0.38	0.37	0.60	0.33
Sweden	0.53	0.75	0.38	0.45	0.34	0.30	0.17
Italy	0.93	0.83	0.87	0.71	0.76	0.59	0.61
France	0.62	0.58	0.47	0.46	0.37	0.31	0.22
Germany	0.56	0.62	0.49	0.38	0.30	0.26	0.28
Netherl.	0.59	0.44	0.61	0.29	0.38	0.35	0.25
Canada	0.91	0.74	0.78	0.62	0.66	0.76	0.63
Austria	0.88	0.87	0.82	0.41	0.55	0.40	0.47
Iceland	0.84	0.96	0.75	0.66	0.55	0.58	0.38
Ireland	0.97	0.93	0.76	0.57	0.77	0.88	0.61
N. Ireland	0.92	0.84	0.60	0.60	0.57	0.83	0.48
Switserland	0.85	0.91	0.59	0.43	0.46	0.45	0.42
Denmark	0.68	0.90	0.77	0.61	0.26	0.16	0.13
USA	0.96	0.76	0.84	0.76	0.84	0.88	0.79
Average	0.79	0.79	0.66	0.52	0.51	0.53	0.41
Average all countries	0.77	0.74	0.67	0.53	0.51	0.49	0.41

Appendix C. System estimation

This appendix is based on Hall et al. (2000, Appendix B), Greene (1997) and Maddala (1983).

The probability that $y_{1i} = 1$ and $y_{2i} = j$ for observation i is given by

$$\begin{aligned}\Pr(y_{1i}=1, y_{2i}=j) &= \Pr(y^*_{1i} > 0,\ \mu_{j-1} < y^*_{2i} \le \mu_j)\\ &= \Pr(v_{1i} > -\bar\beta_1' x_i,\ \mu_{j-1} - \bar\beta_2' x_i < v_{2i} \le \mu_j - \bar\beta_2' x_i)\\ &= \Pr(v_{1i} > -\bar\beta_1' x_i,\ v_{2i} \le \mu_j - \bar\beta_2' x_i) - \Pr(v_{1i} > -\bar\beta_1' x_i,\ v_{2i} \le \mu_{j-1} - \bar\beta_2' x_i)\\ &= \Phi_2(\bar\beta_1' x_i,\ \mu_j - \bar\beta_2' x_i, -\rho) - \Phi_2(\bar\beta_1' x_i,\ \mu_{j-1} - \bar\beta_2' x_i, -\rho)\end{aligned} \tag{C.1}$$

where $\Phi_2(a, b, \rho)$ is the cumulative unit bivariate normal distribution with correlation coefficient ρ evaluated at cutoff points a and b. Notice that for the two outside classes ($j = 1$ or J), the expression simplifies to

$$\begin{aligned}\Pr(y_{1i}=1, y_{2i}=1) &= \Phi_2(\bar\beta_1' x_i,\ \mu_1 - \bar\beta_2' x_i, -\rho)\\ \Pr(y_{1i}=1, y_{2i}=J) &= \Phi(\bar\beta_1' x_i) - \Phi_2(\bar\beta_1' x_i, \mu_{J-1} - \bar\beta_2' x_i, -\rho)\end{aligned} \tag{C.2}$$

where Φ denotes the univariate standard normal cdf. Analogously, the probability that $y_{1i} = 0$ and $y_{2i} = j$ is given by

$$\Pr(y_{1i}=0, y_{2i}=j) = \Phi_2(-\bar\beta_1' x_i,\ \mu_j - \bar\beta_2' x_i,\ \rho) - \Phi_2(-\bar\beta_1' x_i,\ \mu_{j-1} - \bar\beta_2' x_i, \rho). \tag{C.3}$$

The log likelihood function over all observations is obtained by combining the logarithms of the probabilities (C.1) and (C.3):

$$\ln L = \sum_{i=1}^{N}\sum_{j=1}^{J} \left\{ I(y_{1i}=1, y_{2i}=j) \ln \Pr(y_{1i}=1, y_{2i}=j) + I(y_{1i}=0, y_{2i}=j) \ln \Pr(y_{1i}=0, y_{2i}=j) \right\} \tag{C.4}$$

where I indicates a dummy variable that equals 1 when observation i matches the combination of y_1 and y_2. Maximising (C.4) gives the estimates of the structural coefficients (α_k, β_k), the cutoff points (μ_j) and the correlation ρ.

Notice that in the special case with $\rho = 0$, the bivariate system separates into the binary probit and the ordered probit since $\Phi_2(a, b, 0) = \Phi(a)\Phi(b)$. The log likelihood (C.4) simplifies to the sum of the log likelihood functions of the single equations.

Appendix D. Malginal effects

Marginal effects are calculated for the unconditional mean functions of the structural (1) and the reduced form (2) equations (see Greene, 1997, p. 910). The structural Eq. (1) are evaluated after substituting $u_k = v_k - \alpha_k v_{k'}$ ($k \neq k'$) and (2):

$$y^*_{ki} = \alpha_k \hat y^*_{k'i} + \beta_k' x_{ki} + v_{ki} \quad \text{with } \hat y^*_{ki} = \bar\beta_k' x_i$$

D.1. Discrete variables

The 'marginal' effects of dummy variables in the reduced form equations are computed as

$$\frac{\Delta Pr(y_{1i}=1)}{\Delta x_i(l)} = \Phi(\bar\beta_1' x_i | x_i(l)=1) - \Phi(\bar\beta_1' x_i | x_i(l)=0) \tag{D.1}$$

$$\begin{aligned}\frac{\Delta Pr(y_{2i}=j)}{\Delta x_i(l)} &= [\Phi(\mu_j - \bar\beta_2' x_i | x_i(l)=1) - \Phi(\mu_{j-1} - \bar\beta_2' x_i | x_i(l)=1)]\\ &\quad - [\Phi(\mu_j - \bar\beta_2' x_i | x_i(l)=0) - \Phi(\mu_{j-1} - \bar\beta_2' x_i | x_i(l)=0)]\end{aligned} \tag{D.2}$$

where Φ is the normal cumulative distribution function. Similar expressions hold for the structural equations. The dummies $Breadwinner_{NoPart}$ and $NoBreadwinner_{Part}$ are exclusive. In the calculation of the marginal effect of one of these dummies, the competing dummy is set to 0. The index variable *Education* is increased by one scale to evaluate the marginal effect.

D.2. Continuous variables

Continuous variables include *Age* for all equations and the latent variables in the structural equations. Marginal effects for the reduced form equations are calculated using:

$$\frac{\partial Pr(y_{1i}=1)}{\partial x_i(l)} = \phi(\bar\beta_1' x_i)\bar\beta_1(l) \tag{D.3}$$

$$\frac{\partial Pr(y_{2i}=j)}{\partial x_i(l)} = -[\phi(\mu_j - \bar\beta_2' x_i) - \phi(\mu_{j-1} - \bar\beta_2' x_i)]\bar\beta_2(l) \tag{D.4}$$

Table D.1
Average probability and marginal effects with structural form equations.

	Income decile										Decile	Member
	1	2	3	4	5	6	7	8	9	10		
Average prob.	26.64	18.33	17.84	12.56	10.49	6.49	4.03	2.21	1.36	0.05	3.17	62.05
Marginal effects												
Income												−21.27
Member	15.52	4.37	1.97	−1.81	−4.65	−4.99	−4.40	−3.19	−2.66	−0.15	−1.12	
Age	0.55	0.04	−0.12	−0.14	−0.14	−0.09	−0.06	−0.03	−0.02	0.00	−0.02	1.15
Man	5.03	1.38	0.57	−0.58	−1.46	−1.57	−1.40	−1.03	−0.89	−0.06	−0.36	−10.10
Br_{NoPart} [a]	14.01	4.19	0.68	−3.03	−4.99	−4.28	−3.19	−1.97	−1.35	−0.06	−0.89	−13.10
$NoBr_{Part}$ [b]	−1.05	−0.35	−0.25	0.06	0.32	0.39	0.37	0.27	0.24	0.01	0.09	0.00
NoKids	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	−2.68
Education	−3.33	−0.96	−0.53	0.27	0.93	1.09	1.02	0.78	0.70	0.05	0.25	1.94

[a] Breadwinner.
[b] No breadwinner.

Table D.2
Average probability and marginal effects with reduced form equations.

	Income decile										Decile	Member
	1	2	3	4	5	6	7	8	9	10		
Average prob.	26.64	18.33	17.84	12.56	10.49	6.49	4.03	2.21	1.36	0.05	3.17	62.05
Marginal effects												
Age	3.56	0.25	−0.76	−0.91	−0.89	−0.58	−0.36	−0.19	−0.10	0.00	−0.15	3.53
Man	−2.61	−0.74	−0.33	0.31	0.78	0.84	0.74	0.54	0.45	0.03	0.19	−12.53
Br_{NoPart} [a]	12.41	3.71	0.57	−2.73	−4.45	−3.79	−2.80	−1.72	−1.16	−0.05	−0.79	−2.44
$NoBr_{Part}$ [a]	−2.45	−0.81	−0.58	0.14	0.75	0.91	0.84	0.63	0.54	0.03	0.20	−2.38
NoKids	−3.71	−1.07	−0.56	0.32	1.04	1.20	1.12	0.85	0.76	0.05	0.28	−6.26
Education	−4.94	−1.45	−0.86	0.31	1.31	1.61	1.56	1.22	1.15	0.08	0.39	−2.84

[a] Breadwinner.

Table D.3
Average probability and marginal effects with structural form equations.

	Income decile										Decile	Member
	1	2	3	4	5	6	7	8	9	10		
Average prob.	0.36	4.60	5.27	8.53	10.18	11.10	14.19	15.43	14.87	15.47	6.88	77.37
Marginal effects												
Income												0.19
Member	−0.22	−1.86	−1.57	−1.91	−1.56	−0.98	−0.27	0.95	2.32	5.10	0.48	
Age	0.51	2.19	0.96	0.62	0.10	−0.31	−0.74	−1.06	−1.13	−1.14	−0.26	1.39
Man	−0.30	−2.72	−2.28	−2.73	−2.19	−1.36	−0.36	1.34	3.26	7.35	0.68	−5.56
Br_{NoPart} [a]	0.53	5.39	4.46	4.96	3.47	1.57	−0.65	−3.61	−6.21	−9.89	−1.17	−6.47
$NoBr_{Part}$ [a]	−0.06	−1.10	−1.24	−1.75	−1.65	−1.25	−0.74	0.42	1.96	5.38	0.41	0.00
NoKids	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	−4.78
Education	−0.21	−2.02	−1.87	−2.45	−2.21	−1.62	−0.90	0.68	2.76	7.84	0.62	−2.23

[a] Breadwinner.

where ϕ is the standard normal density function.[35] Similar expressions hold for the structural equations. The marginal effect of a continuous variable is multiplied by its standard deviation to obtain a better scaling.

D.3. Reported marginal effects

The sample average of the individual marginal effects is reported. From the marginal effects computed from the income equation, the average change in decile is reported as

$$\sum_{j}^{J} \frac{j}{N} \left[\sum_{i=1}^{N} \frac{\Delta Pr(y_{2i} = j)}{\Delta x_i(l)} \right]. \tag{D.5}$$

[35] Note that for simplicity the quadratic effect of age is not included in the formula. However, this effect is included in the reported marginal effects.

Table D.4
Average probability and marginal effects with reduced form equations.

	Income decile										Decile	Member
	1	2	3	4	5	6	7	8	9	10		
Average prob.	0.36	4.60	5.27	8.53	10.18	11.10	14.19	15.43	14.87	15.47	6.88	77.37
Marginal effects												
Age	0.39	1.67	0.73	0.48	0.07	−0.23	−0.57	−0.81	−0.86	−0.87	−0.20	1.37
Man	−0.22	−1.98	−1.68	−2.02	−1.63	−1.01	−0.27	1.00	2.43	5.40	0.50	−5.50
Br_{NoPart} [a]	0.66	6.63	5.36	5.85	4.00	1.71	−0.93	−4.38	−7.35	−11.55	−1.40	−6.65
$NoBr_{Part}$ [a]	−0.05	−1.03	−1.20	−1.73	−1.66	−1.29	−0.81	0.33	1.91	5.55	0.41	0.05
NoKids	0.08	0.62	0.51	0.62	0.50	0.31	0.07	−0.33	−0.76	−1.61	−0.15	−4.80
Education	−0.20	−1.85	−1.69	−2.20	−1.96	−1.42	−0.75	0.66	2.50	6.90	0.55	−2.15

[a] Breadwinner.

The structure of the detailed tables in this appendix is as follows:

- In the first 10 columns, the first line gives the average probability for each income decile (percent). The remaining lines give the marginal effects on the probabilities (percentage points).
- The first entry in the column labelled 'Decile' is the average decile. The other entries give the marginal change in the average decile, calculated using (D.5).

Table E.1
Income results for different denominations: six other religion variables.

		Members versus non-members	Roman-Catholics versus non-members	Protestants versus non-members	Non-Roman-Catholics versus non-members
Belief in God					
Low-income	Coef.	−0.29	−5.01	na	na
	Obs.	8 298	6 065	3 192	5 075
High-income	Coef.	**0.34**	0.25	**0.63**	**0.53**
	Obs.	13 950	9107	6937	7893
Religious person					
Low-income	Coef.	**−1.65**	**−1.89**	−2.39	**−2.11**
	Obs.	8700	6402	3505	5432
High-income	Coef.	**0.39**	**0.34**	**0.56**	**0.49**
	Obs.	14 330	9282	7259	8214
Confidence in church					
Low-income	Coef.	**−2.21**	−3.16	na	−4.93
	Obs.	8898	6555	3613	5575
High-income	Coef.	**0.93**	1.23	**1.13**	**1.05**
	Obs.	14 580	9441	7398	8359
Religion important					
Low-income	Coef.	**−1.35**	**−1.22**	−2.38	−2.12
	Obs.	9154	6797	3829	5798
High-income	Coef.	**0.39**	**0.31**	**0.60**	**0.52**
	Obs.	14 761	9529	7536	8515
Belief in Heaven					
Low-income	Coef.	−7.31	−9.40	na	na
	Obs.	7344	5630	3156	4588
High-income	Coef.	**0.72**	0.44	**1.04**	**0.98**
	Obs.	13 443	8709	6885	7807
God important					
Low-income	Coef.	**−1.75**	**−1.44**	na	−3.23
	Obs.	9044	6671	3724	5714
High-income	Coef.	**0.38**	**0.28**	**0.57**	**0.55**
	Obs.	14 682	9478	7476	8452

Bold coefficients are significant at 5 percent. All specifications estimated with country fixed effects.
Results for other explanatory variables are available on request.

Table E.2
Income results for membership at different levels of participation: six other religion variables.

		> 1/week	> 1/month	Special	< 1/year
Belief in God					
Low-income	Coef.	na	−3.35	−2.09	−2.38
	Obs.	4519	5295	6829	7581
High-income	Coef.	0.29	0.26	**0.32**	**0.38**
	Obs.	6479	8041	9996	11921
Religious person					
Low-income	Coef.	**−1.60**	**−1.32**	**−1.21**	**−1.35**
	Obs.	4814	5593	7150	7951
High-income	Coef.	**0.31**	**0.29**	**0.34**	**0.39**
	Obs.	6573	8141	10122	12138
Confidence in church					
Low-income	Coef.	−5.46	−2.13	**−1.46**	**−1.87**
	Obs.	4917	5707	7299	8125
High-income	Coef.	0.70	0.62	1.02	1.32
	Obs.	6651	8228	10271	12324
Religion important					
Low-income	Coef.	**−1.10**	**−1.07**	**−1.05**	**−1.19**
	Obs.	5121	5908	7526	8359
High-income	Coef.	**0.27**	**0.30**	**0.35**	**0.40**
	Obs.	6719	8307	10362	12459
Belief in Heaven					
Low-income	Coef.	−4.46	−2.45	−3.30	−7.86
	Obs.	4355	4960	6141	6751
High-income	Coef.	0.32	0.47	0.61	**0.78**
	Obs.	6289	7730	9569	11410
God important					
Low-income	Coef.	**−1.20**	**−1.22**	**−1.29**	**−1.40**
	Obs.	5018	5810	7428	8254
High-income	Coef.	**0.31**	**0.31**	**0.35**	**0.41**
	Obs.	6691	8281	10337	12424

Bold coefficients are significant at 5 percent. All specifications estimated with country fixed effects.
Results for other explanatory variables are available on request.

- The last column, labelled 'Member', gives the average probability (/marginal effects for the religion equation (percentage points).

D.4. Marginal effects in low-income countries

These marginal effects are based on the estimates in column C in Table 3 (Tables D.1 and D.2).

D.5. Marginal effects in high-income countries

These marginal effects are based on the estimates in column *D* in Table 3 (Tables D.3 and D.4).

Appendix E. Extended sensitivity analysis

See Tables E.1 and E.2.

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