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Religion and income: heterogeneity between countries

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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 of 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 religiosity. We find that estimation outcomes are different between 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 religiosity.

Key words: Income, Religious Membership, Religious Participation

JEL classification: Z12, D31

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1 Introduction

Religion is believed to affect income levels and growth. Theories have put forward different channels through which religion influences income, positively or negatively (see the survey of Iannaccone, 1998). Azzi and Ehrenberg (1975) were the first to apply the neo-classical framework to explain the allocation of time between working and religious activities. Religious activities are at the expense of productive activities, resulting in a lower income. In line with this, Barro and McClearly (2003) argue that belief is the crucial factor influencing income. An increase in church attendance without strengthening beliefs would depress income growth. The Weber-hypothesis is the prime example stressing a favourable effect of Protestant ethic (Weber, 1930). More recent theories see religion as an important component of social capital (Sacerdote and Glaeser, 2001 and Gruber, 2005). Churches are seen as part of a social network that contributes to better income opportunities. The income effects of religion are thus theoretically undetermined but also the empirical support remains mixed.

This paper focuses on the estimation of the total effect of religion on income. The central question is whether this effect is heterogeneous between countries, a question barely explored in the literature. We distinguish two types of studies in the 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 macro level (study 8). All micro-studies are applied to the USA and Canada, except Bettendorf and Dijkgraaf (2005, The Netherlands). The question whether the results found for one country can be considered representative for other countries is analyzed 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 between countries. While he finds an insignificant effect of participation on income for five countries, two countries show a negative and one a positive effect.[1]

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

The second type of studies is based on a panel of US-states (studies 9−11) or of countries (study 12). Barro and McCleary (2003) use a pooled dataset for 41 countries and 3 time periods.[2] They conclude that religious beliefs (in hell, heaven and an after-life) relative to attendance is the main channel through which religion stimulates economic growth. As these studies pool cross-country/state data, they implicitly assume that the behavior of individuals in different countries/states is homogenous 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. The literature on the role of religion in general 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.

We check the consequences of heterogeneity by using household level data for 25 Western countries. Next to heterogeneity, we also deal with the endogeneity problem in estimation.[3] According to the survey of Iannaccone (1998), income affects religious variables (like attendance, membership, frequency of prayer and beliefs). 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 (2005). In this study we deal with the endogeneity problem by estimating a system of equations. The estimation of a system of equations also enables the identification of the main determinants of religion. We find that heterogeneity matters substantially between low and high-income countries. While we find a positive effect of religion on income for high-income countries, this effect is found to be negative for low-income countries. This main finding is found to be robust by several sensitivity

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

[3] 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 data	Measure 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 (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 countries)
				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 (2005), 8. Mangeloja (2005), 9. Heath et al. (1995), 10. Crain and Lee (1999), 11. Lipford and Tollison (2003), 12. Barro and McCleary (2003).

analyses.

A related paper is Guiso et al. (2003). They also study the impact of religion on income by using micro-data from the World Values Survey. We notice two main differences. First, whereas we estimate directly the relationship between religion and income, Guiso et al. (2003) 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. (2003) do not consider differential effects across countries, although they use a more heterogeneous panel with 66 countries. They do stress heterogeneous effects over denominations, a result we also discuss (in section 5.2).

The next two sections discuss the data and the estimation methodology. Section four reports the estimation results, followed by sensitivity analyses in section five. The last section concludes.

2 Data

Data are from the European and World Values Survey.[4] 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, next to Canada, New Zealand and the United States (see Table 2 for a list of countries included).

An important source for exclusion is whether sufficient information is available on income. In the survey a card with ten income deciles was shown to respondents. The respondents were asked in which class their household is in, counting all wages, salaries, pensions and other incomes.[5] As the income deciles are chosen country specific, the decile information of the different countries does not match. In many cases the decile points were not based on the regular ten equal sized groups.

[4] Data and codebooks are downloadable from www.worldvaluessurvey.org.

[5] As household size is not available, we cannot calculate the income per household member.

Table 2: Descriptive statistics

	Average income decile	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	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
United States	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 dollars using PPP's.

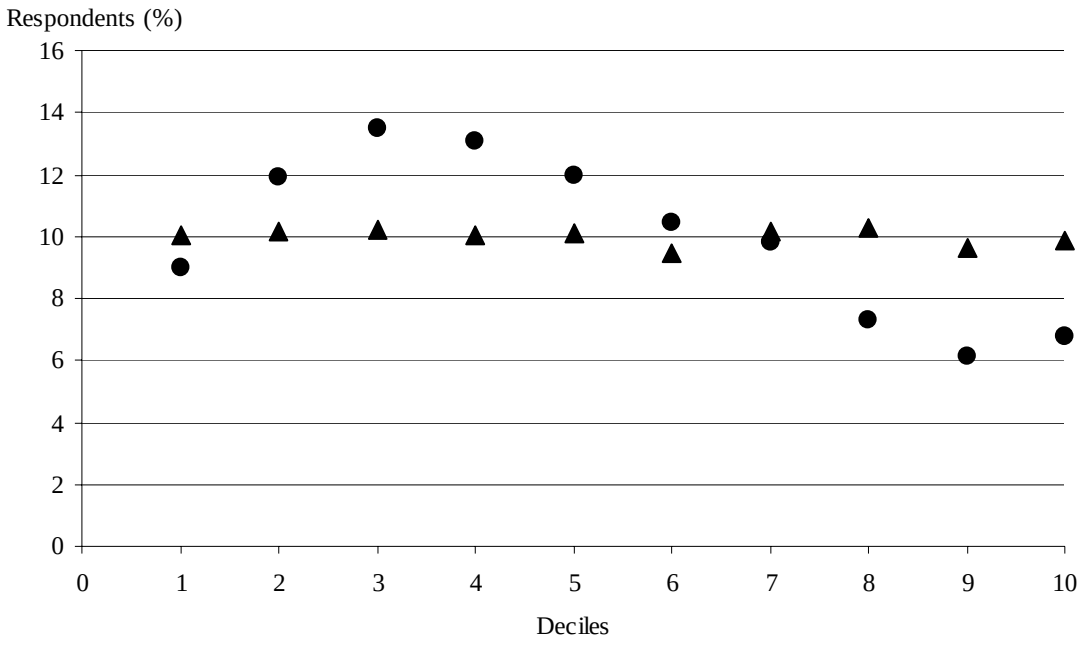

Figure 1: Original deciles (dots) and final deciles (triangles)

For five countries the decile points rise with a fixed and equal amount in all deciles, while for six countries the higher deciles have a larger interval than the lower deciles.[6] For the whole panel this results in unequal frequencies. Figure 1 shows that deciles 2 till 5 are overrepresented in our sample at the cost of especially deciles 8, 9 and 10. The distribution is even more unequal per country. In Germany, e.g., 80% of the respondents is found in deciles 2 till 5, while the last three deciles include only 3.8% of respondents. Another example is Latvia, where 32.5% of respondents are in decile 2, while this is only 1.5% for 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 in a common currency and price level. Given the available information, we use the following procedure.[7] First, we calculate the decile points in US dollars using purchasing power parities from the Penn World Table (2000). Note that this results in

[6] Countries in the first group are Germany, Austria, Sweden, Iceland and Malta. The second group consists of The Netherlands, Estonia, Latvia, Lithuania, Canada and the USA.

[7] We test whether our results depend on this procedure using the original decile information in a sensitivity analysis (section 5.4).

exclusion of a number of countries for which decile points are not given.[8] Second, we calculate the average level of income per decile as the average of the lower and upper bound of the decile.[9] Third, all individuals are sorted on their average income level. Finally, new deciles are created aiming at the regular ten equal 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.[10] The decile with the lowest number of observations has a share of 9.5%, while the decile with the highest number of observations has a share of 10.3% (see the triangles in Figure 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 kids (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 dataset several measures are available how religious individuals are. In the next section 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, membership and the number of observations. As we analyze whether heterogeneity exists between countries, we include also the GDP per capita (in PPP dollars).[11] In our basic models we test whether a difference exists with respect to the religion − income relation between low-income and high-income countries. 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 larger or equal than the level of Spain. It would, of course, be attractive to

[8] This results in exclusion of observations for Australia, Belarus, Britain, Belgium, Finland, Hungary, Luxembourg, Norway. Poland, Portugal, Ukraine and Romania.

[9] The income level of the first decile is set at 50% of the first decile point. The last decile income level is equal to the last decile point.

[10] Note that this means that a natural alternative, creating equal deciles per 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.

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

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.

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

- Age effects are captured by a quadratic function $0.06163Age - 0.00073Age^2$, where Age is the age of the respondent and the coefficients are based on single estimation results.
- The dummy Man equals one if the respondent is male.
- The dummy $Breadwinner_{NoPart}$ is one if the respondent is the breadwinner without a partner; $NoBreadwinner_{Part}$ is one if the respondent has a partner who is the breadwinner. The benchmark covers the case in which the respondent is a breadwinner with a partner.
- The dummy $NoKids$ is one when the household does not include kids.
- To reduce the number of exogenous variables, education dummies are transformed into one index. $Education = 1$ if the respondent has only finished education at lower level; $= 2$ at medium level and $= 3$ at high level. These scores are based on single equation estimation results.
- Country fixed effects are included to correct for country specific features.

3 Methodology

We are primarily interested in the effect of religion on income. However, as described in the former section, 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 system estimation is more efficient than single estimation, we only present results for the system

approach.[12] As income and religion are measured as discrete variables, a probit-estimator is applied. We take membership of a church as our main measure of religion.[13] Membership is denoted by the dummy y_{1i} with the value 1 if the household i is 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 completely flexibility in their decisions but that the researcher can only observe the choices as discrete variables (see Blundell and Smith, 1994).[14] 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:

$$\begin{aligned} y_{1i}^* &= \alpha_1 y_{2i}^* + \beta_1' x_{1i} + u_{1i} \qquad y_{1i} = 1 \quad \text{if } y_{1i}^* > 0, \ = 0 \text{ otherwise} \\ y_{2i}^* &= \alpha_2 y_{1i}^* + \beta_2' x_{2i} + u_{2i} \qquad y_{2i} = j \quad \text{if } \mu_{j-1} < y_{2i}^* \leq \mu_j \quad j = 1, ., J \end{aligned} \tag{3.1}$$

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 (3.1) cannot be directly estimated since it contains non-observables at the right-hand side. Therefore, the *reduced* form equations are derived as, with $D \equiv (1 - \alpha_1\alpha_2)$,

$$\begin{aligned} y_{1i}^* &= \bar{\beta}_1' x_i + v_{1i} \qquad \bar{\beta}_1' x_i = \left(\beta_1' x_{1i} + \alpha_1 \beta_2' x_{2i}\right)/D \qquad v_{1i} = \left(u_{1i} + \alpha_1 u_{2i}\right)/D \\ y_{2i}^* &= \bar{\beta}_2' x_i + v_{2i} \qquad \bar{\beta}_2' x_i = \left(\alpha_2 \beta_1' x_{1i} + \beta_2' x_{2i}\right)/D \qquad v_{2i} = \left(\alpha_2 u_{1i} + u_{2i}\right)/D \end{aligned} \tag{3.2}$$

[12] 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%. As income influences religion a single equation approach will result in biased coefficients. Our main finding, a positive effect of religion on income for high-income countries and a negative effect for low-income countries, however, is also found for the single equation approach. Results for the single equations are available on request.

[13] Although data are available about the specific denomination of individuals, we have chosen to concentrate on membership in general. Main motivation is 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 5.2.

[14] 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.

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.[15] The reduced form disturbances v_k are assumed to have a joint normal distribution with means zero, variances one, and covariance ρ.[16] 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 (3.1), where the latent variable y_k^* at the RHS is replaced by the observed y_k.[17] 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 kids ($NoKid$). We first discuss the estimated cross-effects between membership and income; next, 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 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%. The insignificant membership coefficient is in accordance with some studies using microdata for one country (Tomes (1984), Crain and Lee (1999) and Cornwell et al. (2003)). It contradicts

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

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

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

results from Barro and McCleary (2003) which are also based on an international database.[18] 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.[19] We do this by introducing an interaction effect with the high-income dummy (see section 3 for definition). Model A, which does not discriminate between low and high-income countries, is clearly rejected against model B using a Likelihood-ratio 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. The opposite effect is found for low-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 model C (the sub-sample for the low-income countries) and D (the sub-sample for 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 in coefficients are very modest, however, compared to 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.

[18] 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.

[19] 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 also other explaining characteristics have a heterogeneous relationship with religion. Sacerdote and Glaeser (2001), for instance, find cross-country difference in the relation between education and religion.

Table 3: Results homogeneity (A), heterogeneity (B) and sub-samples for low-income (C) and high-income (D)

	A	B	C	D
Effect on income				
Member	0.07	-1.15***	-1.20***	
*high-income		1.68***		0.52***
Age function	1.03***	0.16	0.20	
*high-income		1.03***		1.15***
Man	0.26***	-0.31**	-0.32**	
*high-income		0.73***		0.41***
Breadwinner$_{NoPart}$	-0.77***	-0.79***	-0.83***	
*high-income		0.10		-0.67***
No breadwinner$_{Part}$	0.21***	0.07	0.07	
*high-income		0.19***		0.25***
Education	0.34***	0.20***	0.22***	
*high-income		0.19***		0.38***
Effect on religion				
Income	-0.24*	-0.50*	-0.48*	
Income*high-income		0.51		0.01
Age function	-0.44***	-0.30	-0.29	
*high-income		-0.23		-0.53***
Man	-0.25***	-0.33***	-0.33***	
*high-income		0.12**		-0.21***
Breadwinner$_{NoPart}$	-0.36***	-0.43*	-0.43**	
*high-income		0.19		-0.24*
No kid	-0.19***	-0.09	-0.09	
*high-income		-0.09		-0.18***
Education	-0.01	0.06	0.06	
*high-income		-0.14		-0.08
LLH	-53,288	-53,170	-18,464	-34,534
ρ	-0.02*	-0.02*	-0.08***	0.02
Observations	24,262	24,262	9,380	14,882

Coefficients with ***/**/* are significant at the 1%/5%/10% level.
All specifications estimated with country fixed effects.

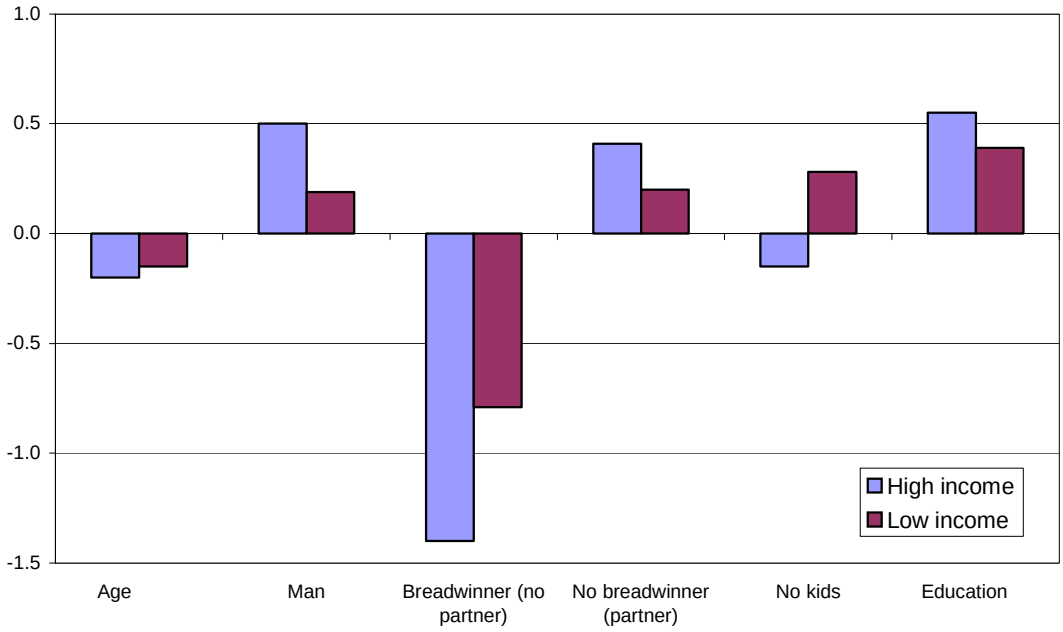

Figure 2: Marginal effects socio-economic characteristics on income

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 are found, while in the opposite case positive results might prevail.

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 column C and D in Table 3). The marginal effects averaged over the households are reported. From the marginal probabilities computed for each income decile, the average decile change is shown in Figure 2 (The calculation of the marginal effects is explained in more detail in Appendix D).

Since age is modelled as a hump-shaped quadratic function, a positive coefficient means that income

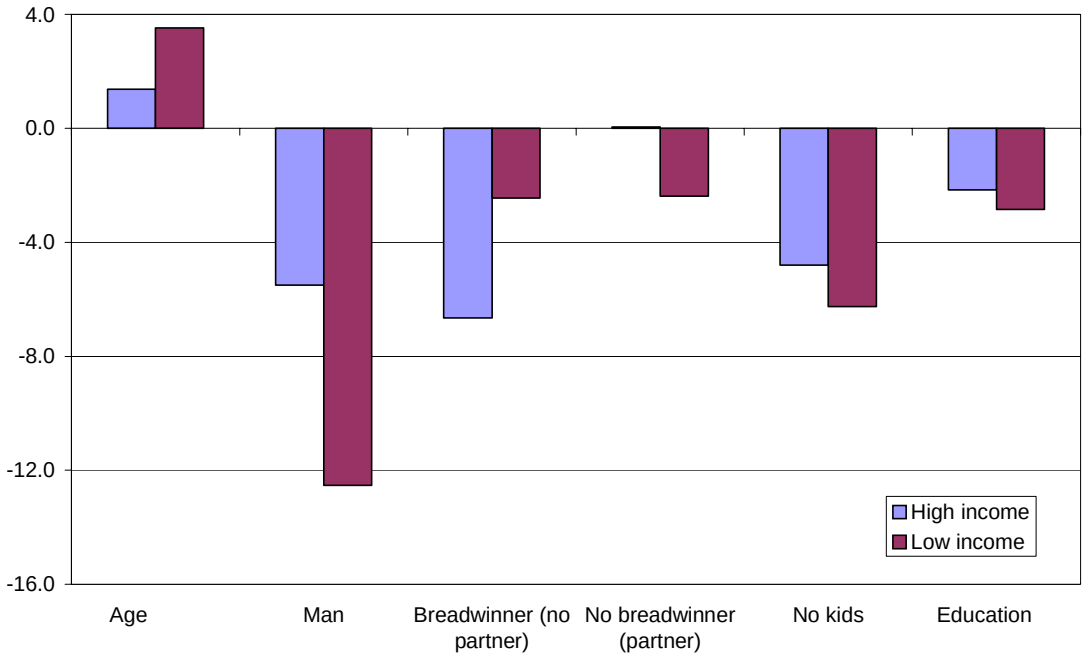

Figure 3: Marginal effects socio-economic characteristics on religion

first rises and then falls with age.[20] As the marginal effects are evaluated on average at a high age, age has a negative effect on income in both sub-samples.[21] Households for which the respondent is a man earn a higher income than when the respondent is female. For low-income countries, the structural coefficient is negative but the total effect gets positive by the upwards effect of lower church membership. Breadwinners without a partner obviously have a lower income than breadwinners with a partner. The reverse effect holds when the respondent is not the breadwinner but the partner is. Since its structural coefficient is restricted to zero, the effect of $NoKid$ is running 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 Figure 3. Age effects now follow a U-pattern, implying that marginal effects get positive for higher ages.[22] Male

[20] 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, next to age, of the respondent.

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

[22] 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 the believes in heaven, as well as in hell, fall with the share of the

respondents are less often member of a church than female respondents. The three dummies representing the family composition all have a depressing effect on religiosity. Finally, membership seems to fall with the education level (although the structural coefficients are not significant).[23]

5 Sensitivity analysis

This sections 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 estimate our preferred sub-sample models (C and D) for six alternative measures. These measures are based on the answers of the following questions: (i) do you believe in God, (ii) are you a religious person, (iii) do you have confidence in 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 (76% of respondents believe in God, 75% are members of a church), while the importance of God is the strictest measure (44% finds God important).

Results for the cross-effects are presented in Table 4. Note that we use a smaller database for these analyses compared with 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

population older than 65 (whereas its effect on church attendance is not significant).

[23] 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 behavior when they decide to stay. Sawkins et al. (1997) also find a positive effect of education on church attendance.

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		8,298	8,700	8,898	9154	7,344	9,044
% religious		0.72	0.67	0.54	0.47	0.40	0.37
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	0.52	0.42

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

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. Also for the alternative measures system estimation is preferred as ρ is often significant at 1%.

5.2 Denomination

In the analysis presented so far we 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 in which Roman Catholics have a lower income than Protestants, high-income countries are dominated by Protestants and low-income countries by Roman Catholics. In this paragraph 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 dataset to individuals which are either non-member or member of a specific church, which leaves us with only two equations to estimate. Interestingly, this test explores not only the question whether households with the same denomination behave differently when living in different countries but also whether the effect of religion differs across denominations (Guiso et al. (2003) confirm the last type of heterogeneity).

Table 5 presents the results. The first column repeats the base case of Table 3. The next three columns are based on subsamples containing only, next to non-members, Roman Catholics, Protestants and 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 homogenous Roman-Catholic church, the relations differ between low and high-income countries. However, effects are not significant different from zero in all cases. Interestingly, Roman Catholics seem to drive the negative effect for low-income countries as we find an insignificant effect for Protestants and non-Roman Catholics. This result might suffer from the relatively low number of observations for the last two groups. For high-income countries Protestants and other members of a non-Roman Catholic church seem to drive the positive effect. This conclusion is robust as the Roman Catholics sample is large, while the effect of religion on income is insignificant.

The opposite effect of income on religion remains insignificant in high-income countries for all cases. A negative effect for low-income countries is found only for the sample with members not belonging to the Roman Catholic church.

Appendix Table E.1 presents the income effects of religion for the other six religion measures. In main lines the discussed results are robust. We find in almost all cases a significant difference for the effect of religion on income between low and high-income countries. The finding that the negative effect in low-income countries is driven by Roman Catholics is confirmed for three measures. The

Table 5: 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		9,380	6,954	3,927	5,966
% religious		67%	49%	12%	40%
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	9,611	7,624	8,608
% religious		79%	65%	56%	61%

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

positive effect in high-income countries is driven by Protestants in all cases (when significant, the coefficient for the Roman Catholics is the smallest).

5.3 Membership or participation

The literature analyses both the effect of religious membership and participation. Barro and McCleary (2003) stress that both measures have an opposite impact 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. We study in this section whether effects on income are also different for individuals who participate actively in church services compared with members who go not or less often to church. For each respondent we know whether church services are attended at least (i) once a week, (ii) once a month, (iii) on special days like Easter and Christmas, (iv) less than once a year or (v) never. While we have all these respondents in our results presented before, the first

Table 6: Results for membership versus 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		5,227	6,034	7,698	8,557
% religious		32%	41%	54%	58%
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		6,771	8,368	10,448	12,559
% religious		50%	60%	68%	77%

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

column of Table 6 restricts the group of members to households that attend services at least once a week with again non-members as benchmark.[24] In subsequent columns, the sample is extended with members who participate less frequently.

Our main result is found, 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. This suggests that the main effect is driven by membership rather than participation. For high-income countries a declining pattern in intensities 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.

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

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 that hardly attend services.

The exercise is repeated for the six alternative religion variables with similar results (see the income coefficients in Appendix 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.

5.4 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 Table 7 tests interaction effects in terms of levels of GDP per capita. This model finds indeed 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 till a GDP level of 22,000 dollars per capita, just above the level of our poorest high-income country (compare 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 of the poorest country, Bulgaria, are located in the lowest four deciles, whereas most households of the richest country, the US, are found in the five top deciles. We are thus assuming that households

Table 7: Results gradual heterogeneity and 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**		
Age function	**-0.75**	0.20	**1.12**
*GDP	**0.08**		
Man	**-0.86**	**-0.27**	**0.41**
*GDP	**0.05**		
Breadwinner$_{NoPart}$	**-0.86**	**-0.84**	-0.66
*GDP	0.01		
No breadwinner$_{Part}$	0.00	0.07	**0.23**
*GDP	**0.01**		
Education	0.03	**0.23**	**0.39**
*GDP	**0.01**		
Effect on religion			
Income	**0.81**	-0.51	0.01
*GDP	**-0.02**		
Age function	**-2.01**	-0.31	-0.53
*GDP	**0.05**		
Man	**-0.52**	**-0.33**	**-0.21**
*GDP	**0.01**		
Breadwinner$_{NoPart}$	**0.61**	**-0.47**	-0.24
*GDP	**-0.03**		
No kid	**-0.41**	-0.09	**-0.18**
*GDP	**0.01**		
Education	**-0.36**	0.08	-0.08
*GDP	**0.01**		
LLH	-53,144	-24,201	-37,327
ρ	-0.02	**-0.11**	0.01
Observations	24,262	9,380	14,882

Bold coefficients are significant at 5%. All specifications estimated with country fixed effects.

with the same income *level* (and other characteristics) behave the same, irrespective of the country they live (except for the country fixed effects).

Another reasonable assumption is that not the position in the international but in the national distribution matters. Households living in different countries are considered to be identical if they report the same 'national' income decile. Notice that a Bulgarian household from the top decile might earn a lower real income than a US-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. Results in 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 literature generally assumes a homogeneous relation between income and religion when data are pooled from different countries. Combining household level data for 25 Western countries enables to test this assumption explicitly. We find a clear distinction between low and 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 religiosity, denominational distribution and participation levels.

This 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 dataset is dominated by high-income countries, it is more likely that a positive income effect is 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 dataset is also dominated by Protestant countries, the

probability to find a positive effect even increases. This suggests that research should check for composition effects, for example by varying included countries. For future research, we plan to combine large micro datasets from different countries. This would allow testing for individual country heterogeneity, where this paper only was able to test heterogeneity between groups of countries.

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

References

Azzi C., Ehrenberg R., 1975. Household allocation of time and church attendance, Journal of Political Economy 83, 27-56.

Barro R.J., McCleary R., 2003. Religion and economic growth, NBER Working Paper 9682.

Bettendorf L., Dijkgraaf E., 2005. The bicausal relation between religion and income, Tinbergen discussion paper 105/2, Erasmus University Rotterdam.

Blundell R., Smith R.J., 1994. Coherency and estimation in simultaneous models with censored or qualitative dependent variables, Journal of Econometrics 64, 355-373.

Chiswick B.R., 1983. The earnings and human capital of American Jews, The Journal of Human Resources 18, 313-336.

Chiswick B.R., 1993. The skills and economic status of American Jewry: Trends over the Last Half-Century, Journal of Labor Economics 11, 229-242.

Cornwell C.M., Tinsley K.L., Warren R.S., 2003. Religious background and the labor supply and wages of young women, University of Georgia.

Crain W.M., Lee K.J., 1999. Economic growth regressions for the American states: a sensitivity analysis, Economic Inquiry 37, 242-257.

Green W.H., 1997. Econometric Analysis, Prentice-Hall.

Gruber J., 2005. Religious market structure, religious participation, and outcomes: is religion good for you?, NBER Working Paper 11377.

Guiso L., Sapienza P., Zingales L., 2003. People's opium? Religion and economic attitudes, Journal of Monetary Economics 50, 225-282.

Hall B.H., Link A.N., Scott J.T., 2000. Universities as research partners, NBER Working Paper 7643.

Heath W.C., Waters M.S., Watson J.K., 1995. Religion and economic welfare: an empirical analysis of state per capita income, Journal of Economic Behavior & Organization 27, 129-142.

Huber J.D., 2005. Religious belief, religious participation, and social policy attitudes across counries, Paper presented at the Annual Meetings of the Midwest Policitical Science Association, Chicago.

Iannaccone L.R., 1998. Introduction to the economics of religion, Journal of Economic Literature 36, 1465-1495.

Lipford J.W., Tollison R.D., 2003. Religious participation and income, Journal of Economic Behavior & Organization 51, 249-260.

Maddala G.S., 1983. Limited-dependent and qualitative variables in econometrics, Cambridge University Press.

Mangeloja E., 2005. Economic growth and religious production efficiency, Applied Economics 37, 2349-2359.

McCleary, R.M., Barro R.J. (2006), Religion and economy, *Journal of Economic Perspectives* 20: 49-72.

Sacerdote B., Glaeser E.L., 2001. Education and religion, NBER Working Paper 8080.

Sala-i-Martin, X., G. Doppelhofer and R.I. Miller (2004), Determinants of long-term growth: A Bayesian averaging of classical estimates (BACE) approach, American Economic Review, 93, 813-835.

Sawkins, J., 1997. Church attendance in Great Britain: An ordered logit approach, Applied Economics 29, 125-134.

Steen T.P., 1996. Religion and earnings: Evidence from the NLS Youth Cohort, International Journal of Social Economics 23, 47-58.

Tomes N., 1984. The effects of religion and denomination on earnings and the returns to human capital, The Journal of Human Resources 19, 472-488.

Tomes N., 1985. Religion and the earnings function, American Economic Review 75, 245-250.

Weber M., 1930. The Protestant ethic and the spirit of capitalism, Allen & Unwin: London.

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 one when:

Member	Respondent is member of a church
Belief in God	Respondent answers yes to question do you belief 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 church
Relig. import.	Respondent answers yes to question do you belief in heaven
Belief in Heaven	Respondent answers yes to question is God important in your life
God import.	Respondent answers yes to question is religion important in your life
Man	Respondent is male
Breadwinner$_{NoPart}$	Respondent is breadwinner, has no partner
No breadwinner$_{Part}$	Respondent is not the breadwinner, has partner
No kid	Respondent has no kids
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$_{high}$	Respondenthas education at higher professional or university level
High-income	Respondent lives in country with relative high per capita GDP
Age	Age of respondent (integer)

Appendix B Descriptive statistics

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

	Age	Man	Breadw$_{NoPart}$	Nobreadw$_{art}$	Nokid	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.	48.55	0.45	0.29	0.34	0.11	1.60
- High-inc.	48.01	0.48	0.32	0.33	0.21	1.38

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

	Belief in God	Member church	Religious person	Confid. church	Relig. import.	Belief in Heaven	God import.
Bulgaria	0.60	0.71	0.50	0.35	0.49	0.31	0.28
Russia	0.66	0.54	0.66	0.60	0.49	0.40	0.36
Latvia	0.78	0.65	0.78	0.67	0.40	0.36	0.39
Lithuania	0.86	0.86	0.87	0.76	0.68	0.70	0.61
Croatia	0.93	0.87	0.85	0.68	0.80	0.62	0.60
Estonia	0.50	0.31	0.44	0.44	0.23	0.23	0.19
Slovak	0.85	0.83	0.85	0.74	0.67	0.63	0.61
Czech	0.37	0.34	0.41	0.22	0.23	0.22	0.19
Slovenia	0.66	0.71	0.69	0.39	0.38	0.30	0.30
Malta	1.00	0.99	0.78	0.85	0.93	0.88	0.92
Spain	0.85	0.85	0.67	0.51	0.53	0.55	0.40
New Zeal.	0.75	0.83	0.59	0.42	0.45	0.64	0.42
Sweden	0.52	0.75	0.40	0.46	0.36	0.32	0.18
Italy	0.93	0.84	0.89	0.73	0.79	0.62	0.65
France	0.60	0.58	0.48	0.46	0.38	0.33	0.23
Germany	0.55	0.60	0.49	0.39	0.32	0.27	0.30
Netherl.	0.58	0.44	0.60	0.29	0.38	0.36	0.26
Canada	0.92	0.76	0.80	0.64	0.68	0.78	0.65
Austria	0.87	0.87	0.83	0.43	0.57	0.43	0.48
Iceland	0.84	0.97	0.77	0.67	0.57	0.60	0.41
Ireland	0.97	0.94	0.77	0.60	0.79	0.88	0.64
N-Ireland	0.92	0.86	0.65	0.64	0.62	0.83	0.55
Switzerl.	0.85	0.91	0.62	0.45	0.50	0.48	0.45
Denmark	0.69	0.89	0.75	0.62	0.29	0.19	0.15
USA	0.96	0.78	0.86	0.78	0.86	0.89	0.81
Average	0.76	0.75	0.68	0.55	0.54	0.51	0.44
- Low-inc.	0.72	0.68	0.68	0.57	0.53	0.47	0.45
- High-inc.	0.79	0.79	0.68	0.54	0.54	0.54	0.44

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

$$\begin{aligned}
\Pr(y_{1i} = 1, y_{2i} = j) =& \Pr(y_{1i}^* > 0,\, \mu_{j-1} < y_{2i}^* \leq \mu_j) \\
=& \Pr(v_{1i} > -\bar{\beta}_1' x_i,\, \mu_{j-1} - \bar{\beta}_2' x_i < v_{2i} \leq \mu_j - \bar{\beta}_2' x_i) \\
=& \Pr(v_{1i} > -\bar{\beta}_1' x_i,\, v_{2i} \leq \mu_j - \bar{\beta}_2' x_i) - \\
& \Pr(v_{1i} > -\bar{\beta}_1' x_i,\, v_{2i} \leq \mu_{j-1} - \bar{\beta}_2' x_i) \\
=& \Phi_2(\bar{\beta}_1' x_i,\, \mu_j - \bar{\beta}_2' x_i,\, -\rho) - \Phi_2(\bar{\beta}_1' x_i,\, \mu_{j-1} - \bar{\beta}_2' x_i,\, -\rho) \qquad \text{(C.1)}
\end{aligned}$$

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 $j = J$), the expression simplifies to

$$\begin{aligned}
\Pr(y_{1i} = 1, y_{2i} = 1) &= \Phi_2(\bar{\beta}_1' x_i,\, \mu_1 - \bar{\beta}_2' x_i,\, -\rho) \\
\Pr(y_{1i} = 1, y_{2i} = J) &= \Phi(\bar{\beta}_1' x_i) - \Phi_2(\bar{\beta}_1' x_i,\, \mu_{J-1} - \bar{\beta}_2' x_i,\, -\rho)
\end{aligned}$$

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

$$\Pr(y_{1i} = 0, y_{2i} = j) = \Phi_2(-\bar{\beta}_1' x_i,\, \mu_j - \bar{\beta}_2' x_i,\, \rho) - \Phi_2(-\bar{\beta}_1' x_i,\, \mu_{j-1} - \bar{\beta}_2' x_i,\, \rho) \qquad \text{(C.2)}$$

The log likelihood function over all observations is obtained by combining the logarithms of the probabilities (C.1) and (C.2):

$$\ln L = \sum_{i=1}^{N} \sum_{j=1}^{J} \{I(y_{1i} = 1, y_{2i} = j) \ln \Pr(y_{1i} = 1, y_{2i} = j) + I(y_{1i} = 0, y_{2i} = j) \ln \Pr(y_{1i} = 0, y_{2i} = j)\} \tag{C.3}$$

where I indicates a dummy variable that equals one when observation i matches the combination of y_1 and y_2. Maximizing (C.3) 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.3) simplifies to the sum of the log likelihood functions of the single equations.

Appendix D Marginal effects

Marginal effects are calculated for the unconditional mean functions of the structural (3.1) and the reduced (3.2) equations (see Greene, 1997, p. 910). The structural equations (3.1) are evaluated after substituting $u_k = v_k - \alpha_k v_{k'}$ $(k \neq k')$ and (3.2):

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

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

$$\frac{\Delta Pr(y_{1i}=1)}{\Delta x_i(l)} = \Phi\left(\bar{\beta}'_1 x_i \,|\, x_i(l)=1\right) - \Phi\left(\bar{\beta}'_1 x_i \,|\, x_i(l)=0\right) \tag{D.1}$$

$$\frac{\Delta Pr(y_{2i}=j)}{\Delta x_i(l)} = \left[\Phi\left(\mu_j - \bar{\beta}'_2 x_i \,|\, x_i(l)=1\right) - \Phi\left(\mu_{j-1} - \bar{\beta}'_2 x_i \,|\, x_i(l)=1\right)\right] - \left[\Phi\left(\mu_j - \bar{\beta}'_2 x_i \,|\, x_i(l)=0\right) - \Phi\left(\mu_{j-1} - \bar{\beta}'_2 x_i \,|\, x_i(l)=0\right)\right] \tag{D.2}$$

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 zero. The index variable *Education* is increased by one scale to evaluate the marginal effect.

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:

$$\frac{\partial Pr(y_{1i}=1)}{\partial x_i(l)} = \phi\left(\bar{\beta}'_1 x_i\right)\bar{\beta}_1(l) \tag{D.3}$$

$$\frac{\partial Pr(y_{2i}=j)}{\partial x_i(l)} = -\left[\phi\left(\mu_j - \bar{\beta}'_2 x_i\right) - \phi\left(\mu_{j-1} - \bar{\beta}'_2 x_i\right)\right]\bar{\beta}_2(l) \tag{D.4}$$

where ϕ is the standard normal density function.[25] 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.

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:

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

The structure of the following, detailed Tables is as follows:

- In the first 10 columns, the first line gives the average probability for each income decile (%). The remaining lines give the marginal effects on the probabilities (%).
- The first entry in the column labelled 'Income' is the average decile. The other entries give the marginal change in the average decile, calculated using (D.5).
- The last column labelled 'Member' gives the average probability and the marginal effects for the religion equation (%).

[25] 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.

Marginal effects Low-income countries

These marginal effects are based on the estimates in column C in Table 3.

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

Decile income	1	2	3	4	5	6	7	8	9	10	decile	member
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}[1]	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}[1]	-1.05	-0.35	-0.25	0.06	0.32	0.39	0.37	0.27	0.24	0.01	0.09	0.00
No kids	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

1. Br=Breadwinner

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

Decile income	1	2	3	4	5	6	7	8	9	10	decile	member
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}[1]	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}[1]	-2.45	-0.81	-0.58	0.14	0.75	0.91	0.84	0.63	0.54	0.03	0.20	-2.38
No kids	-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

1. Br=Breadwinner

Marginal effects in high-income countries

These marginal effects are based on the estimates in column *D* in Table 3.

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

Decile income	1	2	3	4	5	6	7	8	9	10	decile	member
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}[1]	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}[1]	-0.06	-1.10	-1.24	-1.75	-1.65	-1.25	-0.74	0.42	1.96	5.38	0.41	0.00
No kids	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

1. Br=Breadwinner

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

Decile income	1	2	3	4	5	6	7	8	9	10	decile	member
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}[1]	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}[1]	-0.05	-1.03	-1.20	-1.73	-1.66	-1.29	-0.81	0.33	1.91	5.55	0.41	0.05
No kids	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

1. Br=Breadwinner

Appendix E Extended sensitivity analysis

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.	8298	6065	3192	5075
High-income	Coef.	**0.34**	0.25	**0.63**	**0.53**
	Obs.	13950	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.	14330	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.	14580	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.	14761	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.	13443	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.	14682	9478	7476	8452

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

Table E.2: Income results for membership versus 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%. All specifications estimated with country fixed effects.
Results for other explaining variables are available on request.